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The Extended Air Defense Testbed (EADTB) Delivery Order (DO) was conducted under the Site Activation Process described in the Systems Engineering Management Plan (SEMP) and Delivery Order Management Process section of the ADST II Operational Description Plan. This site activation effort was for the Fort Bliss, TX, EADTB facility. The technical period of performance was from June 17, 1997 to November 20, 1997. The effort was performed as DO #0046 under the Lockheed Martin Advanced Distributed Simulation Technology II (ADST II) Contract administered by the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM).

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EXTENDED AIR DEFENSE TESTBED

EADTB #0046

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EXECUTIVE SUMMARY

The Extended Air Defense Testbed (EADTB) Delivery Order (DO) was conducted under the Site Activation Process described in the Systems Engineering Management Plan (SEMP) and Delivery Order Management Process section of the ADST II Operational Description Plan. This site activation effort was for the Fort Bliss, TX, EADTB facility. The technical period of performance was from June 17, 1997 to November 20, 1997. The effort was performed as DO #0046 under the Lockheed Martin Advanced Distributed Simulation Technology II (ADST II) Contract administered by the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM).

A requirement was identified in 1996 to define and implement the EADTB at Fort Bliss, TX. A Feasibility Analysis Study (FAS) was conducted and a report was published on January 22, 1997. A STRICOM Statement of Work (SOW) was published on April 8, 1997. The purpose of the EADTB is to leverage distributed simulation technologies in order to participate in Battle Laboratory Experiments (BLEs), Advanced Technology Demonstrations (ATDs), Advanced Concept Technology Demonstrations (ACTDs), and Advanced Warfighting Experiments (AWEs). The intent of the EADTB is to support combat development experiments, demonstrations, training, and exercises. It is also to be used during the development and test of Distributed Interactive Simulation (DIS) software extensions, and for performance of verification and validation studies on DIS software developed by other DIS users as it pertains to Air Defense. The EADTB is located in building 1043 which is linked to building 1044 at Fort Bliss TX. Buildings 1043 and 1044 are composed of various rooms which house computer platforms for EADTB, Extended Air Defense Simulation (EADSIM), ModSAF, Advanced Research Projects Agency Reconfigurable Simulator (ARSI), Reconfigurable Tactical Operations Simulator (RTOS), and the Defense Simulations Internet (DSI) infrastructure equipment in building 1043. A conference room is also included in building 1043 where the control room is located. Adjacent to the conference room are office spaces. Building 1044 houses platforms for Corps Battle Simulation (CBS), Brigade/Battalion Simulation (BBS), and JANUS systems in addition to the networking infrastructure. The two building have a secure capability and require security clearances for access.

The objectives of this effort are as follows:

a) Build up the existing infrastructure to a design and configuration flexible to accomplish different tasks, that is capable of conducting simultaneous events, that is expandable to meet the increasing activities in the experimental use of DIS, and that is affordable to both establish and maintain.

b) Extend the infrastructure to be capable of providing sufficient capability to replicate air defense combat functionality within the synthetic environment.

c) Provide the infrastructure necessary to perform, record and analyze synthetic environment produced data.

The approach to the execution of this DO started with the procurement of hardware recommended by the FAS, and an integration period from August 13 through August 29,

1997 at the Operational Support Facility (OSF) in Orlando, FL. During this initial integration period the hardware was loaded with the most current ADST II baseline software that will allow the execution of experiments in a Core DIS facility. Once the hardware and software were configured and tested on the network at the OSF, the equipment was shipped to the EADTB for an additional three week integration effort. The on-site integration effort at the EADTB was between September 4 and September 26, 1997. The initial EADTB integration effort was focused on the installation and upgrade of the local area network. This was followed by the installation and checkout of equipment, testing the equipment on the EADTB network, and training for the on-site personnel.

This Final Report includes a description of the effort, its conditions and conduct, and lessons learned. This report addresses the interconnectivity of the systems, and the integration of Government Furnished software models.

1. INTRODUCTION

1.1 Purpose

The purpose of this final report is to document the ADST II effort which supported the site activation effort for the EADTB. This report includes a full description of the integration effort, its conditions, and lessons learned.

1.2 Contract Overview

EADTB was performed as DO #0046 under the Lockheed Martin Corporation (LMC) ADST II contract with STRICOM. The contract required LMC to participate with STRICOM in a site survey, to evaluate the requirements as established in the Key Enabling Investments (KEI) for the Fort Bliss Modeling and Simulation Environment Tables of Estimated Cost, and the Fort Bliss Warfighting Center Feasibility Analysis Study, and to determine the best technical approach to upgrade the facilities to the requirements as established in these documents. The purpose of this upgrade was to build up the existing infrastructure to a design and configuration flexible to accomplish different tasks. The goal was to establish the capability of conducting simultaneous events and being expandable to meet the increasing activities in the experimental use of DIS. The FAS was completed in January 1997, and a Statement of Work was published on April 8, 1997. Contract award was June 19, 1997. LMC procured the required equipment, and had an integration period at the OSF from August 13 to August 29, 1997. Following integration at the OSF the equipment was shipped to Fort Bliss, TX for on-site integration which took place from September 4 to September 26, 1997.

1.3 Technical Overview

The technical approach to the EADTB effort initially involved the participation in a site survey, the evaluation of the requirements of the KEI and FAS, and the procurement of equipment. Following the procurement of equipment and an initial integration phase at the OSF, the equipment was shipped to the EADTB for final integration. The following is a short synopsis of the technical integration effort for the experiment.

The initial integration effort at the OSF ensured the proper operation of equipment prior to shipping it to the EADTB for installation and final integration. Upon receipt of the equipment at the OSF, field engineers configured the equipment, installed software, and tested the systems in both a stand alone and network configuration. Additional baseline software was obtained from the ADST II Configuration Management (CM) library which would provide the EADTB the capability to conduct, and participate in experiments in the ADST II program. Following the OSF integration phase the equipment was shipped to the EADTB. The initial focus of the on-site integration effort was to install and configure a new local area network which took seven days to complete. Following the installation of the network, efforts were oriented on the installation of the equipment that was shipped from the OSF. The equipment was installed, checked out and tested on the EADTB network. This

phase of the on-site effort took an additional 14 days. The on-site integration effort also included a capabilities demonstration, and training of on-site personnel.

2. Applicable Documents

2.1 Government

-ADST II Work Statement for Extended Air Defense Testbed (EADTB), April 8, 1997, AMSTI-97-WO01.

- Fort Bliss Warfighting Center Feasibility Analysis Study January 22, 1997.

- Fort Bliss Warfighting Center Modeling and Simulation Environment Master Plan, January 31, 1997.

2.2 Non-Government

-ADST II Technical Approach for Extended Air Defense Testbed (EADTB), May 19, 1997, ADST II-TAPP-EADTB-9700171A.

3. EADTB Site Description

3.1 Site Configuration and Layout

The EADTB contains a variety of platforms and applications. These platforms and applications provide the EADTB with the following capabilities; Semi-Automated Forces (SAF), displays for monitoring the battlefield, utilities to facilitate exercises, automated data collection capabilities, and data reduction and analysis subsystems. The EADTB systems platforms are depicted in Figure 1.

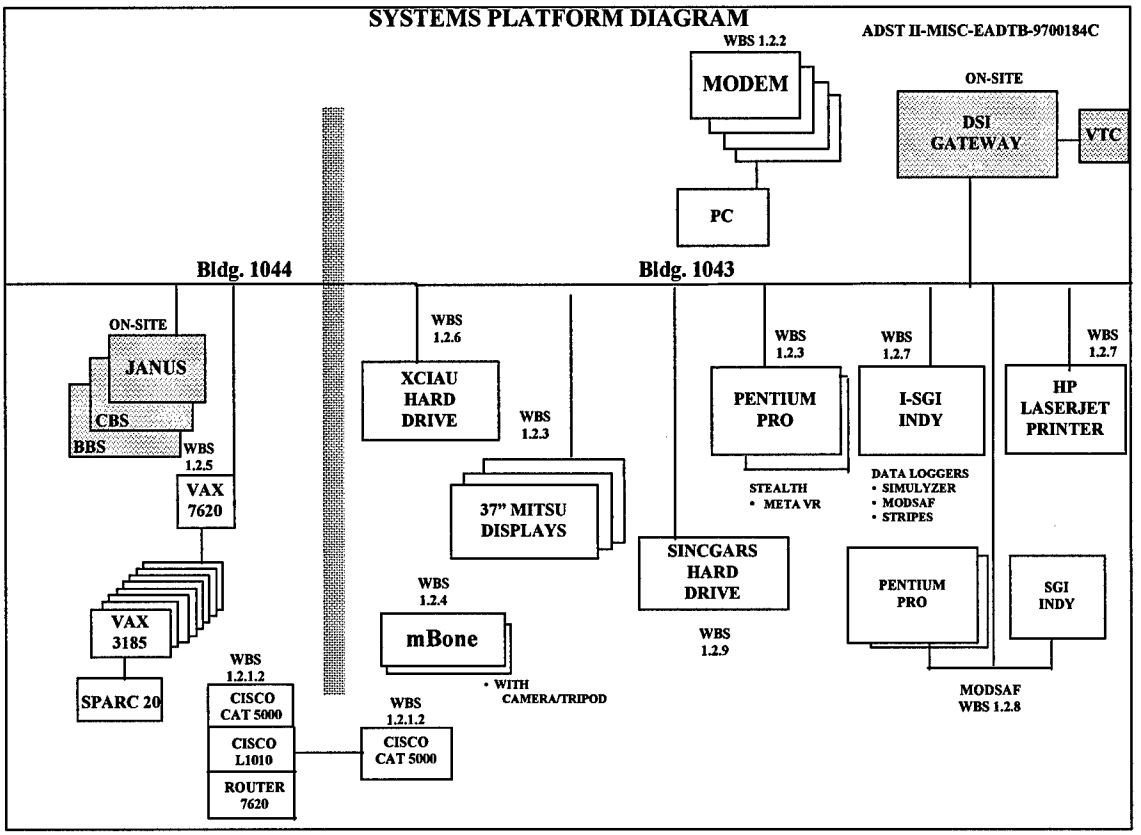

Figure 1. Systems Platforms Diagram EADTB

The table below identifies the system configurations delivered to the EADTB.

WBS	*System*	*Description*
1.2.3	Pentium Pro	Stealth
1.2.7	SGI Indy	Data Collection
1.2.8	Pentium Pro	ModSAF
1.2.8	SGI Indy	ModSAF

Table 1. System Configurations Delivered to EADTB

3.2 Description of Components

This section discusses the description, functionality and operation of the system components installed under this effort. This description also describes the Government furnished software models and their integration with the hardware at the EADTB.

3.2.1 Local Area Network (LAN) Upgrade

The local area network upgrade consisted of two components. The first involved the installation of a new network in building 1043 and the second component consisted of enhancing the routing capability between buildings 1043 and 1044. Additional capability to enhance the routing capability of building 1044 with distant simulation and learning facilities was also provided. The primary enhancement to the network is the logical separation of

network traffic into virtual LANs. This eliminates network congestion due to the entire facility sharing a single ethernet backbone.

3.2.1.1 LAN Upgrade

The local area network upgrade in Building 1043 consisted of the installation of approximately 14,000 feet of Category 5 cable into seven rooms. Within the seven rooms 96 wall sockets for 10/100 Base T connections were installed at the locations selected by the customer. These connections were linked to a network station in the computer room which consisted of four patch panels with 96 ports and six network hubs with 96 ports. The figure below depicts network upgrade with 10/100 BaseT drops.

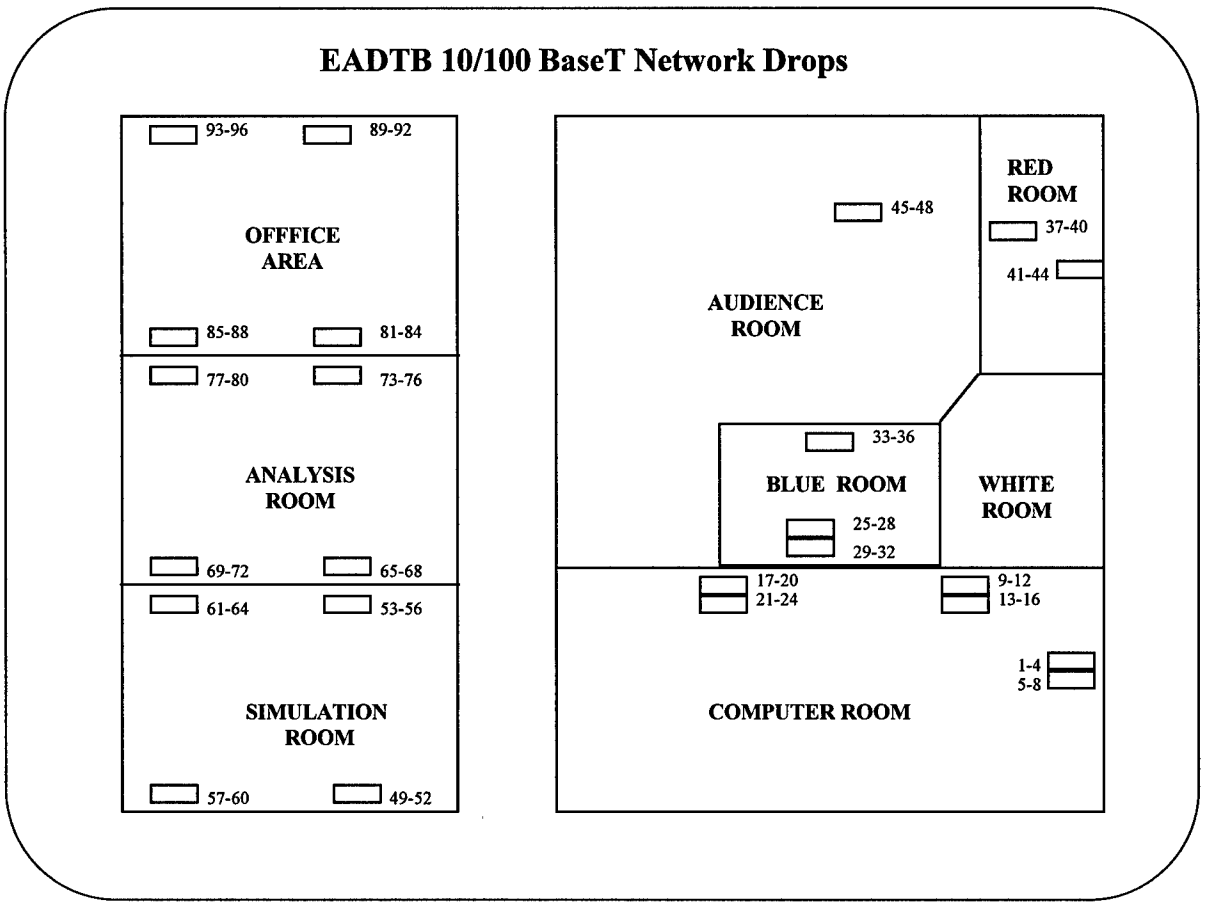

Figure 2. EADTB 10/100 BaseT Network

3.2.1.2 Data Video Hub

The data video hub effort involved the installation of equipment in both Building 1043 and 1044. This effort had two objectives, the first was to install a Cisco Catalyst 5000 10/100 Mb switch in both Buildings 1043 and 1044. This switch has Asynchronous Transfer Mode (ATM) Lane capabilities. It also provides a point of presence on the ATM network for ethernet devices without requiring network drivers and hardware upgrades. This also enhances the routing capability between the two buildings.

The second objective involved the installation of a Cisco 7200 ATM equipped router and Lightstream 1010 full ATM switch in Building 1044. The 7200 ATM equipped router is used for connectivity to the campus ATM backbone from the local ATM network. The Lightstream 1010 is a full ATM switch providing automatic ATM switch connectivity between the 7200 Router and Catalyst 5000 Switch. These enhancements to Building 1044 allow for connectivity to the Director of Information Management (DOIM) and the linkage to distant learning and simulation facilities for Air Defense training and simulation activities. The figure below depicts the enhanced linkage to distant learning facilities.

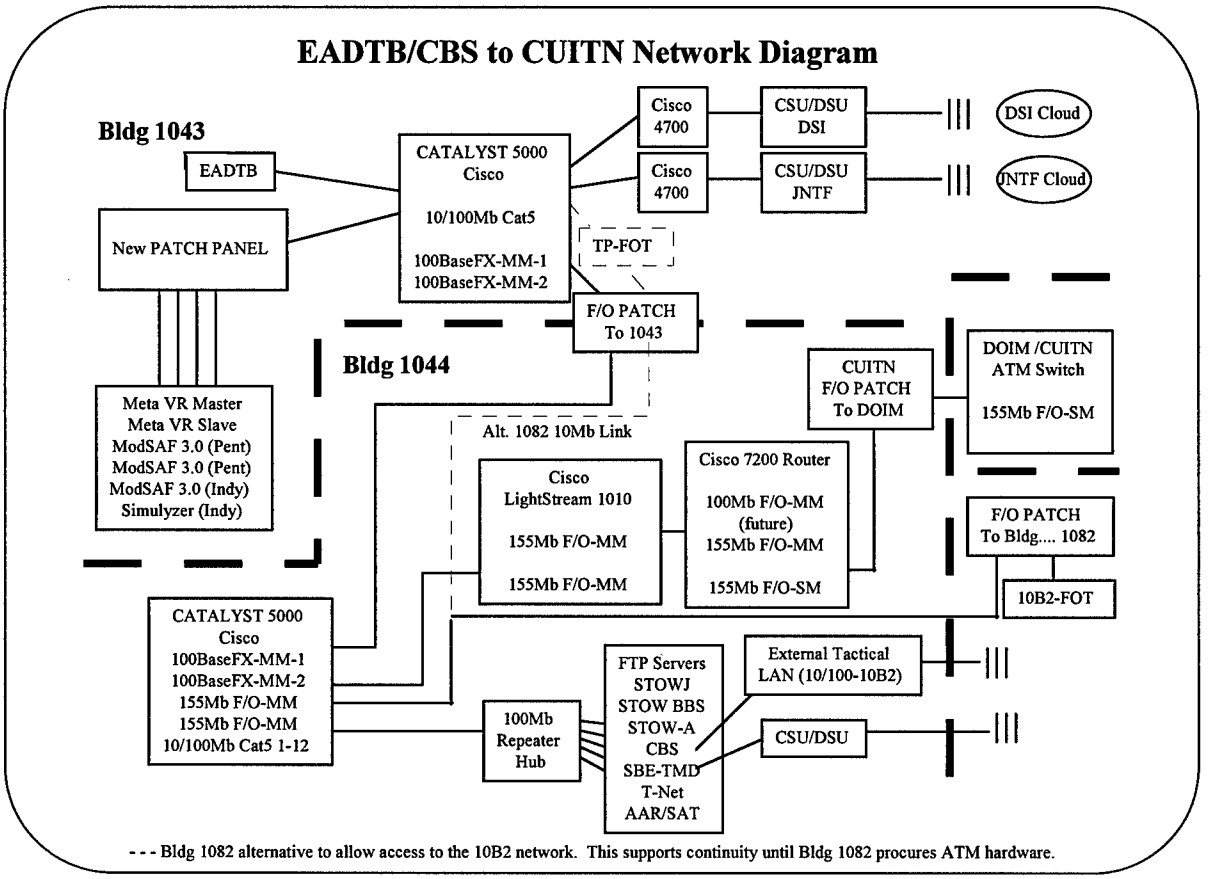

Figure 3. EADTB/CBS to CUITN Network Diagram

The figure below depicts the enhanced internal network in Building 1043 and it's link through Building 1044 to distant learning facilities.

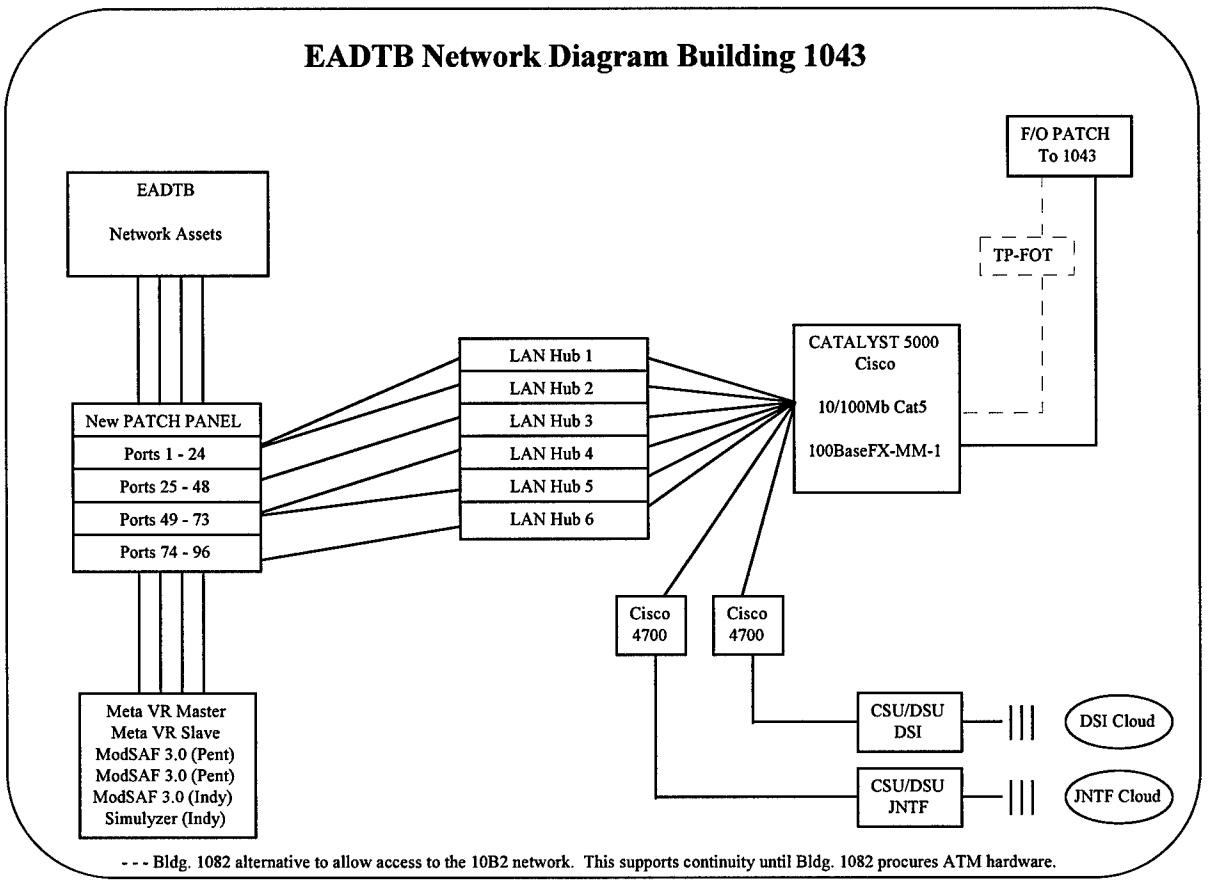

Figure 4. EADTB Network Diagram for Building 1043

3.2.2 Wide Area Network

The focus of this effort was to provide a modem based communication system as an alternative to the DSI which would allow communication to sites not on the DSI network. The original requirement was to procure eight modems and two personal computers. However, due to financial constraints and customer priorities, the hardware procurement was reduced to four modems and one personal computer. The procured hardware is on-site and has been checked for functionality. As customer funding increases and additional hardware is procured the full capability of the requirement will be achieved.

3.2.3 Stealth

The ADST II Stealth gives the Observer/Controller (O/C) personnel a "window" into the virtual battlefield allowing them to make covert observations of the action occurring during an exercise. In addition, through the use of the data logger, the Stealth gives observers and analysts an After Action Review (AAR) capability. The Stealth is displayed on two video displays with the PVD displayed on the third video display.

The Stealth permits the controller to fly around the virtual battlefield and view the simulation without interfering with the action. The features of the Stealth allow the observer to survey the virtual battlefield from a variety of different perspectives, including:

a. Tethered View - Allows the user to attach unnoticed to any vehicle on the virtual battlefield.

b. Mimic View - Places the user in any vehicle on the virtual battlefield and provides the same view as the vehicle commander.

c. Orbit View - Allows the operator to remain attached to any vehicle on the virtual battlefield and to rotate 360° about that vehicle, while still maintaining the vehicle as a center point of view.

d. Free Fly Mode - Permits independent 3-D movement anywhere in the virtual battlefield.

Stealth applications provided to the EADTB are:

a. MetaVR Stealth on the MetaVR personal computers, LMC Tag # 02600/02601.

3.2.4 Plan View Display (PVD)

The PVD provides a high resolution and real-time display of data packets received from all vehicles on the network. A color map display shows the current situation in an exercise by displaying the current positions of all entities involved in the exercise. The PVD also allows the user to view the entire database or zoom to a particular location and view a single vehicle. The PVD also allows the user to work with numerous map tools which enables the user to use terrain definition options, make intervisibility checks, and use overlay functions. The PVD can also connect to the data logger for remote control of exercise playback.

3.2.5 Video Teleconferencing (VTC)

The intent of the effort was to integrate and install the mBone VTC capability on EADTB GFE equipment in both Buildings 1043 and 1044. However, due to a customer decision this task was only partially completed. The mBone capability is fully operational in Building 1043 and the connectivity to Building 1044 is functional. The installation of the mBone in Building 1044 is not installed due to the nonavailibility of EADTB GFE equipment. Internal distribution of EADTB equipment and changing priorities by the EADTB staff eliminated this requirement for the current time. With the connectivity established between the buildings, this task can easily be accomplished by on-site personnel once internal equipment issues are resolved.

3.2.6 Distributive Interactive Simulation (DIS) Upgrade

The DIS upgrade was accomplished with the procurement of one Digital VAX 7260 and eight Digital VAX 3185 machines. With this procurement Building 1044 has enhanced the

DIS compatible interface to CBS utilizing the Run Time Gateway (RTG) to provide high fidelity air defense missile play within the simulation.

3.2.7 Cell Interface Unit (CIU)/Protocol Translator Cell Adapter Unit (XCIAU)

The XCIAU application software provides a bridge between two networks and allows control of the PDUs being transmitted to each network by providing PDU filtering capabilities. This protocol translator translates messages between a DIS 2.0.3 compliant and a SIMNET 6.6.1 compliant network. XCIAU Version 4.2.2 is loaded on a hard drive with single bay enclosure LMC Tag # 02513.

3.2.8 Data Collection

The Data Logger is an ADST II asset that captures the DIS network traffic. PDUs are time stamped and written to a file on a disk. External 8mm and 4mm tape drives were provided to back up logged data files. The Data Logger performs the following functions:

a. Packet Recording - Receives packets from the DIS network, time stamps and then writes to a disk or tape.

b. Packet Playback - Packets from a recorded exercise can be transmitted in real time or faster than real time. The Data Logger can also suspend playback (freeze time) and skip backward or forward to a designated point in time. The logger can be controlled directly from the keyboard or remotely from the Plan View Display (PVD). Playback is visible to any device on the network (PVD, Stealth Vehicle, a vehicle simulator, etc.).

c. Copying or Converting - Files are copied to another file, which can be on the same or a different medium; and files from the older version of the Data Logger can be converted to a format compatible with the current version of the Data Logger.

Data collection applications provided to the EADTB are:

a. Simulyzer on the SGI Indy R5000, LMC Tag # 02639.

b. STRIPES on the SGI Indy R5000, LMC Tag # 02639.

3.2.9 Modular Semi-Automated Forces (ModSAF)

ModSAF is a constructive simulation system which has the capability of populating the Synthetic Battlespace with computer-generated DIS forces for large scale multi-service exercises. ModSAF can be used as both friendly and enemy forces as both single entities or large units. ModSAF is controlled by an operator exercising supervisory control and can perform opposing, flanking, subordinate, and supporting force roles. The operator controls his forces by the use of Operations Orders and Fragmentary Orders that augment the built-in automated reactions of the ModSAF forces.

ModSAF 3.0 was installed at the EADTB. This application was installed on three platforms, SGI Indy R5000, LMC Tag # 02638, and both Linux machines, LMC Tag # 02560/02561.

3.2.10 Radio Simulator Upgrade

The SINCGARS application was provided as GFE from the ADST II CM Library to enable them to communicate with previously established SINCGARS systems. SINCGARS version 4.1 was installed for this effort on a hard drive with a single bay enclosure LMC Tag # 02517.

4. Conduct of The Experiment/Effort

4.1 OSF Integration

The integration effort was part of the ADST II Systems Engineering Process. The Systems Engineering Integration Team (SEIT) participated in an Engineering Review Board for all technical materials generated, and all site configuration decisions. This process started early in the design and development phase. The process also used the Concurrent Engineering Approach with STRICOM engineers participating.

The OSF integration period was a 12 day effort from August 13 -29. The purpose of this effort was to ensure the proper operation of equipment prior to shipping it to the EADTB for installation and final integration. During this phase field engineers configured the hardware, installed the software, and tested the systems in both a stand alone and network configuration. Software applications from the ADST II CM Library were installed on the equipment, and all new hardware and software was brought under CM control. After installation of the software was complete, backup tapes were made and provided to the EADTB for use in case of emergency situations. Appendix A lists all items brought under CM control with copies furnished to the EADTB.

The following items from CM were used:

WBS	SW Item	Version	Purpose
1.2.6	XCIAU	4.2.2	Network filtering and protocol translation
1.2.7	STRIPES Datalogger	4.1	Data Collection
1.2.7	Simulyzer	1.5	Data Analysis
1.2.8	ModSAF	3.0	Computer Generated Forces, Plan View Display, and Datalogger
1.2.9	SINCGARS Radio Model (SRM)	4.1	DIS Radio Simulation

Table 2. ADST Software Items for EADTB

4.2 On-Site Integration

The on-site integration phase was from September 4-26. The initial effort during this phase was oriented on the installation of the new network in building 1043. Upon completion of the network installation all hardware was configured and tested with the software in both a stand alone and network configuration. A migration plan was prepared to allow for a smooth transition of EADTB equipment from the old to the new network. Training was provided to on-site personnel. The purpose of the training was to allow EADTB personnel to become familiar with the power up and power down requirements, how to use the applications, how to change applications, and mix and match applications. Discussions were also held with the

MWTB, LWTB, and OSF integration team, and site personnel on activities that normally take place during daily operations. These discussions oriented on the setting up and execution of exercises and experiments.

5. Follow-on Support

Throughout the program, the customer was constrained by budget and not technical capabilities of the contract. Several decisions were made by the customer to reduce hardware items recommended by the FAS in order to get to the target cost. Through the Integrated Product Team (IPT) process it was determined that any funds remaining at the end of the contract would be used to procure additional hardware for the customer. Once the exact amount of funding is known and hardware priorities are established, LMC through the IPT process, will coordinate with STRICOM and EADTB personnel and establish the final requirements.

6. Observations and Lessons Learned

6.1 Development and Integration

- Observation #1

The installation of hardware in Building 1043 and 1044 for the Data Video Hub was extremely difficult.

- Discussion #1

The accomplishment of this task was more difficult than anticipated. During the on-site integration period key personnel from the EADTB who were the most familiar with the requirements were absent due to training or on temporary duty away from Fort Bliss. Lockheed Martin personnel were briefed by the EADTB personnel prior to their departure on the requirements as known to them and the instructions they had received from the DOIM. The DOIM was also not present during this integration due to other requirements. This resulted in the Lockheed Martin personnel acting on third party information. As a result some confusion did exist with the identification of system addressees and the connectivity of the new system with the rest of the DOIM network. This confusion resulted in the calling in of the Cisco area representative, and the task taking twice as long as anticipated.

- Lesson Learned #1

With the absence of EADTB key personnel, the Lockheed Martin integration team should have initiated immediate direct coordination with the DOIM to ensure that the requirements were completely understood. By relying on third party information communication broke down. Once coordination with the DOIM was made the systems were operational within thirty minutes.

- Observation #2

The procurement of hardware was hampered by inaccurate data provided by the user. The user held discussions with vendors to aid their education process of the incoming technology. When the requirements definition meeting was held with STRICOM, Lockheed Martin, and the user, this data was relayed to the IPT for proposal input. The IPT included the information in the proposal, to find out later that the data was incorrect. This caused shipments from the vendors which had to be returned and additional shipments had to be made with the correct equipment.

- Discussion #2

The original Bill of Materials (BOM) in the proposal was continuously changed after contract award as more information was received concerning the technology to be implemented in the EADTB. the changes occurred as updated information/more information was received by the user. This caused a delay in ordering equipment necessary to complete the integration at the EADTB.

- Lesson Learned #2

Closer coordination needs to occur in the IPT to baseline the BOM. Information should be verified by the IPT before being incorporated in the BOM.

6.2 Overall

- Observation #1

Direct shipment of hardware created confusion and temporary loss of control of property.

- Discussion #1

It is the common practice to have newly procured hardware shipped to the OSF for initial integration and checked out for functionality prior to shipping it to the site for final integration. With this Delivery Order several items did not require any initial integration. A joint decision was made between Lockheed Martin, STRICOM, and EADTB personnel to have these items shipped directly to the EADTB. This course of action would reduce shipping cost and save money. To complicate this effort the United Parcel Service had a strike during the peak shipping time for this delivery order. As a result, some property was lost, some property was damaged, and coordination between Lockheed Martin and EADTB personnel was not as efficient as it should have been. At times all parties were in some state of confusion as to what property was shipped, what property was in transit, and what property had arrived at the EADTB. It was also noted that some of the property that was directly shipped was in the wrong configuration.

- Lesson Learned #1

All newly procured hardware should initially be shipped to the OSF. This will ensure that the hardware procured meets the established configuration requirements, and ensures proper functionality and accountability.

7. Conclusion

The Extended Air Defense Testbed Delivery Order has completed its initial on-site integration. It is apparent that the delivery order accomplished it's objectives of implementing the recommendations of the Feasibility Study and enhancing the DIS capability of the site. The infrastructure is in place to establish a Core DIS facility if the need exists. A network is installed and configured with a high band capability. DSI access is present, and the hardware and software is in place for the use of ModSAF, Stealth, Data Collection, and SINCGARS radio applications.

Three additional tasks should be accomplished to completely close out the effort:

a.) Determine the exact requirements for additional equipment based on the funding status.

b.) If required, extend the period of performance to allow for the procurement of additional hardware with the excess funds that are available.

Acronym List

AAR	After Action Review
ACTD	Advanced Concept Technology Demonstration
ADST	Advanced Distributed Simulation Technology
ARPA	Advanced Research Project Agency
ARSI	ARPA Reconfigurable Simulator
ATD	Advanced Technology Demonstration
ATM	Asynchronous Transfer Mode
BBS	Brigade and Battalion Simulation
BLE	Battle Laboratory Experiments
BLUFOR	Blue Forces
BOM	Bill of Materials
C2	Command and Control
CBS	Corps Battle Simulation
CIU	Cell Interface Unit
CDF	Core DIS Facility
CDRL	Contract Data Requirements List
CM	Configuration Management
DCD	Director of Combat Developments
DIS	Distributive Interactive Simulation
DO	Delivery Order
DSI	Defense Simulations Internet
EADTB	Extended Air Defense Testbed
EADSIM	Extended Air Defense Simulation
FAS	Feasibility Analysis Study
GFE	Government Furnished Equipment
H/W	Hardware

IPT	Integrated Product Team
KEI	Key Enabling Investments
LMC	Lockheed Martin Corporation
LMSG	Lockheed Martin Service Group
LWTB	Land Warrior Testbed
ModSAF	Modular Semi-Automated Forces
MWTB	Mounted Warfare Testbed
OC	Observer Controller
OSF	Operational Support Facility
PVD	Plan View Display
RIU	Radio Interface Unit
RTG	Run Time Gateway
RTOS	Reconfigurable Tactical Operations Simulator
SAF	Semi-Automated Forces
SEIT	Systems Engineering Integration Team
SEMP	Systems Engineering Management Plan
SINCGARS	Single Channel Ground and Airborne Radio System
SOW	Statement of Work
SRM	SINCGARS Radio Model
STRICOM	(US Army) Simulation Training and Instrumentation Command
VTC	Video Teleconference
XCIAU	Protocol Translator Cell Adapter Unit

Appendix A - Configuration Management Inventory

4mm DAT tape STOWEX Stripes Field Installation, CM# MD0191-3

4mm DAT tape SINCGARS Field Installation (Engineering Release),

CM# MD0203-5

4mm DAT tape XCIAU STOWEX Field Installation 4.2.2, CM# MD)184-4

4mm DAT tape ModSAF 3.0 (SGI/Linux), CM# MD0306-5

Appendix B - Key Personnel

ADST II EADTB Team

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