

END-TO-END TEST
Verification and Validation Plan

Prepared by: Gary Marchand, SAIC
End-To-End Verification and Validation Team Lead

Joint Advanced Distributed Simulation
Joint Test and Evaluation
11104 Menaul Blvd NE
Albuquerque, New Mexico 87112-2454

20000822 114

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Appendix A Verification Plan for Phase II of the Virtual Surveillance Target Attack Radar System (VSTARS)
prepared by Northrop Grumman, Electronics and Systems Integration Division

Appendix B Software Test Plan for the JADS Ground Data Terminal 1553 Bus Interface Unit
prepared by Motorola

Appendix C V&V Techniques

Appendix D References

1.0 Introduction

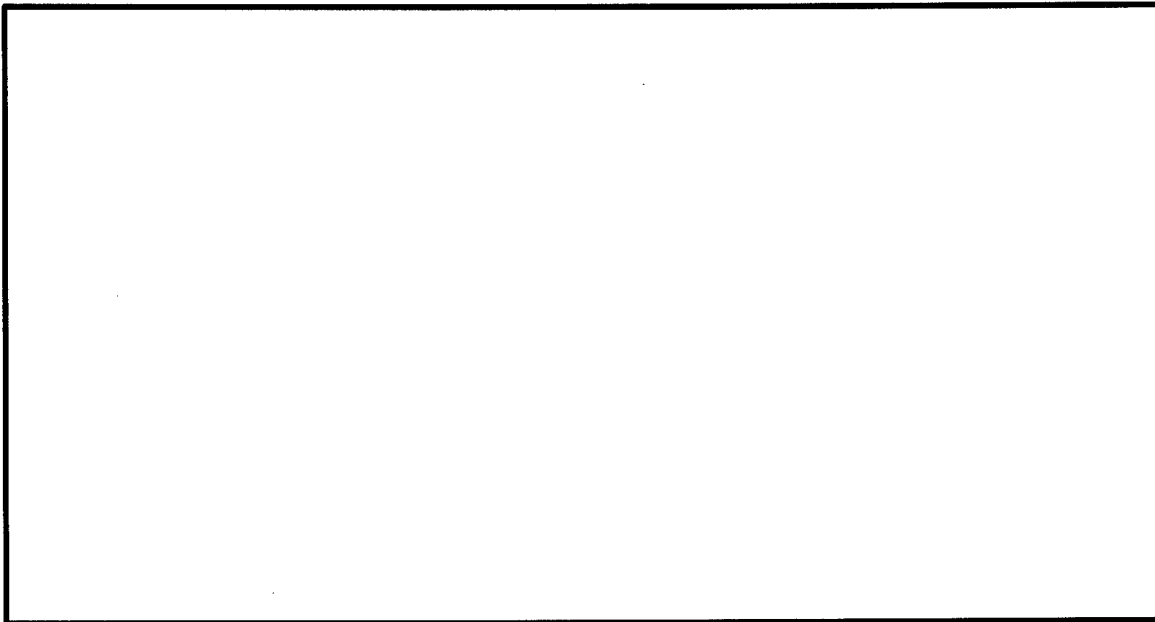
One of the major issues associated with the use of advanced distributed simulation (ADS) is the credibility of the modeling and simulation (M&S) used and the credibility of their interactions over a distributed network. The credibility of M&S is commonly measured by verification and validation (V&V) and then formally approved as adequate for use for a specific application by accreditation. The V&V of M&S and distributed simulations are formally required by Department of Defense (DoD) Instruction 5000.61, *DoD Modeling and Simulation (M&S) Verification, Validation and Accreditation (VV&A)*, prior to their use in testing. Numerous guides and pamphlets exist which cover V&V requirements, techniques, practices and tools (Annex G).

Since Joint Advanced Distributed Simulation (JADS) is a DoD-sponsored joint test, the overall guide for the V&V of the JADS End-to-End (ETE) Test will be the *Department of Defense Verification, Validation and Accreditation Recommended Practices Guide*. This guide includes a number of V&V processes that may be used for the V&V of M&S and ADS environments and includes definitions of key terms used in V&V (Appendix D). Specifically, verification and validation are described as:

- Verification--The process of determining that a model implementation accurately represents the developer's conceptual description and specifications.
- Validation--The process of determining the manner and degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model.

The JADS ETE Test utilizes the Institute of Electrical and Electronics Engineers (IEEE) Standard 1278 for Distributed Interactive Simulation (DIS) to develop its ADS synthetic environment (SE). During the development of the IEEE Standard 1278, one of the key methodologies associated with DIS was the verification, validation and accreditation (VV&A) process for distributed simulation applications. The Defense Modeling and Simulation Organization (DMSO), in cooperation with the VV&A subgroup of the DMSO/U.S. Army Simulation, Training and Instrumentation Command (STRICOM) Workshop on Standards for the Interoperability of Distributed Simulations, sponsored a project to define the VV&A process for distributed simulation applications using DIS. This project, known as the VV&A of Distributed Simulations, has developed a DIS VV&A process model that is an elaboration and expansion of the nine-step model originally accepted for consideration by the 10th DIS Workshop.

Within the DIS community, the process model has been extensively discussed with numerous members of the DIS M&S community and has generally been accepted by V&V practitioners. The process model has also been selected by the developers of the DoD *VV&A Recommended Practices Guide* as the VV&A process for DIS SE. A pictorial of the DIS VV&A process model is at Figure 1.



The process model and its accompanying *Recommended Practice for Distributed Interactive Simulation -- Verification, Validation, and Accreditation* (Draft-4 November 1996) form the basis for the VV&A of the ETE Test SE.

The DIS Nine Step Process Model was developed with a conventional, short-lived, DIS exercise in mind, as opposed to a test of a major system, and presupposes a full complement of funds and personnel available at the beginning of the exercise development. This disparity was brought to the attention of the developers of the DIS Nine Step Process Model, and the conclusion was reached that since the model was recommended and intended for tailoring to the needs of the user, the model would continue to be tied to the DIS exercise development and construction process contained within IEEE Standard 1278.3.

If one tailors the DIS Nine Step Process Model to the joint test process, then the process model would appear as shown in Figure 2.

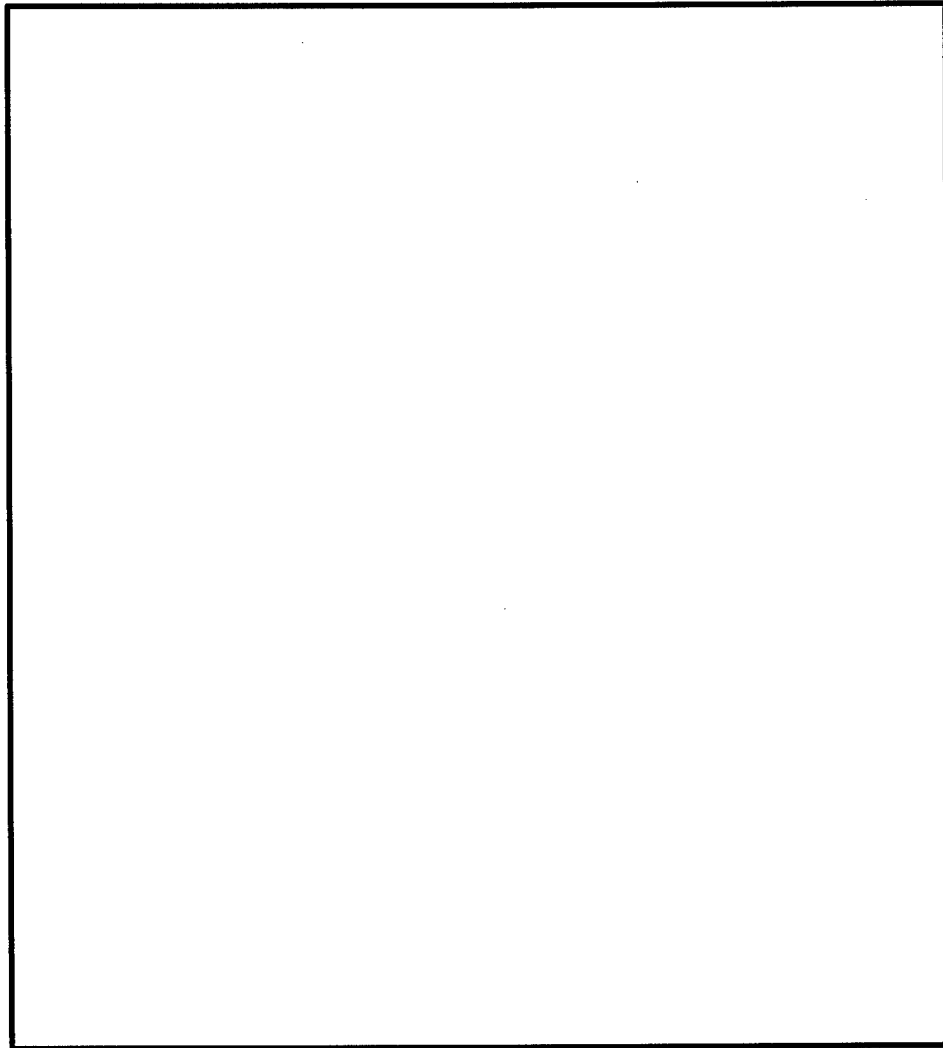


Figure 2. JADS ETE Test Process Model

In the JADS ETE Test Process Model, test events, which consist of the planning, construction and assembling of the SE, integration and testing of the SE, accreditation of the SE, and conduct of the test all proceed on the left side from top to bottom. The V&V events, to include documentation, proceed to the right for each test event.

The JADS ETE Test is presently executing the test event shown as “Develop Test Activity Plan” and has started the test event shown as “Construct and Assemble Synthetic Environment.” The test events ‘Conduct Feasibility Study’ and ‘Develop Program Test Plan’ were completed three and two years ago, respectively. As will be shown later, formal V&V for these two activities will consist of documenting actions taken several years ago.

The major change from the DIS VV&A Process Model is the inclusion of the SE accreditation as a part of the test process, resulting in an eight step V&V process. Accreditation is not a part of the DIS exercise process in the DIS VV&A Process Model. Instead, it is shown as a part of the

VV&A process, and by implication is not something that is required prior to the conduct of the DIS exercise. When ADS is used in support of operational and developmental testing, accreditation is a management function and is a mandatory part of the test process.

Finally, it should be noted that the JADS ETE Test Process Model can be easily adapted to any test and does not require the use of DIS to develop the SE. Program test plan can easily be changed to test and evaluation master plan (TEMP), and DIS could be easily replaced by high level architecture (HLA) or aggregate-level simulation protocol (ALSP).

2.0 ETE Test VV&A Roles and Responsibilities

2.1 JADS and ETE Test Roles

The IEEE document, IEEE 1278.3, *Recommended Practice for Distributed Interactive Simulation -- Exercise Management and Feedback*, describes the roles and responsibilities of the personnel, agencies, and systems involved throughout the exercise management and feedback (EMF) process. Those most closely associated with the VV&A process are identified below.

ETE Test Manager: The person in charge of planning, coordinating and executing the DIS-complemented ETE Test.

ETE Test Architect: The person responsible for designing, constructing and testing the DIS-complemented ETE Test.

ETE Test Sponsor: The person funding the DIS-complemented ETE Test development and execution.

JADS ETE Test Network Manager: The person or agency who maintains and operates the ETE Test network capable of providing the DIS link between two or more sites.

2.2 JADS and ETE Test Responsibilities

Table 2 identifies the individuals, by name and position within the JADS Joint Test and Evaluation (JT&E) organization, who will fulfill the JADS and ETE Test roles identified in the paragraph 2.1.

Table 1. JADS and ETE Test Responsibilities

Role	Name	Position
ETE Test Sponsor	Colonel Mark Smith	JADS Joint Test Force Director
ETE Test Manager	MAJ Paul Hovey	ETE Test Team Lead
ETE Test Architect	Mr. Gary Marchand	ETE Test Technical Lead
JADS ETE Test Network Manager	MAJ Steve Sturgeon	Network and Engineering Team Lead

2.3 V&V Roles

Specific V&V roles involved in the V&V of the ETE Test are described below.

ETE Test V&V Team Lead: The person responsible for oversight of the ETE Test V&V activities. The ETE Test manager designates the V&V team lead who will oversee, coordinate, participate in, and integrate the V&V activities in support of the test. The V&V team lead will develop the ETE Test V&V plan and recommend the V&V participants.

Accreditation Agent: The person responsible for oversight of the JADS JT&E accreditation activities. The JADS Joint Test Force (JTF) director designates the accreditation agent who will oversee, coordinate, and integrate the accreditation activities in support of the exercise. The accreditation agent will select personnel who will observe the efforts of the ETE Test V&V Team and report back to the accreditation agent as to the validity and thoroughness of the V&V of the ETE Test SE.

ETE Test V&V Team: The group responsible for planning and conducting verification and validation on the combination of components that comprise the ETE Test, preparing and submitting the V&V report to the accrediting authority, and documenting the results of the V&V effort.

Accreditation Team: The personnel who will represent the Accreditation Agent during ETE Test V&V events and will assist the accreditation agent in evaluating the results of the ETE Test V&V activities.

2.4 VV&A Responsibilities

Table 2 identifies the individuals, by name and position within the JADS JT&E organization, who will fulfill the VV&A roles identified in paragraph 2.3.

Table 2. VV&A Roles and Responsibilities

Role	Name	Position
Accreditation Agent	Mr. Eric Keck	JADS Technical Advisor
ETE Test V&V Team Lead	Mr. Gary Marchand	ETE Test Technical Lead
V&V Team	Maj Mark Scott	ETE Test Team
V&V Team	Capt Rod Houser	ETE Test Team
Accreditation Team	TBD by Accreditation Agent	TBD
Accreditation Team	TBD by Accreditation Agent	TBD

3.0 ETE Test Synthetic Environment Requirements and Acceptability Criteria

Prior to conducting the V&V of a SE, one must ascertain the functional requirements and acceptability criteria from the test plan and other documents that describe the SE. The V&V agent will then develop the V&V plan by identifying the tasks required to meet these requirements and acceptability criteria in a manner that matches and complements the test activity plan, test requirements, component requirements, available resources, and timelines.

3.1 JADS Program Test Plan -- February 1996

The description of the ETE Test SE is contained within the JADS Program Test Plan (PTP). It should be noted that the SE employed in the ETE Test is limited to a corps slice of what would be a larger scale real-world scenario. V&V activities are conducted from that perspective. The ETE Test SE is described within the PTP as:

The test concept is to use ADS to supplement the operational environment the E-8C and ground station module (GSM) operators would experience. By mixing the available live targets with targets generated by a constructive model, a battle array that approximates the major systems present in a "notional corps" area of interest can be presented. Additionally, by constructing a network with nodes representing appropriate command, control, communications, computers and intelligence (C4I) and weapon systems, a more robust cross section of players is available with which the E-8C and GSM operators can interact.

Several components are required to create the ADS-enhanced operational environment that will be used in the ETE Test. In addition to Joint Surveillance Target Attack Radar System (Joint STARS), the ETE Test will require a simulation capable of generating entities that will represent the elements in the rear of a threat force (at least 5000 entities). Also, simulations of the Joint STARS moving target indicator (MTI) radar and synthetic aperture radar (SAR) will be used to insert the simulated entities into the radar processing stream onboard the E-8C while it is flying a live mission. Other simulations used to support the test include the Army Tactical Missile System (ATACMS) and a corps-level fire control element (FCE). Communications among these simulations will be accomplished using doctrinally correct means such as All Source Analysis System (ASAS) message traffic and tactical fire (TACFIRE) or Advanced Field Artillery Tactical Data System (AFATDS) message traffic encapsulated within DIS communications protocol data units (PDU). Additional live elements that will be integrated into the ETE Test SE include the corps analysis and control element (ACE), which uses the ASAS and the GSM or common ground station (CGS).

3.2 Analysis of ETE Test Concept

Prior to determining the requirements and acceptability criteria for the ETE Test, it is necessary to analyze the ETE Test concept in terms of operational and ADS needs and characteristics. These needs and characteristics drive both the design of the ETE Test SE and the requirements the ETE Test SE must meet.

The ETE Test SE is actually composed of two synthetic subenvironments (SSE) which share two common components, the simulation(s) that provides the battlefield environment and the GSM or CGS. The first SSE, which will be called the sensor SSE, consists of the simulation(s) that provides the battlefield environment, the simulation of the sensor system onboard the E-8C, and the GSM or CGS. The second SSE, which will be called the command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) SSE, consists of the simulation(s) that provides the battlefield environment; the corps ACE which uses the ASAS; a simulation of the ATACMS and a corps-level FCE; and the GSM or CGS. Figure 3 illustrates these two SSEs and their intersection.

Figure 3. ETE Test Synthetic Environment

The reason it is important to make these distinctions is that the two SSEs have different operational and ADS needs and characteristics. The sensor SSE will deal with millions of entity State protocol data units (ESPDU) representing the movement of thousands of entities across the battlefield. Operationally, the fastest practical revisit time for the sensor is on the order of six seconds. Average revisit time is approximately forty seconds. In addition, the sensor is used to look at groups of targets, such as a convoys or air defense sites, and normally looks at a series of scans, called history files, taken over time.

The end result is that latency only becomes an issue when the environment is broken or showing very abnormal behavior. Missing or damaged ESPDUs are also not a problem unless the environment is broken or showing very abnormal behavior, because the probability of looking at a particular entity at any one time is practically zero. A broken or very abnormal environment will manifest itself in a number of real-time ways long before any post-test analysis of latency and ESPDUs damaged or missing takes place.

The C4ISR SSE, however, operates much differently than the sensor SSE. It consists primarily of man-in-the-loop nodes where decisions are made and actions are taken based upon information received. It also contains a weapons system with a circular error probable (CEP) that impacts within the battlefield environment simulation(s). As a result, the C4ISR SSE uses two types of PDUs: the message PDU (MPDU) and the fire and detonate PDUs. The latency and dropout or damaged requirements for these types of PDUs are very different.

The MPDU is used to convey relatively nontime sensitive information between decision makers on a non-scheduled basis and thus is not subject to normal latency considerations. If it takes more than a few seconds for the MPDU to travel from node to node, the environment is broken. If a MPDU is lost or damaged, however, that is another matter. Since each MPDU will carry message traffic vital to the SE, the loss of even one PDU will have an effect upon the environment.

The MPDUs, however, carry standard, digitized messages that are normally transmitted over networks. One can expect that some are normally lost or damaged with a resultant effect upon the operational environment, and this results in what is sometimes called the 'fog of war.' Thus, the true measure of the degree of PDU dropouts or damage that the C4ISR SSE can live with now becomes an evaluation by a subject matter expert (SME) of how 'foggy' the operational environment has become as compared to a live operational environment.

The fire and detonate PDUs require rapid transmission across the SE since they act to notify the SE of what has happened in the originating simulation. The receiving simulation then uses the information to determine what effect the action has upon itself and changes its state to reflect this effect. The simulations involved are closely coupled, but the fire PDU will serve primarily as an alert because of the long flight time of the ATACMS. Additionally, the CEP is large enough that even if the detonate PDU is delayed by several seconds the moving target location would still fall within the CEP of the ATACMS. Since the SE is not being used to assess the accuracy nor effectiveness of the ATACMS, and in actuality unclassified weapons performance data sets are used to assess damage, any effect upon the target is acceptable. Once again, if the SE is functioning normally, latency is not an issue.

The detonate PDU is a critical PDU to the SE, and every detonate PDU must be received by the battlefield environment simulation(s). This requires that each firing of the ATACMS must be closely monitored by the test control and if, for whatever reason, the detonate PDU is not received, then the mission must be refired. Based upon network reliability, it is anticipated that this will never occur during the limited life of the ETE Test.

In conclusion, it is not possible to set a priori values for the SE's latency requirements and PDU dropout or damaged rates. Instead, each incidence of PDU damage or dropout must be investigated to determine what effects, if any, the loss or damage had on the SE. In addition, the network performance must be monitored to ensure that overall latency remains within normal bounds as determined during the network characterization phase of the test.

3.3 Requirements and Acceptability Criteria

From this description and analysis of the ETE Test SE, statements of work (SOW) for the components of the ETE Test SE and interagency agreements, requirements and acceptability criteria may be derived for the simulations and components, known as nodes, that comprise the environment and for the environment itself. For purposes of clarity, the requirements and acceptability criteria will be listed by node and then for the environment as a whole.

3.3.1 Simulation Nodes

3.3.1.1 J6K

The entity generator that will be used in the ETE Test SE will be based upon a simulation known as Janus. It is an Army, constructive, entity-level simulation under the configuration control of the Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC), White Sands Missile Range (WSMR) and STRICOM. Janus will be modified, as appropriate, to be able to represent at least 5000 entities. The entity-level data generated by Janus will be converted into ESPDUs by an interface developed by TRAC-WSMR for that purpose.

Requirements

- Capable of simulating or of being modified to simulate at least 5000 distinct entities with at least twenty-five percent moving, in a reasonable and affordable manner.
- Capable of issuing DIS 2.0.4 ESPDUs that describe each entity simulated.
- Capable of receiving and acting upon ESPDUs, fire PDUs, and detonation PDUs.
- Capable of running for at least eight hours with human intervention as required.
- Capable of running at or representing real-time actions.
- Must use terrain data base at least 200 kilometers (km) by 200 km and based on National Imagery and Mapping Agency products.
- Must have a V&V history, an accreditation history for analysis, be under configuration control, and be well documented.
- Must reasonably represent entity movement, stopping, and turning.
- Must represent the effects of a bombing or missile attack on the entities represented in an acceptable and credible manner.

Acceptability Criteria

- At least 5000 entities with at least twenty-five percent moving will be simulated using a commercial off-the-shelf (COTS) product costing less than 100,000 dollars.
- Each ESPDU will conform with the DIS 2.0.4 standards as amended by JADS as to content and format.
- The simulation will receive and act upon each ESPDU, fire PDU, and detonate PDU issued to it by the network and will take the appropriate action as dictated by the PDU provided the appropriate data sets regarding the PDU have been entered into the simulation.
- The simulation will accept and process scenarios with a duration longer than eight hours.
- The operator(s) will be capable of fully interacting with a scenario while it is running.
- The simulation will be capable, when running, of proceeding in a step-wise fashion at a pace representative of real time. That is, when a unit of game time is represented within Janus a corresponding amount of time will have elapsed since the start of the simulation. This feature will be adjusted by tuning the scenario.
- The simulation will be capable of utilizing scenarios conducted upon terrain representing a simulation area of 200 km by 200 km.

- The simulation will have a V&V history, an accreditation history for analysis, be under configuration control, and be well documented.
- The simulation will represent vehicle behavior to the degree detectable by a Joint STARS target analyst using an Advanced Technology Work Station (ATWS).
- Area coverage and attrition for area weapons will be representative of the real weapon system. Unclassified data sets will be used for the ETE Test as the JADS ETE Test is not testing area weapon effects. The simulation must be capable of using classified data sets to represent actual weapons effects if so required.

3.3.1.2 Target Acquisition Fire Support Model (TAFSM).

The simulation that will be located at Fort Sill, Oklahoma, and represents the ATACMS and a corps-level FCE is known as TAFSM. It is a constructive model that is under the configuration control of the Depth and Simultaneous Attack Battle Lab (DSABL). The simulation is used extensively in analysis of alternatives (AOA), doctrinal studies, and training by numerous agencies.

Requirements

- Simulation must be a doctrinally correct simulation of a corps-level artillery battle that is verified, validated and accredited for training and analysis by the DSABL.
- Simulation must be capable of receiving artillery missions via DIS PDUs and broadcasting fire and detonation PDUs when artillery weapons are fired.
- Simulation must represent all fielded artillery systems to include the ATACMS.

Acceptability Criteria

- Simulation must be accredited for training and analysis by DSABL for use in representing in a doctrinally correct manner a corps-level employment of ATACMS
- Simulation will accept artillery missions using TACFIRE or AFATDS messages encapsulated in a DIS PDU. Simulation will issue a fire and detonate PDU whenever an ATACMS missile is fired and subsequently detonated.
- Simulation will represent the performance characteristics of the ATACMS in a matter acceptable to the DSABL.

3.3.1.3 Virtual Surveillance Target Attack Radar System (VSTARS).

The simulation of the radar onboard the E-8C subsystem is called the Virtual Surveillance Target Attack Radar System (VSTARS). It is being developed by Northrop Grumman and Lockheed Martin and integrated into the radar subsystem by Northrop Grumman. VSTARS is composed of an integration and management set of software and simulations of the two radar modes onboard the aircraft: SAR and MTI radar. When used within the laboratory, VSTARS will also use existing navigation and programmable signal processor (PSP) simulations. Requirements and acceptability criteria for VSTARS overall and the components of VSTARS will be addressed separately.

Requirements

- VSTARS will enable the mixing of MTI radar virtual entities, terrain, and SAR images in a seamless manner with the actual radar images produced by the E-8C while performing an operational mission. VSTARS will operate within the timeline standards, utilize the same system parameters, and use the same message formats established for the Joint STARS radar system.
- When installed on the E-8C, VSTARS will provide simulated radar data integrated with live radar data when operating within the JADS JTF ETE Test environment.
- For MTI radar reports, VSTARS will allow operation in three modes: live, where all data are provided by the radar operating system; mixed, where both live and virtual data are provided; and virtual, where all data are provided by VSTARS. SAR reports will be either real or virtual with no mixing.
- In all modes of operation, VSTARS will permit all of the normal operations performed by the console operator to remain possible, such as target tracking, target type identification, etc., even though most or all of the targets are virtual entities.
- When working on a VSTARS supplemented workstation, the operators should not be able to easily distinguish between live and virtual targets, either visually or as a result of any action normally taken in the course of performing their duties.

Acceptability Criteria

- VSTARS will be integrated into the Joint STARS radar subsystem in such a manner as to be transparent to the operations and control (O&C) subsystem, thereby permitting the mixing of virtual entities, terrain, and SAR images in a seamless manner with the actual radar images produced by the E-8C while performing an operational mission.
- VSTARS must receive virtual target data from the JADS JTF ETE Test environment and integrate it with live target data received and processed by the radar subsystem.
- For MTI reports VSTARS operates in three modes: only live targets displayed, mixed live and virtual targets displayed, and only virtual targets displayed. Display will be upon the currently installed version of the operator's workstation. VSTARS will permit the SAR report to consist of either a real report or a virtual report.
- In all modes of operation, VSTARS will permit all of the installed operator workstation software to function without abnormal fault messages occurring. Abnormal fault messages are defined as those caused specifically by the use of VSTARS.
- VSTARS will present all virtual radar results using the standard format for MTI and SAR reports. For the MTI reports, virtual targets will exhibit radar performance measures as defined during developmental testing of the Joint STARS radar. Operational behavior characteristics of the virtual targets will not differ noticeably from the operational characteristics of real targets. Virtual SAR reports will also exhibit radar performance measures as defined during developmental testing of the Joint STARS radar. In addition, virtual SAR reports will exhibit an acceptable degree of fidelity matching that found in actual images.

3.3.1.4 Ground Network Interface Unit (GNIU)

Requirements

- The ground network interface unit (GNIU) will receive and process DIS 2.0.4 ESPDUs at a rate equal to or greater than 350 ESPDUs per second.
- The GNIU will perform a coordinate transform upon entities selected for transmittal to the air network interface unit (ANIU) and prepare a VSTARS data packet containing all entity data required by the radar processor simulator and integrator (RPSI) for transmission to the ANIU.
- The VSTARS data packet will be less than 527 bits. Total bandwidth requirements for the link between the GNIU and ANIU will be less than 19.2 kilobits per second (Kbits/sec).
- The GNIU will prepare and transmit an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.

Acceptability Criteria

- The GNIU receives and processes DIS 2.0.4 ESPDUs at a rate greater than 350 ESPDUs per second.
- Filtering schema, such as the GNIU determining if arriving ESPDUs are within VSTARS area of interest, are employed

- The GNIU performs a coordinate transform upon entities selected for transmittal to the ANIU and prepares a VSTARS data packet containing all entity data required by the RPSI for transmission to the ANIU.
- The VSTARS data packet is less than 527 bits. Total bandwidth requirements for the link between the GNIU and ANIU are less than 19.2 Kbits/sec.
- The GNIU prepares and transmits an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.

3.3.1.5 Air Network Interface Unit (ANIU)

Requirements

- Operate upon and be compatible with E-8C onboard operating systems and hardware.
- Receive and process VSTARS data packets at a rate commensurate with a maximum bandwidth of 19.2 Kbits/sec.
- Store entity data received in an ANIU target database.
- Conduct dead reckoning upon moving targets at a minimum rate of 1 hertz (Hz) and store revised locations in the ANIU target database.
- Provide, from the navigational update message available from the navigation subsystem, the necessary data required for the GNIU to construct an ESPDU.

Acceptability Criteria

- Operates upon and is compatible with E-8C onboard operating systems and hardware.
- Receives and processes VSTARS data packets at a rate commensurate with a maximum bandwidth of 19.2 Kbits/sec.
- Stores entity data received in an ANIU target database.
- Conducts dead reckoning upon moving targets at a minimum rate of 1 Hz and stores revised locations in the ANIU target database.
- Provides, from the navigational update message available from the navigation subsystem, the necessary data required for the GNIU to construct an ESPDU.

3.3.1.6 Radar Processor Simulator and Integrator (RPSI) Management and Integration Software (M&IS)

Requirements

- Operate upon and be compatible with E-8C onboard operating systems and hardware.
- Receive the details of a radar mission from the radar subsystem as a PSP parameter message and determine if it is an MTI or SAR mission. Determine from the PSP parameter message the coordinates of the area covered by the mission and retrieve from the ANIU target database all targets that are located within the area. Append the targets to the PSP parameter message and send to the appropriate simulation depending upon mission type.
- For MTI radar missions, receive the outputs from the radar processor and the MTI simulation

and determine the appropriate distribution of targets within the area covered by the mission based on mode of operation (real, virtual, or mixed). Send the composite target report to the radar post-processor.

- For SAR missions, receive the outputs from the radar processor and Advanced Radar Imaging Emulation System (ARIES) and determine if the mission is for a real area or a virtual area. Forward the appropriate report, real or virtual, to the radar post-processor.

Acceptability Criteria

- Operates upon and is compatible with E-8C onboard operating systems and hardware.
- Receives the details of a radar mission from the radar subsystem as a PSP parameter message and determines if it is an MTI or SAR mission. Determines from the PSP parameter message the coordinates of the area covered by the mission, and retrieves from the ANIU target database all targets that are located within the area. Appends the targets to the PSP parameter message and sends them to the appropriate simulation depending upon mission type.
- For MTI radar missions, receives the outputs from the radar processor and the MTI simulation and determines the appropriate distribution of targets within the area covered by the mission, based on mode of operation (real, virtual, or mixed). Sends the composite target report to the radar post-processor.
- For SAR missions, receives the outputs from the radar processor and ARIES and determines if the mission is for a real area or a virtual area. Forwards the appropriate report, real or virtual, to the radar post-processor.

3.3.1.7 Moving Target Indicator (MTI) Radar Simulation

Requirements

- Operate upon and be compatible with E-8C onboard operating systems and hardware.
- The MTI simulation will receive PSP parameter messages from the RPSI M&IS and perform the necessary functions to simulate the Joint STARS MTI signal processing. The emulation will represent radar performance measures as defined during developmental testing of the Joint STARS radar and will consider environmental effects that affect the radar's performance.
- The simulation will be performed on a dwell basis.
- The simulation will have no perceived impact upon the radar timeline.

Acceptability Criteria

- Operates upon and is compatible with E-8C onboard operating systems and hardware.
- The MTI simulation receives PSP parameter messages from the RPSI M&IS and performs the necessary functions to simulate the Joint STARS MTI signal processing. The emulation represents radar performance measures as defined during developmental testing of the Joint STARS radar and considers environmental effects that affect the radar's performance.
- The simulation performs on a dwell basis.

- The simulation has no perceived impact upon the radar timeline.

3.3.1.8 Advanced Radar Imaging Emulation System (ARIES)

Requirements

- Operate upon and be compatible with E-8C onboard operating systems and hardware.
- ARIES will receive PSP parameter messages from the RPSI M&IS and perform the functions required to generate a proper Joint STARS SAR image. ARIES will represent radar performance measures as defined during developmental testing of the Joint STARS radar and will consider environmental effects that affect the radar's performance
- ARIES will format the image information into the proper Joint STARS format for transmittal to the RPSI M&IS and subsequent transmittal to the radar post-processor.
- ARIES will visually match the fidelity of Joint STARS SAR images as determined by the naked eye.
- The simulation will have minimal impact upon the radar timeline such that the issue of real versus simulated image will not be decided based upon timing alone.

Acceptability Criteria

- Operates upon and is compatible with E-8C onboard operating systems and hardware.
- ARIES receives a PSP parameter message from the RPSI M&IS and performs the functions required to generate a proper Joint STARS SAR image. ARIES represents radar performance measures as defined during developmental testing of the Joint STARS radar.
- ARIES formats the image information into the proper Joint STARS format for transmittal to the RPSI M&IS and subsequent transmittal to the radar post-processor.
- ARIES visually matches the fidelity of Joint STARS SAR images as determined by the naked eye.
- The simulation has minimal impact upon the radar timeline such that the issue of real versus simulated image will not be decided based upon timing alone.

3.3.1.9 Programmable Single Processor (PSP) Simulation (Laboratory Only)

Requirements

- Must receive and process radar service requests from O&C subsystem
- Must request and receive navigation information from the navigation simulation
- Must develop and issue to RPSI M&IS, a PSP parameter message corresponding to a specific radar service request.

Acceptability Criteria

- Receives and processes radar service requests from O&C subsystem
- Requests and receives navigation information from the navigation simulation

- Develops and issues to RPSI M&IS, a PSP parameter message corresponding to a specific radar service request.

3.3.1.10 Navigation Simulation (Laboratory Only)

Requirements

- Must simulate the position, altitude and speed of an E-8C aircraft flying a specified orbit and provide these data to the navigation software associated with the radar function.
- Must provide the required data, reports and messages to the radar subsystem as called for by the PSP simulation.

Acceptability Criteria

- Simulates the position, altitude and speed of an E-8C aircraft flying a specified orbit and provides these data to the navigation software associated with the radar function.
- Provides the required data, reports and messages to the radar subsystem as called for by the PSP simulation.

3.3.2 ETE Test Synthetic Environment (ETE Test SE)

Requirements

- Using DIS PDUs, provide doctrinally correct C4ISR connectivity required to conduct the end-to-end sequence. This sequence is defined as target detection, target selection, target engagement, and battle damage assessment.
- Using DIS PDUs, provide near real-time virtual situational awareness to the E-8C aircraft in the laboratory and onboard the aircraft during an operational mission. The timeliness of the situational data presented to the operators onboard the aircraft is determined by a number of factors: radar mode used for a specific situation, weather, and range to target. At a minimum, data presented to the operators are 5 to 6 seconds old and can be a minute or more old.
- Latency requirements for the ETE Test SE PDUs are coupled to many factors: the requirement for near real-time virtual situational awareness and the CEP associated with each individual virtual target. Based on the CEP alone, it is anticipated that the minimally acceptable latency for ESPDUs will be on the order of several seconds. This requirement cannot be stated as a specific value but instead is stated as the latency associated with each PDU shall be small enough so as to not invalidate the data derived from the PDU.
- The requirement for determining a corrupted or lost PDU rate is also difficult to quantify. There are three distinct categories of PDUs in the ETE Test SE with vastly different reliability requirements. Those that update the situation or sensor must be reliable to the extent that the overall situation presented by the sensor is not appreciably different from the situation present in the scenario driver. As an example, if one vehicle out of a convoy of 100 vehicles is missing because of a lost or corrupted PDU, there is little or no change in the situation presented by the sensor. However, if the only missile transportor, erector, launcher (TEL) is

missing from a convoy of three vehicles because of a lost or corrupted PDU, there is a drastic change in the situation presented by the sensor. The same is true of PDUs that carry critical commands and PDUs, such as the detonate PDU, that initiate a critical reaction in the simulation receiving the PDU. In other words, valid PDUs must be received reliably enough that the event or situation they are a part of is correctly represented. If incorrectly represented situations or events do occur, they must have a disrupting influence on the overall SE for them to be counted against the requirement. In addition, these incorrect situations must occur at a rate noticeably different from the events in real life for targets are often not detected because of low probability of detection, and messages are often lost or garbled because of atmospheric effects or jamming.

Acceptability Criteria

- The end-to-end sequence is conducted in a doctrinally correct manner using the ETE Test SE.
- Near real-time, virtual situational awareness is provided to the sensor system represented by VSTARS.
- The latency associated with each PDU will be small enough that the data provided by the PDU remain valid for the simulation receiving the PDU.
- The rate of PDUs lost or corrupted will be low enough for each type of PDU that the ETE Test SE will be perceived as representing reality.

4.0 ETE Test V&V Status and Requirements

Prior to describing the verification and validation events that will be carried out as a part of this plan, it is necessary to describe the current V&V status of each node in the ETE Test SE. This status, when compared with the requirements and acceptability criteria for each node, will identify the additional V&V activities that must be performed for each node. This is an important step in developing a V&V plan, since the identification of requirements that have been met by prior V&V efforts will save valuable resources and permit more time and effort to be placed on those requirements that are unique to the ETE Test SE.

It should also be noted that the ETE Test SE contains nodes that are composed of live elements and fielded equipment. Technically speaking, one does not V&V a live node. By definition, the node is valid, and it performs like the real piece of equipment because it is the real piece of equipment. What one must do, however, is determine that the live elements are trained to function in a doctrinally correct manner and in the proper use of the equipment. In addition one must test that the interfaces to the SE function properly. These tasks will be performed as a part of the V&V of the ETE Test SE and will be so indicated below.

4.1 V&V Status

The following briefly reviews the V&V status of the legacy models contained in the ETE Test SE. A part of the V&V of the ETE Test is to review the requirements for each simulation, and conduct or have conducted V&V activities to satisfy those requirements not already satisfied by previous V&V efforts. The V&V status reported herein will focus on the requirements met, while the following sections will focus on additional V&V activities to be performed.

4.1.1 J6K

The simulation known as J6K is based upon Janus, Version 6, which is under the configuration control of STRICOM and TRAC-WSMR. The name stands for Janus, Version 6, with thousands of entities. Currently, J6K is capable of representing up to 9999 entities. Janus is an interactive, two-sided, closed, stochastic, ground combat simulation featuring precise color graphics. Janus has been accredited for use in combat development studies such as cost and operational effectiveness analyses (COEA) or AOAs, operational test planning and post-test studies, and training. Janus accurately models weapons systems as a function of each system's capabilities as affected by terrain and weather. The Janus data bases describe systems extensively and in detail. Individual fighting systems have distinct properties: dimensions, weight, carrying capacity, speed, weapons, and weapons capabilities like range, type of ordnance, and ammunition basic load. Multiple sets of data bases may be available for different uses, day and night, for instance, or classified and unclassified.

Janus is composed of multiple software modules, such as the terrain editor (TED) and the command and control overlay editor, which are required to develop scenarios and databases used during the running of Janus. Changes made to J6K for these modules involve changing sizes of

arrays, databases, and files. These changes do not affect the validity of Janus except that as the sizes of the arrays, databases, and files increase, Janus may have difficulty in running in near real time. For this reason, each scenario developed for Janus must be tuned by adjusting the level of activity within the scenario such that near real-time operation is achieved.

The software module that depicts the ground combat within Janus is known as the Janus execution module and is unchanged within J6K except for the detection algorithm used for those combat systems using their sighting systems for combat actions. The change uses the new algorithm supplied by the Army's Night Vision Laboratories and is mandatory for all new revisions of Janus.

Janus Version 6, as used within J6K, has a V&V history, an accreditation history for analysis, is under configuration control, and is well documented. TRAC-WSMR will certify to JADS that these conditions exist and that the Janus execution module is a verified and validated representation of ground combat to include movement.

This certification will suffice to meet the following acceptability criteria: The simulation has a V&V history, an accreditation history for analysis, is under configuration control, and is well documented.

Area coverage and attrition for area weapons will be representative of the real weapon system. Unclassified data sets will be used for the ETE Test as the JADS ETE Test is not testing area weapon effects. The simulation must be capable of using classified data sets to represent actual weapons effects if so required.

4.1.2 TAFSM

TAFSM is a verified and validated simulation of a theater-level U.S. Army field artillery battle. It has been accredited for use in combat development studies such as COEAs or AOAs, operational test planning and post-test studies, and training. TAFSM will be used as is by the DSABL and will be certified as representing a valid simulation of the U.S. Army field artillery battle.

This certification will suffice to meet the following acceptability criteria: Simulation must be accredited by DSABL for use in representing, in a doctrinally correct manner, a corps-level employment of ATACMS. The battle lab will certify that the representation of the U.S. Army field artillery battle within TAFSM is doctrinally correct.

Simulation will represent the performance characteristics of the ATACMS in a matter acceptable to DSABL. The battle lab will certify that the performance characteristics of the ATACMS within the simulation is acceptable.

4.2 Additional V&V Activities to Be Performed

Additional V&V activities must be performed on the legacy models, J6K and TAFSM, the newly developed VSTARS, and the ETE Test SE. These additional V&V activities will be associated with the acceptability criteria for each simulation as stated earlier. The activities will be conducted to the extent required to satisfy the associated acceptability criteria, as time and funds allow, and will be described in detail within the following verification and validation plans. In addition, components of the ETE Test SE environment, such as network interface units, will require testing to determine that they perform correctly.

4.2.1 J6K

Verification Requirements

- Verify that J6K is capable of simulating at least 5000 entities with at least twenty-five percent moving using a COTS product costing less than 100,000 dollars.
- Verify that J6K issues DIS 2.0.4 ESPDUs that conform with the DIS 2.0.4 standards as amended by JADS as to content and format.
- Verify that J6K will receive and act upon each ESPDU, fire PDU, and detonate PDU issued to it by the network and will take the appropriate action as dictated by the PDU provided the appropriate data sets regarding the PDU have been entered into the simulation.
- Verify that the simulation will accept and process scenarios with a duration longer than eight hours.
- Verify that the operator will be capable of fully interacting with a scenario while it is running.
- Verify that the simulation will be capable, when running, of proceeding in a step-wise fashion at a pace representative of near real time. That is, when a unit of game time is represented within Janus, a corresponding amount of time will have elapsed since the start of the simulation. This feature will be adjusted by tuning the scenario.
- Verify that the simulation will be capable of utilizing scenarios conducted upon terrain representing a simulation area of at least 200 km by 200 km.

Validation Requirements

- Validate that J6K represents vehicle behavior to the degree detectable by the Joint STARS operator(s). This capability will be judged based upon viewing vehicle movement upon the Joint STARS ATWS. Joint STARS operator SMEs will be used to evaluate these criteria.

4.2.2 TAFSM

Verification Requirement

- Verify that TAFSM will accept artillery missions using TACFIRE or AFATDS messages encapsulated in a DIS PDU. Simulation will issue a fire and detonate PDU whenever an ATACMS missile is fired and subsequently detonated.

Validation Requirement

- None additional. All validation requirements for TAFSM are already met. See Paragraph 4.1.2 TAFSM.

4.2.3 VSTARS

Verification Requirements

- Verify that VSTARS receives virtual target data from the JADS JTF ETE Test environment and integrates it with live target data received and processed by the radar subsystem.
- Verify that for MTI reports, VSTARS operates in three modes: only live targets displayed, mixed live and virtual targets displayed, and only virtual targets displayed. Display will be upon the currently installed version of the operator's workstation.
- Verify that VSTARS permits the SAR report to consist of either a real report or a virtual report.
- Verify that in all modes of operation, VSTARS will permit all of the installed operator workstation software to function without abnormal fault messages occurring. Abnormal fault messages are defined as those caused specifically by the use of VSTARS.
- Verify that VSTARS presents all virtual radar results using the standard format for MTI and SAR reports within Joint STARS timelines where specified.

Validation Requirements

- Validate that for the MTI reports, virtual targets exhibit radar performance measures as defined during developmental testing of the Joint STARS radar. Operational behavior characteristics of the virtual targets will not differ noticeably from the operational characteristics of real targets. The operational behavior characteristics will be evaluated visually.
- Validate that for virtual SAR reports, the images will exhibit radar performance measures as defined during developmental testing of the Joint STARS radar. In addition, virtual SAR reports will exhibit an acceptable degree of fidelity matching that found in actual images. The fidelity of SAR reports will be evaluated visually.

4.2.4 Ground Network Interface Unit (GNIU)

Test Requirements

- The GNIU receives and processes DIS 2.0.4 ESPDUs from the ETE Test DIS network at a rate greater than 350 ESPDUs per second.
- The GNIU determines if arriving ESPDUs are within VSTARS area of interest. For those that are, the GNIU checks to see if the ESPDU represents a new entity or a change in velocity for a previously received entity, and passes new or changed entities to the coordinate transform routine.

- The GNIU performs a coordinate transform upon entities selected for transmittal to the ANIU and prepares a VSTARS data packet containing all entity data required by the RPSI for transmission to the ANIU.
- The VSTARS data packet is less than 527 bits and the total bandwidth requirements for the link between the GNIU and ANIU are less than 256 Kbits/sec.
- The GNIU prepares and transmits an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.

4.2.5 Air Network Interface Unit (ANIU)

Test Requirements

- The ANIU operates upon and is compatible with E-8C onboard operating systems and hardware.
- The ANIU receives and processes VSTARS data packets at a rate commensurate with a maximum bandwidth of 256 Kbits/sec.
- The ANIU stores entity data received in an ANIU target database.
- The ANIU conducts dead reckoning upon moving targets at a minimum rate of 1 Hz and stores revised locations in the ANIU target database.
- The ANIU provides, from the navigational update message available from the navigation subsystem, the necessary data required for the GNIU to construct an ESPDU.

4.2.6 Radar Processor Simulator and Integrator (RPSI) Management and Integration Software (M&IS)

Verification Requirements

- Verify that the RPSI M&IS operates upon and is compatible with E-8C onboard operating systems and hardware.
- Verify that the RPSI M&IS receives the details of a radar mission from the radar subsystem as a PSP parameter message and determines if it is a MTI or SAR mission. Determines from the PSP parameter message the coordinates of the area covered by the mission, and retrieves from the ANIU target database all targets that are located within the area. Appends the targets to the PSP parameter message and sends them to the appropriate simulation depending upon mission type.
- Verify that the RPSI M&IS, for MTI radar missions, receives the outputs from the radar processor and the MTI simulation and determines the appropriate distribution of targets within the area covered by the mission, based on mode of operation (real, virtual, or mixed).
- Verify that the RPSI M&IS sends the composite target report to the radar post-processor.
- Verify that the RPSI M&IS, for SAR missions, receives the outputs from the radar processor and ARIES and determines if the mission is for a real area or a virtual area.
- Verify that the RPSI M&IS forwards the appropriate report, real or virtual, to the radar post-processor.

Validation Requirements

- None required.

4.2.7 Moving Target Indicator (MTI) Radar Simulation

Verification Requirements

- Verify that the MTI radar simulation operates upon and is compatible with E-8C onboard operating systems and hardware.
- Verify that the MTI radar simulation receives PSP parameter messages from the RPSI M&IS.
- Verify that the MTI radar simulation performs on a dwell basis.
- Verify that the MTI radar simulation has minimal impact upon the radar timeline.

Validation Requirements

- Validate that the MTI radar simulation performs the necessary functions to simulate the Joint STARS MTI signal processing. The emulation represents radar performance measures as defined during developmental testing of the Joint STARS radar and considers environmental effects that affect the radar's performance.

4.2.8 Advanced Radar Imaging Emulation System (ARIES)

Verification Requirements

- Verify that ARIES operates upon and is compatible with E-8C onboard operating systems and hardware.
- Verify that ARIES receives a PSP parameter message from the RPSI M&IS and performs the functions required to generate a Joint STARS SAR image.
- Verify that ARIES formats the image information into the proper Joint STARS format for transmittal to the RPSI M&IS and subsequent transmittal to the radar post-processor.
- Verify that ARIES has minimal impact upon the radar timeline.

Validation Requirements

- Validate that ARIES represents radar performance measures as defined during developmental testing of the Joint STARS radar.
- Validate that ARIES visually matches the fidelity of Joint STARS SAR images as determined by ATWS operators.

4.2.9 Programmable Single Processor (PSP) Simulation (Laboratory Only)

Verification Requirements

- Verify that the PSP simulation receives and processes radar service requests from the O&C subsystem.
- Verify that the PSP simulation requests and receives navigation information from the navigation simulation.
- Verify that the PSP simulation develops and issues to the RPSI M&IS, a PSP parameter message corresponding to a specific radar service request.

Validation Requirements

- Validate that the PSP simulation simulates the performance of the PSP with respect to the time required to produce the PSP parameter message.

4.2.10 Navigation Simulation (Laboratory Only)

Verification Requirements

- Verify that the navigation simulation provides the required data, reports and messages to the radar subsystem as called for by the PSP simulation

Validation Requirements

- Validate that the navigation simulation simulates the position, altitude and speed of an E-8C aircraft flying a specified orbit.

4.3 ETE Test Synthetic Environment (ETE Test SE)

The ETE Test SE is handled differently, with respect to V&V, than the individual simulations and interfaces considered above. V&V of the ETE Test SE must consider the grouping of the simulations and interfaces, how they communicate, and the condition of the data when passed and received. As stated earlier, the DIS Nine Step VV&A Process Model is included within the DoD *VV&A Recommended Practices Guide* as a process that may be used to address the V&V issues associated with the ETE Test SE

The DIS Nine Step Process Model consists of a VV&A planning step, which this plan represents for V&V; seven V&V steps; and an accreditation step, which will be addressed in a separate plan. The required V&V steps will be discussed in general terms, and the detailed actions required will be discussed in detail in the appropriate sections of the verification pPlan that follows.

Verification Requirements

The verification requirements performed will verify

- that the latency associated with each PDU will be small enough that the data provided by the PDU remain valid for the simulation receiving the PDU.
- that the rate of PDUs lost or corrupted will be low enough for each type of PDU that the ETE Test SE will be perceived as representing reality.

Perform Conceptual Model Verification. The V&V team will compare the conceptual model for the SE with the SE requirements to determine that all

- required processes and their relationships have been adequately described;
- entity requirements have been defined to include required attributes and components and both dynamic interactions and static relationships with other objects;
- input data requirements and authoritative sources have been identified; and
- fidelity requirements have been specified.

Perform Compliance Standards Verification. The V&V team will verify that a model, simulation or simulator complies with the DIS protocol standard as implemented within the JADS ETE Test.

Perform Architectural Design Verification. The V&V team will verify that the developing architecture accurately reflects the SE requirements as described in the conceptual model.

Perform Detailed Design Verification. The V&V team will verify that the SE design continues to accurately reflect SE requirements and is adequate to support the anticipated activities.

Perform Compatibility Verification – The V&V team will verify that

- M&S components exchange data and interact appropriately with each other;
- individual components correctly use the common data (e.g., terrain, weather) to generate their portion of the synthetic environment; and
- the overall implementation is adequate to address the exercise requirements.

Validation Requirements

The validation requirements performed will validate

- that the end-to-end sequence is conducted in a doctrinally correct manner using the ETE Test SE.

- that near real-time, virtual situational awareness is provided to the sensor system represented by VSTARS.

Perform Conceptual Model Validation. The V&V team will validate that the conceptual model is a suitable specification for simulation design of the SE requirements in terms of

- required environments and scenarios;
- requisite number and types of entities;
- required entity behaviors, components, attributes;
- interactions between entities;
- logical context of required processes; and
- degree of fidelity required.

Perform Validation. The V&V team will validate that the integrated simulation is adequate to satisfy SE requirements such that

- SE behaviors and performance map sufficiently to real-world counterparts for the specific application;
- performances and representations of the simulated entities are sufficient to support the intended application; and
- testing has been done to address acceptance criteria.

5.0 Verification Plan

Verification conducted in support of the ETE Test will occur at a number of sites and will be conducted by both contractor and ETE Test team personnel. Prior to the execution of each verification task, a detailed execution plan will be developed and submitted to the ETE Test manager and the accreditation agent for review and approval. Similar or same verification tasks performed on a simulation will normally occur simultaneously and share a common execution plan.

In addition, the verification of the ETE Test synthetic environment will occur both during Phase 2 and Phase 3. This is necessitated by a change in the SE when VSTARS is moved from the laboratory to the E-8C aircraft. The second time the ETE Test SE is verified, the primary effort will be to identify changes from the original SE and to concentrate mainly upon those changes, if any, and their effect upon the SE.

5.1 J6K

- a) Verify that J6K is capable of simulating at least 5000 entities with at least twenty-five percent moving using a COTS product costing less than 100,000 dollars.

This verification task will be performed by the ETE Test V&V team and will consist of an inspection of J6K. The inspection will consist of five phases: overview, preparation, inspection, rework, and follow-up. This inspection will take place during Phase 1 with a written report to document the team's work.

- b) Verify that J6K issues DIS 2.0.4 ESPDUs that conform with the DIS 2.0.4 standards as amended by JADS as to content and format.

This verification task will be performed by the ETE Test V&V team and will consist of an inspection of the ESPDU issued by J6K. The inspection will consist of the five phases previously mentioned and occur during Phase 1 with a written report to document the team's work.

- c) Verify that J6K will receive and act upon each ESPDU, fire PDU, and detonate PDU issued to it by the network and will take the appropriate action as dictated by the PDU provided the appropriate data sets regarding the PDU have been entered into the simulation.

This verification task will be performed by the ETE Test V&V team and will consist of several steps: cause-effect graphing, acceptance testing, execution monitoring, functional testing and data verification. See Appendix C for a description of each of these steps. Each step will consist of preparation, step execution, rework and follow-up, and reporting. This task will be performed during Phase 2 with a written report to document the team's work.

- d) Verify that the simulation will accept and process scenarios with a duration longer than eight hours.

This verification task will be performed by the ETE Test V&V team and will consist of an inspection of J6K. The inspection will consist of five phases: overview, preparation, inspection, rework, and follow-up. This inspection will take place during Phase 2 with a written report to document the team's work.

- e) Verify that the operator will be capable of fully interacting with a scenario while it is running.

This verification task will be performed by the ETE Test V&V team and will consist of an inspection of J6K. The inspection will consist of five phases: overview, preparation, inspection, rework, and follow-up. This inspection will take place during Phase 2 with a written report to document the team's work.

- f) Verify that the simulation will be capable, when running, of proceeding in a step-wise fashion at a pace representative of near real time. That is, when a unit of game time is represented within Janus, a corresponding amount of time will have elapsed since the start of the simulation. This feature will be adjusted by tuning the scenario.

This verification task will be performed by the ETE Test V&V team and will consist of the execution monitoring of J6K. The execution monitoring will consist of preparation, step execution, rework and follow-up, and reporting. This task will be performed during Phase 2 with a written report to document the teams work. This inspection also will take place for each scenario developed for J6K with a written report to document the team's work.

- g) Verify that the simulation will be capable of utilizing scenarios conducted upon terrain representing a simulation area of at least 200 km by 200 km.

This verification task will be performed by the ETE Test V&V team and will consist of an inspection of J6K. The inspection will consist of five phases: overview, preparation, inspection, rework, and follow-up. This inspection will take place during Phase 2 with a written report to document the team's work.

5.2 TAFSM

- a) Verify that TAFSM will accept artillery missions using TACFIRE or AFATDS messages encapsulated in a DIS PDU. Simulation will issue a fire and detonate PDU whenever an ATACMS missile is fired and subsequently detonated.

This verification task will be performed by the ETE Test V&V team and will consist of several steps: cause-effect graphing, acceptance testing, execution monitoring, functional testing and data verification. See Appendix C for a description of each of these steps. Each step will consist of preparation, step execution, rework and follow-up, and reporting. This task will be performed during Phase 2 with a written report to document the team's work.

5.3 VSTARS

The verification and testing of VSTARS will be conducted by Northrop Grumman and the Joint STARS JTF during Phase 2 of the ETE Test. Northrop Grumman will develop a separate V&V plan for VSTARS (Appendix A) and submit this plan to the ETE Test manager for comment and approval. Verification and test tasks will be performed by Northrop Grumman and the Joint STARS JTF with JADS ETE Test V&V team oversight. During Phase 1, VSTARS will undergo acceptance testing as a prerequisite for moving to Phase 2. The test plan will be developed by Northrop Grumman (Appendix A) and submitted to the ETE Test manager for comment and approval. Acceptance testing will be performed by Northrop Grumman with oversight by the ETE Test V&V team and will be successfully completed prior to Phase 2 activities involving VSTARS.

In addition, an acceptance test of the ground data terminal 1553 bus interface unit software will be conducted during Phase 1 by Motorola, the developer of the software. Motorola will develop a test plan (Appendix B) and submit it to the ETE Test manager for comment and approval. The software test will be performed by Motorola, with Northrop Grumman assistance and JADS ETE Test V&V team oversight. A report detailing the results of the acceptance test will be submitted to the ETE Test manager.

5.3.1 Verification Tasks to be Performed on the VSTARS Simulation

- Verify that VSTARS receives virtual target data from the JADS JTF ETE Test environment and integrates it with live target data received and processed by the radar subsystem.
- Verify that for MTI reports, VSTARS operates in three modes: only live targets displayed, mixed live and virtual targets displayed, and only virtual targets displayed. Display will be upon the currently installed version of the operator's workstation.
- Verify that VSTARS permits the SAR report to consist of either a real report or a virtual report.
- Verify that in all modes of operation, VSTARS will permit all of the installed operator workstation software to function without abnormal fault messages occurring. Abnormal fault messages are defined as those caused specifically by the use of VSTARS.
- Verify that VSTARS presents all virtual radar results using the standard format for MTI and SAR reports.

5.3.1.1 Ground Network Interface Unit (GNIU)

- Test that the GNIU receives and processes DIS 2.0.4 ESPDU from the ETE Test DIS network at a rate greater than 350 ESPDU per second.
- Test that the GNIU determines if arriving ESPDUs are within VSTARS area of interest. For those that are, test that the GNIU checks to see if the ESPDU represents a new entity or a change in velocity for a previously received entity and passes new or changed entities to the coordinate transform routine.
- Test that the GNIU performs a coordinate transform upon entities selected for transmittal to the ANIU and prepares a VSTARS data packet, containing all entity data required by the RPSI for transmission to the ANIU.
- Test that the VSTARS data packet is less than 527 bits and that the total bandwidth requirements for the link between the GNIU and ANIU are less than 256 Kbits/sec.
- Test that the GNIU prepares and transmits an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.

5.3.1.2 Air Network Interface Unit (ANIU)

- Test that the ANIU operates upon and is compatible with E-8C onboard operating systems and hardware.
- Test that the ANIU receives and processes VSTARS data packets at a rate commensurate with a maximum bandwidth of 256 Kbits/sec.
- Test that the ANIU stores entity data received in an ANIU target database.
- Test that the ANIU conducts dead reckoning upon moving targets at a minimum rate of 1 Hz and stores revised locations in the ANIU target database.
- Test that the ANIU provides, from the navigational update message available from the navigation subsystem, the necessary data required for the GNIU to construct an ESPDU.

5.3.1.3 Radar Processor Simulation and Integrator (RPSI) Management and Integration Software (M&IS)

- Verify that the RPSI M&IS operates upon and is compatible with E-8C onboard operating systems and hardware.

- Verify that the RPSI M&IS receives the details of a radar mission from the radar subsystem as a PSP parameter message and determines if it is a MTI or SAR mission. Determine from the PSP parameter message the coordinates of the area covered by the mission and retrieves from the ANIU target database all targets that are located within the area. Append the targets to the PSP parameter message and sends them to the appropriate simulation depending upon mission type.
- Verify that the RPSI M&IS, for MTI radar missions, receives the outputs from the radar processor and the MTI simulation and determines the appropriate distribution of targets within the area covered by the mission based on mode of operation (real, virtual, or mixed).
- Verify that the RPSI M&IS sends the composite target report to the radar post-processor.
- Verify that the RPSI M&IS, for SAR missions, receives the outputs from the radar processor and ARIES and determines if the mission is for a real area or a virtual area.
- Verify that the RPSI M&IS forwards the appropriate report, real or virtual, to the radar post-processor.

5.3.1.4 Moving Target Indicator (MTI) Radar Simulation

- Verify that the MTI radar simulation operates upon and is compatible with E-8C onboard operating systems and hardware.
- Verify that the MTI radar simulation receives PSP parameter messages from the RPSI M&IS.
- Verify that the MTI radar simulation performs on a dwell basis.
- Verify that the MTI radar simulation has minimal impact upon the radar timeline.

5.3.1.5 Advanced Radar Imaging Emulation System (ARIES)

- Verify that Aries operates upon and is compatible with E-8C onboard operating systems and hardware.
- Verify that ARIES receives a PSP parameter message from the RPSI M&IS and performs the functions required to generate a Joint STARS SAR image.
- Verify that ARIES formats the image information into the proper Joint STARS format for transmittal to the RPSI M&IS and subsequent transmittal to the radar post-processor.
- Verify that ARIES has minimal impact upon the radar timeline.

5.3.1.6 Programmable Single Processor (PSP) Simulation (Laboratory Only)

- Verify that the PSP simulation receives and processes radar service requests from the O&C subsystem.
- Verify that the PSP Simulation requests and receives navigation information from the navigation simulation.
- Verify that the PSP Simulation develops and issues to the RPSI M&IS, a PSP parameter message corresponding to a specific radar service request.

5.3.1.7 Navigation Simulation (Laboratory Only)

- Verify that the navigation simulation provides the required data, reports and messages to the radar subsystem as called for by the PSP simulation.

5.4 ETE Test Synthetic Environment (ETE Test SE)

The remaining verification of the ETE Test SE will be performed by the ETE Test V&V team during Phases 2 and 3 of the JADS ETE Test. As indicated in Figure 2 many of the verification tasks required to be performed have been performed earlier in the planning of the ETE Test. Execution of these verification steps will consist of documenting those steps already performed.

a) Perform Compliance Standards Verification (Step 2)

Initial compliance standards verification was performed during the development of the program test plan. At this time the models and simulations identified for use in the ETE Test SE were verified by inspection as meeting DIS compliance standards to the extent required. Completion of this initial compliance standards verification will consist of reporting on the steps performed during the development of the PTP.

Further compliance standards verification will be performed during Phase 2 and Phase 3 of the ETE Test and will consist of an inspection of a sampling of PDUs emitted by each simulation to ensure proper adherence to the prescribed format. The inspection will consist of five phases: overview, preparation, inspection, rework, and follow-up with a written report to document the team's work. In addition, a model interface analysis of the SE will be conducted to determine if the submodels within the SE are correctly communicating using DIS PDUs. The interface analysis will consist of four phases: preparation, data collection, analysis, and reporting with a written report to document the team's work.

b) Perform Conceptual Model Verification (Step 3)

The conceptual model verification was performed during the development of the feasibility study. At that time, several conceptual models were verified by inspection and one was chosen for

further development into the ETE Test SE. Completion of the conceptual model verification will consist of documenting the conceptual models considered and the verification steps taken.

c) Perform Architectural Design Verification (Step 4)

The architectural design verification was performed during the development of the PTP. It consisted of a document review, the development of a preliminary model of the SE, an allocation of functions and capabilities to the nodes of the SE, operational requirements mapping, a determination of interface requirements and database requirements, and initial personnel and test requirements. Completion of the architectural design verification will consist of documenting the verification steps taken.

d) Perform Detailed Design Verification (Step 5)

The detailed design verification will be performed by the ETE Test V&V team during Phase 1 of the ETE Test. As the detailed design evolves, the V&V team will

- review M&S component documentation and, if necessary, source code to determine component ability to perform their assigned functions;
- execute key algorithms to ensure they function appropriately to address the exercise requirements;
- assess the logic of the proposed interconnections of the components by evaluating the proposed interchange of PDUs; and,
- analyze the exercise design for its rigor.

Members of the team conducting data verification and validation should evaluate the appropriateness and sufficiency of the input data selected for use in the exercise.

This activity involves five major tasks: evaluate detailed design, evaluate interface design, verify data and databases, evaluate V&V test plans, and evaluate training requirements.

Evaluate Detailed Design: This task will be performed by inspection and will determine if the design is sufficient to ensure

- the individual M&S components are capable of representing the exercise phenomenology at appropriate levels of resolution;
- the underlying network assets can support the exchange data between the components at the necessary levels of fidelity.

Evaluate Interface Design: This task will be performed by inspection and will evaluate the ability of the individual M&S components to interoperate with each other and with the network by

- determining that interfaces among components and interfaces with the synthetic environment are adequate and sufficient to allow consistency in the level of details, data fidelity, and data

- sources, and sufficient modes of operation;
- ensuring that user interfaces for input and output can pass information to accomplish efficient scenario construction, component execution, network management, and report generation and
- evaluating the impact of network factors such as latency produced, network loading, and filtering requirements.

Verify Data and Databases: This task will be performed by inspection and will assess the adequacy, sufficiency, and usability of the input data and databases. It will be accomplished in conjunction with evaluate detailed design and evaluate interface design to ensure the data required by the M&S components and the DIS exercise will provide appropriate, consistent, and timely results during execution.

Evaluate V&V Test Plans: This task will be accomplished by inspection to ensure V&V test plans are adequate and complete.

Evaluate Training Requirements: This task will be accomplished by inspection and will consist of reviewing training requirements, assessing the ability of training plans to address the requirements, and recommending appropriate tests for evaluating the success of the training.

e) Perform Compatibility Verification (Step 6)

The compatibility verification will be performed by the ETE Test V&V team during Phase 2 of the ETE Test. The compatibility verification will complete the verification of the ETE Test SE by ensuring

- M&S components exchange data and interact appropriately with each other;
- individual components correctly use the common data (e.g., terrain, weather) to generate their portion of the synthetic environment; and
- the overall implementation is adequate to address the exercise requirements.

This activity involves five major tasks: evaluate design versus implementation, evaluate compatibility, evaluate interface implementation, assess instrumentation requirements, evaluate impact of operator proficiency.

Evaluate Design Versus Implementation: This task will be performed by inspection and will determine if the design is sufficient to ensure the adequacy of the overall implementation by comparing the design as documented (e.g., conceptual model, component compliance profiles and fidelity characterizations) and the exercise configuration. The V&V team will participate in exercise development walk-throughs and apply a series of checks to compare the physical configuration to the documented design. In addition, functional testing will be applied to assess the SE performance over the course of the test.

Evaluate Compatibility: This task will be performed by inspection to determine if the individual components

- represent system performance as required for the exercise;

- transfer information to and from the network without corruption;
- share common perspectives of the virtual reality produced by the exercise; and
- employ database elements, shared models and support systems appropriately.

Evaluate Interface Implementation: This task focuses on network performance needs, interface implementation issues, and identification of changes in the exercise configuration that could impact operation of the network. The V&V team will inspect the hardware configuration and review data collection and transfer (e.g., PDUs) among components to determine that the interface implementation is in accordance with interface specifications. The V&V team will also evaluate the results of network loading and latency tests for possible impacts on simulation results.

Assess Instrumentation Requirements: The V&V team will evaluate the adequacy of the instrumentation requirements for V&V purposes.

Evaluate Impact of Operator Proficiency: The V&V team, in association with identified SMEs, will observe and evaluate the performance of operators to determine if they possess the appropriate skill level to perform the functions required for the test.

6.0 Validation Plan

Validation conducted in support of the ETE Test will occur at a number of sites and will be conducted by both contractor and ETE Test Team personnel. Prior to the execution of each validation task, a detailed execution plan will be developed and submitted to the ETE Test manager and the accreditation agent for review and approval. Similar or same validation tasks performed on a simulation will normally occur simultaneously and share a common execution plan.

In addition, the validation of the ETE Test synthetic environment will occur both during Phase 2 and Phase 3. This is necessitated by a change in the SE when VSTARS is moved from the laboratory to the E-8C aircraft. The second time the ETE Test SE is validated, the primary effort will be to identify changes from the original SE and to concentrate mainly upon those changes, if any, and their effect upon the SE.

6.1 J6K

Validate that J6K represents vehicle behavior to the degree detectable by the Joint STARS. This capability will be judged based upon viewing vehicle movement upon the Joint STARS operator workstation. Joint STARS operator SMEs will be used to evaluate these criteria.

This validation task will be performed by the ETE Test V&V team, assisted by Northrop Grumman and SMEs from the Joint STARS Joint Test Force. Methodologies used for this validation will include inspection, cause-effect graphing, comparison testing (bench-marking), and Turing testing. The validation will occur during Phase 2 and be repeated during Phase 3 with a written report to document the team's work.

6.2 TAFSM

No additional validation tasks are required specifically for TAFSM. However, when the ETE Test SE is validated, TAFSM, as a part of the ETE Test SE, will be validated within the context of the SE.

6.3 VSTARS

Except for ARIES, the validation of VSTARS will be conducted by Northrop Grumman and the Joint STARS JTF. The validation will occur during Phase 2 and will, by necessity, be conducted within the context of the SE. Northrop Grumman will prepare a separate V&V plan for VSTARS and will submit this plan to the ETE Test manager for comment and approval. Validation tasks will be performed by Northrop Grumman and the Joint STARS JTF with JADS ETE Test V&V team oversight. The validation of ARIES will be conducted by Lockheed Martin working with Northrop Grumman and the Joint STARS JTF. Lockheed Martin will develop a separate V&V plan for ARIES and submit this plan to the ETE Test manager for comment and approval. Validation tasks will be performed by Lockheed Martin with Northrop Grumman and the Joint

STARS JTF assistance and with JADS ETE Test V&V team oversight. Following the installation of VSTARS upon the aircraft, the validation will be checked to ensure that no changes have occurred in the radar products. The following validation tasks will be performed.

- Validate that for the MTI reports, virtual targets exhibit radar performance measures as defined during developmental testing of the Joint STARS radar. Operational behavior characteristics of the virtual targets shall not differ noticeably from the operational characteristics of real targets. The operational behavior characteristics will be evaluated visually.
- Validate that for virtual SAR reports, the images will exhibit radar performance measures as defined during developmental testing of the Joint STARS radar. In addition, virtual SAR reports will exhibit an acceptable degree of fidelity matching that found in actual images. The fidelity of SAR reports will be evaluated visually.

Moving Target Indicator (MTI) Radar Simulation

- Validate that the MTI radar simulation performs the necessary functions to emulate the Joint STARS MTI signal processing. The emulation represents radar performance measures as defined during developmental testing of the Joint STARS radar and considers environmental effects that affect the radar's performance.

Advanced Radar Imaging Emulation System (ARIES)

- Validate that ARIES represents radar performance measures as defined during developmental testing of the Joint STARS radar.
- Validate that ARIES visually matches the fidelity of Joint STARS SAR images as determined by ATWS operators.

Programmable Single Processor (PSP) Simulation (Laboratory Only)

- Validate that the PSP simulation emulates the performance of the PSP with respect to the time required to produce the PSP parameter message.

Navigation Simulation (Laboratory Only)

- Validate that the navigation simulation simulates the position, altitude and speed of an E-8C aircraft flying a specified orbit.

6.4 ETE Test Synthetic Environment (ETE Test SE)

The remaining validation of the ETE Test SE will be performed by the ETE Test V&V team during Phases 2 and 3 of the JADS ETE Test. As indicated in Figure 2 the validation task, perform conceptual model validation, was performed during the JADS feasibility study.

a) Perform Conceptual Model validation (Step 3)

The conceptual model validation was performed during the development of the feasibility study. At this time, several conceptual models were validated by inspection and one was chosen for further development into the ETE Test SE. Completion of the conceptual model validation will consist of documenting the conceptual models considered and the validation steps taken.

B) Perform Validation (Step 7)

The final validation of the ETE Test SE will be performed by the ETE Test V&V team assisted by Northrop Grumman and the Joint STARS JTF during Phase 2 of the ETE Test.

The validation of the ETE Test SE is intended to ensure that the integrated simulation is adequate to satisfy the ETE Test requirements such that

- SE behaviors and performance map sufficiently to real-world counterparts for the specific application;
- performances and representations of the simulated entities are sufficient to support the intended application; and
- testing has been done to address acceptance criteria.

This activity consists of five basic tasks: establish context for validation activities, evaluate configuration interoperability, assess exercise test environment, determine validation results, and evaluate operator performance.

Establish Context for Validation Activities: The purpose of this task is to confirm the appropriateness of the validation effort, affirm the availability of correct data, and lay the foundation for the exercise validation report. The V&V team will determine that the scope of the validation effort is adequate, the acceptability criteria are sufficient, and potential shortcomings and limitations are identified.

Evaluate Configuration Interoperability: The purpose of this task is to verify the mapping of individual components to the detailed design. As problem areas are identified during testing, the V&V team can use this mapping as an interoperability blueprint for SE integration and implementation to pinpoint potential sources of difficulty.

Perform Effectiveness Evaluation: The purpose of this task is to assess the ability of the different parts of the SE architecture (including live and computer generated forces) to generate the data needed to address the acceptability criteria. This task will involve

- tracing exercise performance data to the acceptability criteria;
- evaluating the data for accuracy, sufficiency, and appropriateness; and
- testing the algorithms used to collect, aggregate or summarize the exercise data to ensure the resulting values are accurate.

Evaluate Test Results: The V&V team will test the SE and compare the SE to the real world represented by the SE. This validation task will be performed by the ETE Test V&V team, assisted by Northrop Grumman and SMEs from the Joint STARS JTF. Methodologies used for this validation will include inspection, cause-effect graphing, comparison testing (benchmarking), and Turing testing. The validation will occur during Phase 2 and be repeated during Phase 3. It will produce a written report to document the team's work.

When conducting comparisons, the V&V team will consider underlying assumptions, differences in fidelity, and other constraints and limitations in their evaluation. Typical issues that will be addressed include

- correspondence between SE performance and real-world behavior and appearance of the represented systems and forces (to the degree required);
- suitability of the correlation of fidelity among the components;
- adequacy of the environmental representation; and
- correlation of live and synthetic targets.

If test results differ widely from the expected values, the V&V team will identify the causes and report them to the ETE Test manager and appropriate M&S providers for resolution.

Evaluate Operator Performance: The V&V team will compare the operator performance throughout the test period to real-world performance requirements and report deficiencies that may impact the validity of the exercise to the ETE Test manager.

7.0 Integrated Verification and Validation

The following integrated schedule and resource summary will be utilized to conduct the V&V of the ETE Test. The schedule is dependent upon the ETE Test master schedule and, as changes occur to the master schedule, the V&V schedule will also change.

7.1 ETE Test V&V Schedule

The ETE Test schedule is shown in Figure 4. The task names refer to the subparagraphs describing the V&V tasks listed in Sections 5 and 6.

ID	Task Name	1996			1997				1998				1999		
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1	Perform Verification Task 5.4a (Report)(Phase 1)					6/16		6/27							
2	Perform Verification Task 5.4a Inspection (Phase 2)								1/26		3/20				
3	Perform Verification Task 5.4a Inspection (Phase 3)											12/7		1/29	
4	Perform Verification Task 5.4b (Phase 1)					6/30		7/11							
5	Perform Verification Task 5.4c (Phase 1)					7/14		7/25							
6	Perform V&V of Aries (Phase 1)					7/9		7/11							
7	Perform Verification Tasks 5.1a, 5.1b, 5.4d (Phase 1)						9/4		10/7						
8	Perform Verification Tasks 5.1c, 5.1d, 5.1e, 5.1f, 5.1g, 5.2a (PI								1/26		3/20				
9	Perform Verification Task 5.4.e (Phase 2)								3/23			6/26			

Figure 4. ETE Test V&V Schedule

7.2 Resource Summary

ID	Resource Name	97		1998				19	
		Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2
1	Marchand	60h	41.28h	165.2h	91.83h	120.95h		15.2h	55.2h
2	Hovey		17.28h	43.18h	51.83h	120.95h		15.2h	55.2h
3	Houser		17.28h	43.18h	51.83h	120.95h		15.2h	55.2h
4	Tapia				51.83h	120.95h			38.4h
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									

8.0 Acronyms and Abbreviations

ACE	analysis and control element
ADS	advanced distributed simulation
AFATDS	Advanced Field Artillery Tactical Data System
ALSP	aggregate level simulation protocol
ANIU	air network interface unit
AoA	analysis of alternatives
ARIES	Advanced Radar Imaging Emulation System
ASAS	All Source Analysis System
ATACMS	Army Tactical Missile System
ATWS	Advanced Technology Work Station
C4I	command, control, communications, computers and intelligence
C4ISR	command, control, communications, computers, intelligence, surveillance and reconnaissance
CEP	circular error probability
CGS	common ground station
COEA	cost and operational effectiveness analysis
COTS	commercial off-the-shelf
D&ABL	Depth and Simultaneous Attack Battle Lab
DIS	distributed interactive simulation
DMSO	Defense Modeling and Simulation Organization, Alexandria, Virginia
DoD	Department of Defense
EMF	exercise management and feedback
ES	entity state
ES PDU	entity state protocol data unit
ETE	End-to-End Test
FCE	fire control element
GNIU	ground network interface unit
GSM	ground station module
HLA	high level architecture
Hz	hertz
IEEE	Institute of Electrical and Electronics Engineers
J6K	Janus version 6 simulation with thousands of entities
JADS	Joint Advanced Distributed Simulation, Albuquerque, New Mexico
Janus	interactive, computer-based simulation of combat operations
Joint STARS	Joint Surveillance Target Attack Radar System
JT&E	joint test and evaluation
JTF	joint test force
Kbits/sec	kilobits per second
km	kilometer
LGSM	light ground support module
M&IS	management and integration software
M&S	modeling and simulation

MPDU	message protocol data unit
MTI	moving target indicator
O&C	operations and control
PDU	protocol data unit
PSP	programmable signal processor
PTP	program test plan
RPSI	radar processor simulation developed by Northrop Grumman, Melbourne, Florida
SAR	synthetic aperture radar
SE	synthetic environment
SME	subject matter experts
SOW	statement of work
SSE	synthetic subenvironments
STRICOM	U.S. Army Simulation, Training and Instrumentation Command
TACFIRE	tactical fire
TAFSM	Tactical Army Fire Support Model
TBD	to be determined
TCAC	Test Control and Analysis Center
TED	terrain editor
TEL	transporter, erector, launcher
TEMP	test and evaluation master plan
TRAC	U.S. Army Training and Doctrine Command (TRADOC) Analysis Center
TRADOC	U.S. Army Training and Doctrine Command
V&V	verification and validation
VSTARS	Virtual Surveillance Target Attack Radar System
VV&A	verification, validation and accreditation
WSMR	White Sands Missile Range

Appendix A
Northrop Grumman

Verification and Validation Plan for Phase 2
of the
Virtual Surveillance Target Attack Radar System (VSTARS)

**VERIFICATION AND VALIDATION PLAN
FOR PHASE II
OF THE
VIRTUAL SURVEILLANCE TARGET ATTACK RADAR SYSTEM
(VSTARS)**

**CONTRACT NO: F30602-96-C-0281
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Prepared For:

USAF, AFMC
Rome Laboratory/PKRZ
26 Electronic Parkway
Rome, NY 13441-4514

Prepared By:

Northrop Grumman, Electronics & Systems Integration Division
Surveillance and Battle Management Systems - Melbourne
2000 W. NASA Boulevard
Melbourne, Florida 32904

G. Waldrop	Date
Technical Cognizance	

T. Robertson	Date
JADS IPT Lead	

R. Floto	Date
Systems Engineering IPT	

M. Addison	Date
Technical Integration Manager	

J. Lee	Date
Engineering Manager	

C. Liang	Date
Chief Engineer	

J. Newman	Date
System Test IPT Lead	

O. Vega	Date
Software IPT Lead	

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APPENDIX A

DATE: 4 June 1998

1 SCOPE

This document provides Verification and Validation (V&V) planning information for Phase II of the Virtual Surveillance Target Attack Radar System (VSTARS) Joint Advanced Distributed Simulation (JADS) program. The VSTARS V&V Plan is submitted in response to Contract Data Requirement List (CDRL) item A004 under the JADS Program Contract No. F30602-96-C-0281. Content and format are as specified by the contractor and in accordance with the Statement of Work (SOW) paragraph 4.5.

VSTARS Phase II V&V will be conducted by Northrop Grumman test engineers at the Northrop Grumman test facility located at Melbourne, FL. Verification pass/fail criteria will be accomplished using both real-time visual data demonstrations and post-V&V data reductions.

1.1 Purpose

The purpose of this V&V plan is to define the processes to be used to meet JADS Phase II objectives.

1.2 Verification Requirements

This plan covers the requirements of document JADS-RPT-002 Engineering Design Report for the Radar Processor Simulation for the Joint Surveillance Target Attack Radar System dated May 1996.

1.3 VSTARS Program Schedule

V&V for Phase II will be executed in accordance with the Phase II V&V master schedule.

2. APPLICABLE DOCUMENTS

2.1 Documents

Document C99SR077 Sept 24 1997	Preliminary Performance Assessment Test Plan For Phase I of the VSTARS
PR No. A-6-1763 July 1996	Statement of Work for Joint Advanced Distributed Simulation of JSTARS.
JADS-RPT-001 for March 1996	Architectural Design Report for the Radar Processor Simulation the Joint Surveillance Target Attack Radar System
JADS-RPT-002 May 1996	Engineering Design Report for the Radar Processor Simulation for the Joint Surveillance Target Attack Radar System (EDR)

3. VSTARS PHASE II VERIFICATION AND VALIDATION PROGRAM

3.1 VSTARS

VSTARS consists of the following subsystems;

1. Radar Processor Simulation and Integrator (RPSI)
 - Moving Target Indicator Radar Simulation (MTISIM)
 - Synthetic Aperture Radar Simulation (Advanced Radar Imaging Emulation System (ARIES)) (SARSIM)
 - Fixed Target Indicator Radar Simulation (FTISIM)
 - Air Network Interface Unit (ANIU)
2. Advanced Radar Imaging Emulation (ARIES)
3. Distributed Interactive Simulation Network Interface Unit (DISNIU)
 - Ground Network Interface Unit
4. Surveillance and Control Data Link Simulation (SCDLSIM)

The following laboratory software tools are used in support of VSTARS:

- Programmable Signal Processor Simulation (PSPSIM) For Lab Use Only.
- Navigation Simulation (NAVSIM). For Lab Use Only.

3.1.1 Distributed Interactive Simulation Network Interface Unit (DISNIU) Receiving

The ground network interface unit (GNIU), receives and processes Entity State Protocol Data Units (ESPDU) from the ETE DIS network via a T1 communications circuit. The GNIU reduces the ESPDU data to a stripped data packet, normally referred to as a VSTARS data packet, for transmission to the air portion of the DISNIU, known as the ANIU. The minimum formats and contents of the VSTARS data packets transmitted by the GNIU and ANIU are shown in Table 3-1 and Table 3-2.

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Table 3-1 Uplink Entity State PDU for JADS RPSI

FIELD DATA	FORMAT	BITS IN FIELD	INFORMATION
Time Stamp	Unsigned Integer	32	JANUS Game time
Local Target ID	Unsigned Short	16	Local Target ID No.
TCS X Cell	Unsigned Short	16	4K cell and 16m cell in Y axis
TCS Y Cell	Unsigned short	16	4K cell and 16 m cell in X axis
TCS Z Cell	Unsigned Short	16	(16383)m lsb=0.5m
Velocity X	Short	16	(200)m/s lsb=6.1035mm/sec
Velocity Y	Short	16	(200)m/s lsb=6.1035mm/sec
Velocity Z	Short	16	(200)m/s lsb=6.1035mm/sec
Entity Category	char	8	enumeration
Entity Sub Category	char	8	enumeration
Entity Specific	char	8	enumeration
Appearance	char	8	8 bit extraction from 32 bits
Orientation Angle	short	16	(180)deg. extraction from 32 bits
TOTAL BITS		192	

Table 3-2 Downlink Entity State PDU for JADS RPSI

FIELD DATA	FORMAT	BITS IN FIELD
Time Stamp	Unsigned Integer	32
TCS Location X	Float	32
TCS Location Y	Float	32
TCS Location Z	Float	32
TCS Velocity X	Float	32
TCS Velocity Y	Float	32

FIELD DATA	FORMAT	BITS IN FIELD
TCS Velocity Z	Float	32
TBD	Integer	32
TOTAL BITS		256

The DISNIU will receive and process Entity State Protocol Data Units (ESPDU) from the ETE DIS network at a rate greater than the maximum rate capable of being transmitted over a T1 communications circuit. This is determined by replay of a DISNIU scenario at 3 times normal speed. The DISNIU will reduce the ESPDU data to a stripped data packet for transmission to the RPSI. It will determine the minimum formats and contents of these data packets transmitted by the DISNIU that are necessary for the operation of the RPSI.

3.1.2 Distributed Interactive Simulation Network Interface Unit (DISNIU) Transmitting

The GNIU will format and transmit ESPDU onto the ETE DIS network denoting the existence and virtual location of VSTARS. The format of the ESPDU will conform to IEEE 1278 DIS 2.0.4 standards. Pre-V&V Procedures

The following need to be verified prior to any V&V activity:

1. DEC Alpha 600's are powered on and operational.
2. Silicon Graphics Incorporated (SGI) PDU logger is powered on and operational.
3. Current VSTARS software is loaded on the Alpha computers one of the JADS workstations.
4. Current ARIES software is loaded on the Alpha JADS02 workstation.
5. The workstations are linked by a JADS LAN.

Also, prior to formal execution of any Phase II V&V procedure, test engineers will ensure that any applicable extraneous log files, data recordings, etc. are removed from the system. Unless a particular procedure indicates otherwise, the steps listed in Appendix A will be followed to start VSTARS. The Graphics Display (GD) will have pre-determined Areas of Interest (AOI) showing live only, virtual only, and mixed data.

3.2 Equipment Configuration

The formal V&V configuration block diagram is depicted in Figure 3-1.

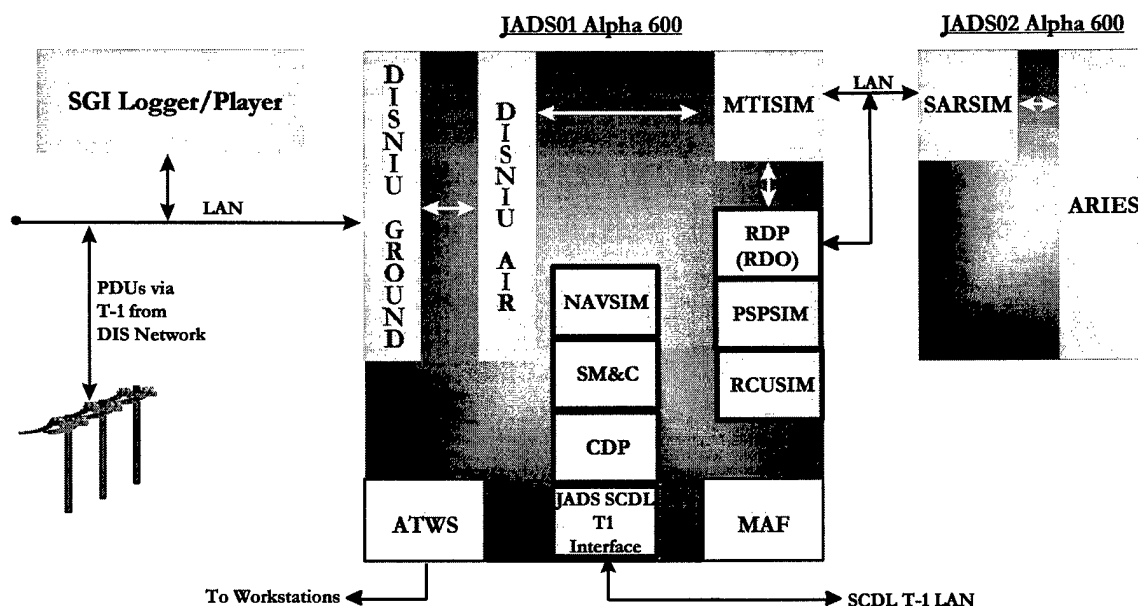


Figure 3-1- VSTARS Phase II Configuration

3.3 Test Tools

Software tools will be used during V&V execution for both real time and post procedure analysis.

3.3.1 MSGMON

MSGMON (Message Monitor) is a Joint STARS software tool that copies messages generated by Joint STARS into a database that allows a user to view the message sequence as well as the ten most recent messages real time.

3.3.2 JADS/VSTARS Data Reduction Program (DRP)

JADS/VSTARS DRP will be used for analysis of VSTARS specific data. The operator is able to make recordings of both processed and unprocessed GNIU and ANIU data. The target coordinates output will be in Topocentric Coordinate System (TCS), Latitude/Longitude, and Time-Space Position Information (TSPI) format. The data will be used to demonstrate ground truth, coordinate conversion, and dead reckoning calculations. In addition, in conjunction with target reports, the data can be used by the contractor for Probability of Detection and Circular Error Probability calculation.

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3.3.3 JADS Toolbox

The JADS Toolbox is a JADS JTF utility installed on the Silicon Graphics INDY machine and is used to perform analysis of logged ESPDU files. For V&V, this tool will be utilized to verify that VSTARS transmits an E-8C ESPDU over the network.

3.4 Twelve Target Scenario

JADS JTF will provide a twelve target scenario created with JANUS for use during Phase II V&V. Target ground truth data will be available for this scenario for use in analysis during and following the V&V activities, when log files are generated.

4. V&V Program Activities

This section of the Phase II V&V plan provides descriptions of V&V objectives and outlines the procedures which will be used to verify those objectives. Appendices B-G (Test Data Sheets) contain the actual procedure steps that are described below.

4.1 VSTARS MTI Verification

EDR: (3.2.3 [23], 3.2.1.1.1 [6,7], 3.2.2.1.3 [26], 3.2.2.1.4 [27], 3.2.2.1.5 [28], 3.2.4.2 [45], 3.2.2.2 [29], 3.2.2 [24], 3.2.4.2 [45], 3.2.4.3 [46], 3.2.2 [23], 3.2.2 [28])(5.3.1-a, b, e; 5.3.4-b, c, d; 5.3.5-b, c, d; 5.3.7-a, b, c; 5.3.8-a)

Verify that VSTARS receives and integrates virtual data from the JADS JTF test environment. Verify that VSTARS operates in three modes: live only, mixed live and virtual, and virtual only using standard Joint STARS MTI message format. Verify that the PSP Simulation receives and processes parameter data. Verify that MTI Radar Simulation receives target reports from the RPSI M&IS and performs on a dwell basis. Verify that the MTI Radar Simulation has minimal impact upon the radar timeline. Verify that the PSP and Navigation Simulation are operational.

4.1.1 Detailed Description

For this procedure, the V&V Operator will first start VSTARS without DISNIU. For demonstration purposes, virtual targets will be tagged as wheeled targets and will appear magenta on the graphics display (GD), while live targets will be tagged as tracked targets and will appear amber on the GD. The operator will then start MSGMON on the JADS02 machine and set up the tool to first display MTI messages processed on GPC2 (RDP) and GPC3 (MTISIM). Once all tools are setup, the first demonstration will show that VSTARS can have live data only (noise in the laboratory environment) displayed. Looking at both MSGMON and virtual Jammed Azimuth data (which will visually display the radar dwells), the operator will demonstrate that the system performs on dwell basis. Next, DISNIU playback will be activated to load virtual targets into the system and live targets will be turned off. VSTARS will have only a virtual target area displayed and MSGMON again will be used to compare MTI messages. Finally, live targets will be activated again to observe VSTARS display a mixed area of target data. Throughout the procedure, the Approved RSR List TD will be observed to show that the Ground Reference Radar Coverage Area (GRCA) does not exceed Joint STARS spec timeline requirements. Final steps will have MSGMON display MTI Parameter Messages to demonstrate that VSTARS receives and processes PSP parameter data. By accomplishing all of the above, PSP and N

4.2 ARIES SAR Validation

EDR: (3.2.3 [41, 42], 3.2.4.2 [45], 3.2.4.3 [46], 3.2.2 [23]) Verification Requirements: (5.3.1-c, e; 5.3.4-e, f; 5.3.6-b, c; 5.3.7-a, b, c; 5.3.8-a)

Verify that VSTARS displays live (noise in laboratory version) SARs in live AOIs, and virtual SARs in mixed and virtual areas using standard Joint STARS SAR message format. Verify that of PSP Simulation and Navigation Simulation are operational.

4.2.1 Detailed Description

SAR requests will be initiated in both live and virtual areas and will be displayed on the Graphics Display (GD). SAR images will be visually inspected. MSGMON will be utilized to observe Joint STARS SAR messages real-time for both virtual and live areas. Accomplishing all of the above demonstrates that PSP and Navigation Simulation are operational.

The CPU monitoring/reporting function provides the ability to report CPU utilization for each CPU in 1-second intervals via an output data file and has the capability to execute from 2 to 1800 seconds.

4.3 VSTARS Operator Interference Verification

EDR: (3.1.1 [3])

Verify that in all modes of operation, VSTARS will permit all of the installed operator workstation software to function without abnormal fault messages occurring. Abnormal fault messages are defined as those caused specifically by the use of VSTARS.

4.3.1 Detailed Description

Various Joint STARS functions will be presented to show that abnormal fault messages do not occur while VSTARS is operating. The following functions will be demonstrated:

- The route function
- The tracker
- Order of battle
- Radar functions

If while executing this procedure any function does not operate as expected, it will be documented.

4.3.2 ANIU and GNIU Verification

EDR: (3.2.1.3.4 [20], 3.2.1.3.3 [17], 3.2.1.3.3 [18], 3.2.1.3.6 [22], 3.2.1.3 [12], 3.2.1.3.5 [21], 3.2.4.2.[46])

This procedure will accomplish the following requirements in three test cases:

- Test Case #1 - Verify that the GNIU receives and processes DIS 2.0.4 Entity State Protocol Data Units (ESPDU) from the ETE Test DIS network at a rate of 100 ESPDUs/second. Demonstrate that the GNIU can process ESPDUs at a rate greater than 350 ESPDU/second. Verify that the VSTARS data packet is than 192 bits.
- Test Case #2 - Verify that the ANIU provides the necessary data required by the GNIU, and that the GNIU prepares and transmits an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.
- Test Case #3 - Verify that the GNIU performs a coordinate transformation upon entities selected for transmittal to the ANIU and prepares a VSTARS data packet, containing all entity data required by the RPSI, for transmittal to the ANIU. In addition, verify that the ANIU stores entity data and conducts dead reckoning upon moving targets at a minimum rate of 1/second.

4.3.3 Detailed Description

- Test Case #1 - The JADS/VSTARS DRP will be used to replay ESPDUs at an accelerated playback rate. An analysis of the playback will be done, which will show a calculation of the number of PDUs that were processed during the playback. The ESPDU DIS logger will be used to replay ESPDUs three times normal speed. The first replay is accomplished with DISNIU recording turned off. After the first replay, perform a second with DISNIU recording turned on.
- Test Case #2 - The SGI will be set up for logging a DIS file. On VSTARS, the E-8C ESPDU transmittal function will be activated via the JADS/VSTARS DRP. The data will be logged for approximately five minutes. The JADS Toolbox will be used to look at the parameters of the logged aircraft ESPDU.
- Test Case #3 - The Twelve Target Scenario will be started with DIS Logger running. Then the JADS/VSTARS DRP will be used to extract TCS coordinates from the GNIU input data and compare them to ANIU output data. Dead reckoned targets will be analyzed to verify they are updated once per second and that the dead reckoned calculations have the appropriate distance and direction based on the input target movements.

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4.3.4 Turing Test

EDR: (3.2.2 [23])

The Turing test will be performed by Northrop Grumman and the Joint STARS Joint Test Force with JADS ETE V&V team oversight. The purpose of the Turing test is to ensure that there are no major distinguishable differences to Joint STARS operators between VSTARS and the actual Joint STARS radar picture. The following areas will be validated:

- Operational behavior characteristics of the virtual targets shall not differ noticeably from the operational characteristics of real targets and have minimal impact upon the radar timeline.
- Validate that ARIES visually matches the fidelity of Joint STARS SAR images, and that ARIES has minimal impact upon the radar timeline.

4.3.5 Detailed Description

Using a JANUS Vignette, Joint STARS JTF tactics will develop a tasking order. Prior to the Turing test, Northrop Grumman will brief test participants on the scenario. There will be two workstations in the OCTL and one in the JADS laboratory. The operator in the JADS laboratory will be the Sensor Management Officer (SMO). The operators will be told that they are evaluating the performance of VSTARS. After the test, a testing psychologist will interview participants and evaluate their responses. The responses will be used to validate that ARIES had minimal impact on the radar timeline.

5. Reports

A test report will be submitted to JADS JTF at the conclusion of the Phase II V&V testing.

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APPENDIX A
Preliminary Procedures for JADs Formal Test

Procedures for performing JADS Verification

1.1 Pre-Test Procedures

Step #	Action	Event
1.	Verify the Alpha and SGI are powered up and initialized.	
2.	Connect all workstations and SGI to the T1 line and log into logbook.	Enables connection to the SGI for DISPDU playback.
3.	Logon to ATWS and enter PERM Number .	Joint STARS start-up screen appears. After a few minutes, Joint STARS windows initialize.
4.	Assign console Tech Control .	Technician Push-button menus are made available,
5.	Open the OAC STAT RCFG TD under STAT RCFG Push-button Menu.	A window showing the status of the SMCs and GPCs.
6.	When GPC 1, 2, and 3 go to operate, access the PROC PRIV ALLOC TD and select MSU radio button .	Enables Mission Support Utilities functions.
7.	In <i>DECterm</i> > Type set def dka0:[secret_radar_dir] then type dir	Sets the default directory.
8.	Delete all SARF , HIST, and THIS files.	This will free up disk space for recording and new history files.
To Bring Up NAVSIM		
9.	Use the pull down menu to bring up a DECterm window .	DECterm window displayed.
10.	In <i>DECterm</i> > Type rtmission jads02 . ¹	Rtmission window appears showing logon prompt.
11.	In <i>rtmission</i> > Logon to MISSION	Prompt for password and perm number displayed.

¹ * Type in the number of the JADS node you are working on.

Step #	Action	Event
12.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_NSE.dat	Displays files selection options for saved window names.
13.	In <i>NSE</i> > Type @[nserdi.com]nse_run_nse	Initializes NSE (the nav sim) and the NSE menu appears in the window after "ALTUNT".
14.	In <i>DECterm</i> > Type rtmission jads01. ²	Rtmission 1 window appears showing logon prompt.
15.	In <i>rtmission</i> > Logon to MISSION	Prompt for password and perm number displayed.
16.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_PJNAV.dat	Displays files selection options for saved window names.
17.	In <i>PJNAV</i> > type @jstars_build_root:[com]run_jads_nav	Runs JADS Nav sim and attaches itself to the NSE window.
18.	In <i>NSE</i> > Use the cursor to select " configuration " and press return.	Displays NSERDI configuration menu.
19.	In <i>NSE</i> > Use the cursor to select " load cfg file " and press return.	Displays load configuration.
20.	In <i>NSE</i> > Use the cursor to select " select cfg file " and press return.	Displays list of available files.
21.	In <i>NSE</i> > Use the cursor to select " jads_TJDT " ³ and press return.	Displays file loaded message.
22.	In <i>NSE</i> > Use the cursor to select " exit " and press return.	NSE/RDI configuration widow displayed.
23.	In <i>NSE</i> > Use the cursor to select " exit " and press return.	Window display reverts to original NSE/RDI version 3.5 window.
24.	In <i>NSE</i> > Use the cursor to select " start simulation " and press return.	Displays simulation control window.

² * Type in the number of the JADS node you are working on.

³ Select the correct file name for your scenario.

Step #	Action	Event
25.	In <i>NSE</i> > Use the cursor to select “ start ” and press return.	NSE processes run.
To Bring Up PJJMON		
26.	In <i>DECterm</i> , type rtmission jads01.*	Rtmission window appears showing logon prompt.
27.	In <i>rtmission</i> > Logon to MISSION3	Prompt for password and perm number displayed.
28.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_PJJMON.dat	Displays files selection options for saved window names.
29.	If your login does not automatically set proc/priv=all , type set proc/priv=all	Give you privileges needed to perform functions in OpenVMS. (PSPSIM will not stay on if you have not done this).
30.	In <i>PJJMON</i> > Type set def runtime_dir	Set default directory to runtime_dir.
31.	In <i>PJJMON</i> > Type run pjimon	Displays JADS Control window.
32.	In <i>PJJMON</i> > Type 1	Displays JADS Process Control configuration.
33.	In <i>PJJMON</i> > Type 1	MTISIM selected for configuration and asks for an “enter option”
34.	In <i>PJJMON</i> > Type L	Loads MTISIM.
35.	In <i>PJJMON</i> > Type 3	PSPSIM selected for configuration.
36.	In <i>PJJMON</i> > Type L	Loads PSPSIM.
37.	In <i>PJJMON</i> > Type R	Applies modifications to JADS Process Control. Do not exit before you reconfigure.

Step #	Action	Event
38.	In <i>PJJMON</i> > Type X	Return to the JADS Control Window.
39.	In <i>PJJMON</i> > Type 2	The MTI Simulation Control Parameters Window selected.
40.	Ensure the following default values are displayed: 1 - Turn off PD (Probability of Detection) 2 - Turn off PFA (Probability of False Alarms) 3 - Turn off CEP (Circular Error of Probability) 4 - Turn off CEP of X-RNG and D-RNG Bias 5 - Turn off Terrain Screening 6 - Set (Live=tracked) and (Virtual=wheeled) 7 - Load DIS target ID into MC44 report 8 - Display Mixed Mode in Same Area 9- Display Dummy Targets 10 - Minimum Detectable Velocity (M/S) 11 - Minimum CEP Cross Range Error 12 - Minimum CEP Down Range Error 13 - Minimum PFA 14 - Minimum PD Cross Loss (dB) 15 - Monitoring Virtual Data ID (-1 for all) - X - Exit	- F - F - F - F - F - F - F - Set to 0 for scenario -1
41.	In <i>PJJMON</i> > Type X and iconify window.	Exit back to the JADS Control window.
To Bring Up PPKOCO		
42.	In <i>DECTerm</i> , type rtmission jads01.*	Rtmission window appears showing logon prompt.

Step #	Action	Event
43.	In <i>rtmission</i> > Logon to MISSION2	Prompt for password and perm number displayed.
44.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_PKXOCO.dat	Displays files selection options for saved window names.
45.	In PKXOCO > Type OCO_TASK	Displays PKXOCO Selection window.
46.	In PKXOCO > Hit return to select default of 5.	Opens System Summary window.
47.	In PKXOCO > Type 2 and press return.	System State is now in operate.
48.	In PKXOCO > Hit return	Displays System Monitor window.
To Bring Up ARIES (SARSIM)		
49.	In <i>DECterm</i> , type rtmission jads02.*	Rtmission window appears showing logon prompt.
50.	In <i>rtmission</i> > Logon to ARIES if SARSIM is the <i>only function running</i> on the ATWS. Logon to ARIES1 if <i>Joint STARS and JADS processes are running on the same machine</i> as SARSIM.	Prompt for password and perm number displayed. After perm number is input, SARSIM automatically starts. If the system comes down, you logged on to the wrong ARIES account and must do a JSMENU 5 to restart Joint STARS
51.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_ARIES.dat	Displays files selection options for saved window names.
52.	In ARIES > At prompt, "Do you want to run SARSIM in stand alone mode (y/n)" press return .	Yes is selected as the default to allow stand alone operations.
53.	In ARIES > At prompt, "Do you want to change the mission center (y/n) press return ."	The default of no change to the mission center is selected.
54.	SARSIM automatically initializes.	"Initialization successful" is displayed in the window.

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Step #	Action	Event
55.	Delete all RSRs left over on the GD from previous sessions.	No RSRs are approved.
56.	Deselect all MFPs for show except the required (Do not delete, just do not show)	Deselected flight plans do not appear on GD. They remain in the data base.

The following steps bring up the DISNETWORK and the Silicon Graphics Machine (SGI), do not bring them up unless the procedure refers you back to this appendix.

To Bring Up DISNIU		
57.	Use the pull down menu to bring up a <i>DECterm</i> window.	DECterm window displayed.
58.	In <i>DECterm</i> > type rtmission JADS0x . (Insert JADS workstation number for x)	DECterm window appears showing logon prompt.
59.	In <i>DECterm</i> > Logon to MISSION3	Prompt for password and perm number displayed.
60.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_DISMON.dat	Displays files selection options for saved window names.
61.	In <i>another DECterm</i> > , type rtmission JADS0x . (Insert JADS workstation number for x)	DECterm window appears showing logon prompt.
62.	In <i>DECterm</i> > Logon to MISSION3	Prompt for password and perm number displayed.
63.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_DISNIU.dat	Displays files selection options for saved window names.
64.	In <i>DISNIU</i> > type @user\$disk:[util]start_disniu JADS0x 966 (or correct configuration)	B. Spalding login file executes to set up symbols and logicals. Sets up network environment and enables the reading of PDUs.
65.	In <i>DISMON</i> > type @user\$disk:[util]start_disniu_monitor.	B. Spalding login file executes to set up symbols and logicals. Brings up the DISNIU monitor.

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66.	Use the pull down menu to bring up a DECterm window.	DECterm window displayed.
67.	In the new DECterm window>type telnet 199.26.42.100.	Telnet to SGI.
68.	At <i>login:</i> type root (in lower case)	Logon to SGI root account
69.	At <i>password:</i> type the correct password (lowercase)	Enables logon to root account and displays "Grumman #1" prompt.
70.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DEC\$Terminal_SGI.dat	Displays files selection options for saved window names.
71.	In <i>SGI ></i> at grumman 1# prompt, type cd /usr/local/bin	Brings up JADS Logger.
72.	In <i>SGI ></i> type ls	Directory is displayed.
73.	In <i>SGI ></i> type ls /disk2/v_v_logfiles	List of directories under either v_v_logfiles are displayed.
74.	In <i>SGI ></i> type jads_player* 3000 1 /disk2/ v_v_logfiles /(filename)	Selected pre-recorded file is played back on the SGI and transmitted to JADS.Opens selected JADS Logger file.

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APPENDIX B
VSTARS MTI Verification

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VSTARS MTI Verification - Verify that VSTARS receives and integrates virtual data from the JADS JTF test environment. In addition, demonstrate with the current Joint STARS software build that VSTARS operates in three modes: live only, mixed live and virtual, and virtual only using standard Joint STARS MTI message format. Verify that the PSP Simulation receives and processes parameter data and MTI Radar Simulation receives target reports from the RPSI M&IS, and performs on a dwell basis. Verify that the MTI Radar Simulation has minimal impact upon the radar timeline. Verify the functionality of the PSP and Navigation Simulation.

Step #	Action	Event	Pass/Fail
1.	Start VSTARS according to Appendix A. Bring up the OCO_TASK and DISSIM windows, but do not start the processes. SGI will be brought up later in this procedure. Note: ARIES is not necessary for this procedure.	VSTARS started without OCO_TASK and DISSIM running.	
2.	Bring up the APPV RSR TD: - Place mouse pointer over “-” symbol on Graphics Display (GD) and press the left mouse button. - Scroll down to Go to TD F19 selection and press left mouse button - In the Enter TD Number field, type 2 and use mouse pointer to select enter.	APPV RSR TD is displayed, showing that the only active RSR is the GRCA labeled V_V; revisit rate is visible on the TD as well.	

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Step #	Action	Event	Pass/Fail
3.	Remove extraneous flight paths from GD. · If necessary, select PRI FCTN button on PDU. · On TECH CNTRL PDU, select MSN CMMN SEL button. · Select FLT PLN MGT button · Select AUX FLT PLNG button · Select FLT PLN List button · Deselect the S button on all flight paths except TJU102, press ENTER · Select the PRI FCTN button.	· TECH CNTRL PDU is displayed · MSN CMMN SEL menu displayed · FLT PLN MGT menu displayed · AUX FLT PLNG menu displays · FLT PLN List TD displayed · Only flight path labeled TJU102 is displayed on the GD. · TECH CNTRL menu displayed.	

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Step #	Action	Event	Pass/Fail
4.	Remove extraneous Order of Battle Areas from GD. - On PDU select MSN CMMN SEL button. - Select PROC OB button - Select OB AREA List button - Deselect the S all button and ENTER. - Select the S button for Live_AOI and Mix_AOI areas, and ENTER. - Close the OB AREA LIST TD - Select the PRI FCTN button. Note: If the Mix_AOI area has been deleted, create new area at the following X,Y,Z (clockwise order) coordinates: 75960X, 49456Y, -452Z 87864X, 49584Y, -588Z 87992X, 35888Y, -480Z 75704X, 35760Y, -325Z Note: If the Live_AOI area has been deleted, create new area at the following X,Y,Z (clockwise order) coordinates: 113976X, 12080Y, -818Z 126264X, 11824Y, -1075Z 127544X, -464Y, -1102Z 114744X, -208Y, -798Z	- MSN CMMN SEL menu displayed - PROC OB menu displayed - OB AREA List TD displayed. - OB AREA on GD disappear. - Live_AOI and Mix_AOI areas are displayed within the GRCA. - OB AREA LIST TD is closed. - TECH CNTRL menu displayed.	

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Step #	Action	Event	Pass/Fail
5.	Set graphic features on GD for all scales. · Press right mouse button over the GD · Scroll down to Graphic Features · Select/deselect radio buttons for the graphic features desired, select radio button for ALL SCALES, and then select ENTER.	The following graphic features will have their radio button active: · Primary Road · Secondary Road · City/Town · Tree/Desert · River/Lake · Political Boundaries	
6.	Center the GRCA on the GD and set scale to 128km · Place mouse pointer in center of GRCA · Press right mouse button and select scales. · Scroll down to 128km and press left mouse button.	GRCA fills GD.	
7.	Log on to the JADS02 machine using the MISSION account. · Enter the appropriate <i>password</i> and <i>perm number</i>	JADS02 is logged on without Joint STARS software running.	
8.	On JADS02, bring up a DECterm window and set host to JADS01. Log on using the MISSION2 account.	DECterm window is brought up and logged onto the JADS01 RDP.	
9.	On JADS02, bring up a second DECterm window and set host to JADS01. Log on using the MISSION3 account.	DECterm window is brought up and logged onto the JADS01 SPR.	

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Step #	Action	Event	Pass/Fail
10.	On the first DECterm window, open the <i>Options</i> feature and select <i>Restore Named Options</i> in the pull down menu. · select user\$disk:[000000] then FILTER. · select DECW\$Terminal_Msgmon_RDP.dat · select OK	The DECterm window is resized and named MSGMON_RDP.	
11.	On the second DECterm window, open the <i>Options</i> feature and select <i>Restore Named Options</i> in the pull down menu. · select user\$disk:[000000] then FILTER. · select DECW\$Terminal_Msgmon_SPR.dat · select OK	The DECterm window is resized and named MSGMON_SPR.	
12.	For both DECterm windows, start MSGMON: · type JSMENU, enter · type 16, enter · type 2, enter · type 3, enter	Message Monitor Program V1.0 is started for both the RDP and SPR GPC's.	

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Step #	Action	Event	Pass/Fail
13.	In the MTISIM Control Parameters menu (<i>PJJMON</i> window on JADS01 console), verify the following parameters are set to the indicated values: - Turn off PD (Probability of Detection) T - Turn off PFA (Probability of False Alarms) T - Turn off CEP (Circular Error Probability) T - Turn off CEP Center of X-RNG and D-RNG bias T - Turn off terrain screening T - Set (Live=Tracked) and (Virtual=Wheeled) T - Load DIS Target ID into MC44 report T - Display mixed mode in same area T - Display dummy targets F - Minimum detectable velocity 0.0	MTISIM parameters are set to display clean virtual targets, with virtual targets appearing on the screen in magenta, while live targets will appear amber.	

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Step #	Action	Event	Pass/Fail
14.	Exit the MTISIM Parameters menu and bring up the PSP Parameters menu. · In <i>PJMON</i>, type 3. · In PSP Control Parameters menu, type 8 then press enter. · Type x and enter. · Iconize the window	PSP load set to 90%, making it easier to see live targets.	
15.	In <i>PKXOCO</i> window start OCO_TASK . · type OCO_TASK, and enter.	The PKXOCO Selection window is displayed.	
16.	In the <i>PKXOCO</i> Selection window, hit enter to select default of 5 .	System Summary window is displayed.	
17.	In System Summary window, type 2 and enter .	System state goes from standby to operate; system alert "RDR IN OPERATE" is displayed.	
18.	In System Summary window, hit enter . Place window away from GD.	System Monitor window is displayed.	
19.	Observe on the GD that "live" amber targets appear within the AOI's; observe APPV RSR TD revisit value.	VSTARS operates in live target mode. APPV RSR TD shows revisit value is within spec requirements.	Pass Fail

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Step #	Action	Event	Pass/Fail
20.	Bring up the <i>PJMON</i> window. - Type 2 for MTISIM Control Parameters window. - Select 9 (Display Dummy Targets) and enter T. - Type x and enter. - Iconize the window.	Using Jammer Strobes, the radar swath for the GRCA with its dwells is illustrated on the screen.	
21.	At JADS02 console, for both MSGMON windows: - scroll down to Select Display of a Message and enter. - scroll down to page 1 (RDP only) - type 1, and enter. - scroll down to TARGET_INDICATOR_RD and enter. - type 1 and enter.	Page one (1) for MC-44 MTI Target Indicator messages for RDP (pre-RPSI processing) and SPR (RPSI processing) are displayed.	
22.	Observe the MHDR.Source_Process_ID in the MSGMON_RDP and compare with the process source ID in the MSGMON_SPR. Observe job.rsr_type and job.ref_num values on both displays. Note: Process ID numbers can be verified in the gexp_exec_proc_ids.inc file, located in the following directory: dka0:[cmsdsk.bld03_108b_secret.include_unclassified]	Source ID for RDP is 270 (this value correlates to process PK4RPT) while source ID for SPR is 390 (this value correlates to process PJMTIS (MTISIM)); values for RSR type and RSR reference number are identical, demonstrating that VSTARS uses the same MTI Joint STARS message format.	Pass Fail

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Step #	Action	Event	Pass/Fail
23.	At JADS02 console, for both MSGMON windows: - press enter - type 3 and enter.	Page three (3) for MC-44 MTI Target Indicator messages for RDP (pre-RPSI processing) and SPR (RPSI processing) are displayed.	
24.	Observe on GD that targets fall within dwells; observe on both MSGMON windows the dwell.tgt_cnt field.	MTI is reported on a dwell basis. MSGMON_RDP target per dwell count is higher than MSGMON_SPR target count; RPSI M&SI receives outputs from RDP and MTI simulation and determines the appropriate distribution of targets, deleting targets that fall outside the designated live areas.	Pass Fail ☐ Pass Fail ☐
25.	Bring up the <i>PJJMON</i> window. - Type 3 for PSP Control Parameters window - Type 11 and enter, then type 0 - Type x to return to the main menu - Type 2 for MTISIM Control Parameters window. - Select 9 (Display Dummy Targets) and enter F. - Type x to return to main menu. - Iconize the window.	PSP generated targets are turned off; jammer strobes are removed.	
26.	Clear the GD of MTI - Press right mouse button over the GD - Scroll down to Clear MTI - Select Yes	GD is cleared of all targets.	

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Step #	Action	Event	Pass/Fail
27.	In the <i>DISMON</i> window, start the DISNIU monitor. · Type @user\$disk:[util]start_disniu_monitor and enter .	DISNIU Monitor is activated.	
28.	In the <i>DISNIU</i> window, start the DISSIM. · Type @user\$disk:[util]start_disniu JADS01 966 and enter .	DISSIM is running.	
29.	On the JADS01 console, bring up a new DECterm window for SGI playback. · Outside of any X-term window, press mouse button. · Under Applications window, scroll to DECterm/Screen 0 selection.	A new DECterm window is displayed on the JADS01 console.	
30.	On the DECterm window, open the <i>Options</i> feature and select <i>Restore Named Options</i> in the pull down menu. · select DECW\$Terminal_SGI.dat · select OK	The DECterm window is renamed and resized.	

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Step #	Action	Event	Pass/Fail
31.	Start the Twelve Target Scenario on the SGI: - in the <i>SGI</i> window type telnet 199.26.42.100 and enter - at logon type root and the correct password. - at grumman 1# prompt, type cd /usr/local/bin and enter - type ls and enter - type ls /disk2/v_v_logfiles and enter - type jads_player* 3000 1 /disk2/v_v_logfiles/(filename) and enter	- connects to the SGI - logon to SGI root account - set directory to JADS Logger - displays directory - displays directory of logfiles - starts scenario	
32.	Observe on GD that 12 magenta virtual targets appear within the GRCA; observe APPV RSR TD revisit value; observe on both MSGMON windows the dwell.tgt_cnt field.	VSTARS operates in live target mode. APPV RSR TD shows revisit value is within spec requirements. MSGMON_RDP target per dwell count is zero while MSGMON_SPR target count fluctuates between 0 and 1; RPSI M&SI receives outputs from RDP and MTI simulation and determines the appropriate distribution of targets and works on a per dwell basis.	Pass Fail Pass Fail
33.	Bring up the <i>PJJMON</i> window. - Type 3 for PSP Parameters window - Select 5 and enter - Type x to return to the main menu	Enables a PSP load of 50%.	

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Step #	Action	Event	Pass/Fail
34.	Observe on the GD that live "amber" targets and virtual "magenta" targets appear together in the MIX_AOI area; observe APPV RSR TD revisit value; observe on both MSGMON windows the dwell.tgt_cnt field.	VSTARS receives virtual and live targets and integrates it on the GD. APPV RSR TD shows that the radar timeline is unaffected by VSTARS. MSGMON_RDP target per count is greater than MSGMON_SPR target count; VSTARS receives live targets and integrates it with virtual targets, then distributes the targets within the appropriate areas (real, virtual, or mixed), and then sends the composite report to the radar post processor.	Pass Fail Pass Fail
35.	On JADS02, in both MSGMON windows press enter twice.	The Display Message selection menu is displayed for both MSGMON_RDP and MSGMON_SPR.	
36.	In both MSGMON windows, scroll to MTI_PARAMETERS_MSG_XD message and press enter .	MC21_MTI_PARAMETERS (a.k.a. PSP Parameters) message is displayed for both the RDP and SPR GPC's.	
37.	Compare Source ID RDP and SPR MSGMON. At Test Conductor's discretion, message on both displays can be paged through for format comparisons.	Process source ID for RDP is 265 (PK2MCP), while the process source ID for VSTARS is also 265; MTI Radar Simulation receives the details of a radar mission from the radar subsystem as PSP Parameter Messages.	Pass Fail
38.	Prepare the system for the next procedure or close down VSTARS at the discretion of the test conductor.	VSTARS is either made ready for the next V&V procedure, or the system is shutdown.	

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V&V PROCEDURE WITNESS CERTIFICATION

DATE _____

PROCEDURE TITLE: VSTARS MTI Verification

This acknowledges that the V&V procedure, VSTARS MTI Verification was performed as documented.

DOCUMENT NO: C99SR090

DATE: 4 June 1998

V&V Conductor (SBMS-M) Date

V&V Witness (Government) Date

DOCUMENT NO: C99SR090
APPENDIX C
DATE: 4 June 1998

APPENDIX C

ARIES SAR Verification

4.2 ARIES SAR Verification - Demonstrate that VSTARS displays live (noise in laboratory) SARs in live AOIs, and virtual SARs in mixed and virtual areas using standard Joint STARS SAR message format.

Step #	Action	Event	Pass/Fail
1.	In ARIES > Verify that SAR Simulation is still running. If not follow procedures in Appendix A.		
2.	In <i>DECterm</i> > Type rtmission jads01 .	Rtmission window appears showing logon prompt.	
3.	In <i>rtmission</i> > Logon to MISSION2	Prompt for password and perm number displayed. Logon to mission 2 will allow access to the RDP Message Monitor.	
4.	Go to the <i>options</i> feature and select <i>Restore Named Options</i> in the pull down menu. Select DECSTerminal_MSGMON.dat	Displays files selection options for saved window names.	
5.	In <i>MSGMON</i> > Type jsmenu 16	Invokes the Joint STARS Tools Menu.	
6.	In <i>MSGMON</i> > Type 2	Sets up the Message Monitor Tool.	
7.	In <i>MSGMON</i> > Type 3	Brings up the Message Monitor Tool	
8.	In <i>MSGMON</i> > Use the arrow keys to select Reset Collection Process type 4 and press return .	This will clear old messages from the old Message Monitor to ensure no other SAR message traffic is present.	
9.	In <i>MSGMON</i> > Use the arrow keys to select Display Msg Summary and press return .	Summary of message traffic on VSTARS is displayed.	
10.	Request and approve a SAR in a virtual area at these coordinates 290616N0465341E and give it a label of " virtual ". Write in notes section below time from SAR approval to display. (This is found in the ARIES window next to elapsed time) Write in RSR# _____	SAR request is sent to the RSR Que for approval. When approved, a virtual SAR displayed on the GD.	Pass ☐ Fail ☐

Step #	Action	Event	Pass/Fail
11.	Request and approve a SAR in a live area at these coordinates 290247N0472414E . Write in notes section below time from SAR approval to display. Write in RSR# _____	SAR request is sent to the RSR Que for approval. When approved, a "live" SAR is displayed on the GD.	Pass ☐ Fail ☐
12.	Request and approve a SAR in mixed area at these coordinates 292317N0470011E . Write in notes section below time from SAR approval to display. Write in RSR# _____	SAR request is sent to the RSR Que for approval. When approved, a virtual SAR is displayed on the GD.	Pass ☐ Fail ☐
13.	In the Msg Summary window, monitor the Msg Summary Window for the display of the SAR_Parameters_MSG_XD and the SAR_REPORT_RD messages.	These messages indicate that the Radar has received a SAR request in the correct SAR message format.	
14.	In the <i>Msg Summary window</i> press return to display the MSG MON window.	The main Message Monitor window is displayed.	
15.	In <i>MSGMON</i> > Use the arrow keys to highlight Select Display of Message and then return . Choose page 1 at the prompt.	A list of messages processed by VSTARS is displayed and available for selection.	
16.	In <i>MSGMON</i> > Use the arrow key to highlight the SAR_REPORT_RD and then return . Choose page 1 at the prompt.	Page one of the SAR_REPORT_RD is displayed. Watch the label fields. Names cycle through quickly.	
17.	In <i>MSGMON</i> > Look in the source field for a value of 271 and a destination of 391 to show that SARs use the same message format whether they are live, virtual, or mixed.	The source ID of 271 indicates the source as PK4SAR and the destination of 391 indicates the destination as PJSARS.	Pass ☐ Fail ☐
18.	Request and approve a SAR at the closest distance from the E-8C but still within the field of view of the radar.	The SAR is generated and displayed on the GD.	Pass ☐ Fail ☐
19.	Request and approve a SAR at the farthest distance from the E-8C but still within the field of view of the radar.	The SAR is generated and displayed on the GD.	Pass ☐ Fail ☐
20.	Request and approve a SAR at the forward most limit of the E-8C but still within the field of view of the radar.	The SAR is generated and displayed on the GD.	Pass ☐ Fail ☐

Step #	Action	Event	Pass/Fail
21.	Request and approve a SAR at the aft limit of the E-8C but still within the field of view of the radar.	The SAR is generated and displayed on the GD.	Pass ☐ Fail ☐
Notes: Virtual SAR processing time: Live SAR processing time: Mixed SAR processing time:			
The following steps verify the FTI (Fixed Target Indicator) functionality while running VSTARS.			
20.	In <i>PJJMON</i> > Select the MTI parameters window and type the number 10 to select the minimum detectable speed. Then type 0.0 to set speed to zero.	Allows the operator to see fixed targets as well as moving.	
21.	Ensure the 12 target scenario is still running. If it has stopped, refer to Appendix A.		
22.	Use the <i>right mouse</i> to access the pull-down menu and select the History option.	The History Playback Window is displayed.	
23.	In the <i>History Playback Window</i> > Select the integrate check box and set the beginning of playback time approximately 1 min prior to current system time. Press Return .	MTI will replay in the integration mode. This will allow the operator to distinguish more easily between the moving and the fixed targets.	
24.	Look at the GD and <i>identify a target that is not moving</i> . Scale down over the target using an expansion of 8 .	Allows for a better view of the target.	
25.	On the push-button menu, select PRI FNCT and then PROC RSR . From PROC RSR , select RSR .	Gives access to the RSR push-button menu.	

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Step #	Action	Event	Pass/Fail
26.	On the RSR menu, click on FTI.	The FTI window is displayed to allow the operator to build a FTI.	
27.	Highlight the POS field in the TD, then move the cursor over the fixed target. Use the middle mouse button to fill in the target's coordinates. Press return. Approve the RSR in the RSR QUE.	An FTI/SAR is "shot" over the target area.	
28.	An FTI appears as a red spot over the location of the fixed target.		Pass ☐ Fail ☐

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V&V PROCEDURE WITNESS CERTIFICATION

DATE

PROCEDURE TITLE: ARIES SAR Verification

This acknowledges that the V&V procedure, ARIES SAR Verification was performed as documented.

V&V Conductor (SBMS-M)
Date

Date

V&V Witness (Government)

DOCUMENT NO: C99SR090
APPENDIX D
DATE: 4 June 1998

APPENDIX D

VSTARS Operator Interference Verification

4.3 VSTARS Operator Interference Verification - In all modes of operation, VSTARS will permit all the installed operator workstation software to function without the occurrence of abnormal fault messages caused by VSTARS.abnormal fault messages caused by VSTARS occurring.

Step #	Action	Event	Pass/Fail
1.	Continue to run VSTARS with SGI file active.	SGI scenario and VSTARS run.	
The following steps verify the Route functionality while running VSTARS.			
2.	Access the RTE TD from the process track push-button menu.	A blank Route TD is displayed.	
3.	Select the ADD radio button and then the CARTO option.	The system highlights the PT POS data field and entered points are correlated to road features.	
4.	Select points along a primary road to form a cartographic route and select ENTER .	A white line appears on the GD showing location of new route.	
5.	Select the ADD radio button and then the ARB option.	The system highlights the PT POS data field and entered points are not tied to cartographic data.	
6.	Select points along a primary road to form an arbitrary route and select ENTER .	A white line appears on the GD showing location of new route.	
7.	Open the ROUTE LIST TD and select the <i>arbitrary</i> route for <i>modification</i> .	The route TD for the selected route is displayed.	
8.	Select the ADD radio button and then the ARB option.	The system highlights the PT POS data field and entered points are not tied to cartographic data.	
9.	Select additional arbitrary points to modify the route and press ENTER .	The route is modified with new points added.	
10.	In the ROUTE LIST TD select the <i>cartographic</i> route for <i>deletion</i> .	The cartographic route is deleted.	

Step #	Action	Event	Pass/Fail
Route functionality is available while running VSTARS.			Pass ☐ Fail ☐
Notes:			
The following steps verify the Tracking functionality while running VSTARS.			
11.	Select the ETRK option on the PROC TRK push-button menu.	A black E-Track TD is displayed.	
12.	Initiate an E-Track by selecting the RDR DERIVED radio button, in the RTE# field input the number of the previous arbitrary route, and select the SEG radio button to use the segment method to determine target centroid position. Press ENTER .	An E-Track is initiated using the radar to determine radial velocity. It is constrained to the route previously created, and it's centroid position is selected via the segment option.	
E-Track functionality is available while running VSTARS.			Pass ☐ Fail ☐
13.	If an AC area is not created over targets, initiate one.	AC is displayed on the GD over SGI targets.	
14.	In the AC, initiate an A-Track by selecting the SPEC SPD CRS radio button, do not select a route number, and use the CNTR radio button to use the center method to determine target centroid position. Press ENTER .	An A-Track is initiated using operator specified speed and course. It is unconstrained and it's centroid position is selected via the center option.	
15.	In the AC, initiate a second A-Track by selecting the DP 1 and DP 2 radio buttons, do not select a route number, and use the BOX radio button to use the box method to determine target centroid position. Press ENTER .	An A-Track is initiated using differential position. It is unconstrained and it's centroid position is selected via the box option.	

Step #	Action	Event	Pass/Fail
16.	Select the AUTO REPOS push-button from the PROC TRK push-button menu.	The Automatic Reposition TD is displayed.	
17.	<i>Highlight</i> the AC containing the A-Track , and then input the A-Track # in the TRK# field. Select the ENBL check button.	The AC is associated to the selected A-Track for auto repositioning.	
18.	Monitor the Auto Reposition area to ensure it repositions as the A-Track approaches its border.	The AC area auto repositions as the assigned A-Track goes outside it's boundary.	Pass ☐ Fail ☐
A-Track functionality is available while running VSTARS.			Pass ☐ Fail ☐
The following steps verify the History Playback functionality while running VSTARS.			
19.	In <i>Display Options</i> , select history playback .	History Playback window is displayed.	
20.	Select integrate, frame , and begin <i>10 min prior</i> to current system time. Select Start .	History is played back in continuously, forming a "fuzzy caterpillar"	
21.	<i>Pause</i> history and select Sliding Window in addition to <i>integrate</i> . Put window size at 10 and window advance to 10 . Select Start .	History is played back in sliding window and integrate mode..	
22.	<i>Pause</i> history and deselect both integrate and sliding window. Select Start .	History plays back in non-integration mode.	
History Playback functionality is available while running VSTARS.			Pass ☐ Fail ☐
Notes:			
The following steps verify the Order of Battle functionality while running VSTARS.			

Step #	Action	Event	Pass/Fail
23.	Select OB POINT from the PROC OB push-button menu.	A blank Order of Battle Point TD is displayed.	
24.	Select the position of the point and choose the FRND and TROOP radio buttons. Press ENTER .	A friendly troop OB Point is displayed.	Pass ☐ Fail ☐
25.	Access the OB POINT SEL TD from the PROC OB push-button menu.	The Order of Battle Selection TD appears.	
26.	Choose the FRND check button and the ALL categories.	The Order of Battle Point List TD is accessed.	
27.	<i>Highlight</i> the OB point just created and the modify option.	The OB TD for the friendly troop is displayed.	
28.	Change the TROOP selection to TRAIN . Press ENTER .	The troop symbol becomes a train symbol on the GD.	Pass ☐ Fail ☐
29.	Open the OB LINE TD from the PROC OB push-button menu.	A blank Order of Battle line TD is shown.	
30.	Initiate an OB Line using the FLOT option. Press ENTER .	A FLOT is displayed on the GD.	Pass ☐ Fail ☐
31.	Open the OB LINE LIST using the PROC OB push-button menu, and select FLOT for <i>modification</i> .	The OB Line TD for the selected line is opened.	
32.	<i>Delete</i> points 3 to 4 from the FLOT . Press ENTER .	Points 3-4 are deleted.	Pass ☐ Fail ☐
33.	Open the OB AREA TD from the PROC OB push-button menu.	A blank Order of Battle Area TD is shown.	
34.	Initiate an OB Area using the AOR option.	An AOR is displayed on the GD.	Pass ☐ Fail ☐

Step #	Action	Event	Pass/Fail
35.	Open the OB AREA LIST using the PROC OB push-button menu, and select AOR for <i>modification</i> .	The OB Area TD for the selected area is opened.	
36.	<i>Insert</i> a point into the AOR . Press ENTER .	The modification to the AOR is shown on the GD.	Pass ☐ Fail ☐
Order of Battle functionality is available while running VSTARS.			Pass ☐ Fail ☐
Notes:			
The following steps verify the Engagement Point functionality while running VSTARS.			
37.	Select the EP TD from the PROC TRK push-button menu.	A blank Engagement Point TD is displayed.	
38.	Choose the BASE radio button and input the position along an established route. Press ENTER .	A white, base engagement point is displayed on the GD.	Pass ☐ Fail ☐
39.	<i>Close</i> the EP TD .	The EP TD is no longer displayed.	
40.	Select the EP TD from the PROC TRK push-button menu.	A blank Engagement Point TD is displayed.	
41.	Initiate a constrained E-track 15 km in front of the EP.	An E-Track is initiated to associate with the EP.	
42.	Choose the ASSOC radio button. <i>Select</i> the base EP from the GD and input in the BASE EP REF # field. <i>Select</i> a track on the GD and input in the TRK # field. Press ENTER .	A red, associated EP is shown on the GD, and Time of Arrival info is displayed in the TOA data field.	Pass ☐ Fail ☐

Step #	Action	Event	Pass/Fail
Engagement Point functionality is available while running VSTARS.			Pass ☐ Fail ☐
Notes:			
The following steps verify the Radar Screening functionality while running VSTARS.			
43.	Ensure SGI scenario is still running. If not restart it.		
44.	Reinitiate A-Track on data.	Track is repositioned on radar data.	
45.	Access the RDR SCRND from the PROC RSR push-button menu.	The Radar Screening TD is shown on the GD.	
46.	Select the FXD GND PT radio button. Then <i>enter the position of a ground point</i> in the POS field. Select the INACT FLT PLN and <i>insert flight plan number</i> . <i>Window the position</i> for the starting location on the flight plan in POS 1 . Leave POS 2 blank. Press ENTER .	The system colors the flight path on the GD in ½ km segments, magenta for visible, cyan for screened.	Pass ☐ Fail ☐
47.	Select the RTE SEG radio button. Next, input a route # in the RTE REF # field. <i>Window the starting point</i> for the route request in the POS 1 field. Choose the LGTH radio button and enter 40 km. Select the INACT FLT PLN and <i>insert flight plan number</i> . Press ENTER .	The system colors the specified route. If the route segment is visible from 95% of the flight segment, the route segment is magenta, if it is between the upper and lower threshold it is amber. If it is below the lower threshold it is cyan.	Pass ☐ Fail ☐
The following steps verify the User Defined Activity functionality while running VSTARS.			
48.	Access the User Defined Activity (UDA) Indicator TD from PROC RSR push-button menu.	The User Defined Activity Indicator TD is displayed,	

Step #	Action	Event	Pass/Fail
49.	Use the position field to <i>create</i> a default (4 km x 4 km) UDA . <i>Select coordinates</i> that are 5 km from in front of a targets route of travel. Change the threshold number to 5. Press ENTER .	A 4 km x 4 km User Defined Activity Indicator Area is defined 10 km in front of targets. When 5 or more targets enter the UDA, an alert "UDA threshold exceeded" appears and the UDA border thickens.	Pass ☐ Fail ☐
Notes:			
The following steps verify Timeline Impact functionality while running VSTARS.			
50.	Use the PROC RSR push-button menu to access the Timeline Impact (TL IMPACT) TD.	The Timeline Impact TD is displayed.	
51.	Select the FP radio button and input the inactive flight plan number in use. Input the waypoint number , and enter the projected time the AC will be at that waypoint. Input a start time that is 2 minutes later than the waypoint time. Select duration of 60 and select all RSRs for projection. Press ENTER .	A Timeline Impact TD is displayed for the inactive flight path for all RSRs for a period of 60 minutes.	Pass ☐ Fail ☐
The following steps verify the Update Radar Status functionality while running VSTARS.			
52.	Open RSR QUE TD , the Approved List TD , and the Pending RSR List TDs .	The RSR QUE TD, the Approved List TD, and the Pending RSR List TDs are opened.	
53.	Select the Update Radar Status (UPDATE RDR STATUS) push-button on the RDR MGT Push-Button Menu.	The System does an immediate update of the RSR QUE TD, the Approved List TD, and the Pending RSR List TD.	Pass ☐ Fail ☐
The following steps verify the Jammer Sector functionality while running VSTARS.			
54.	From the RDR MGT Push-Button Menu, select the Jammer Sector (JMR SCTR) TD. Input a location for the sector, threshold of 10 , and a azimuth width of 15 . Press ENTER .	Jammer Sector is displayed on the GD as a wedge centered at the indicated location.	Pass ☐ Fail ☐

Step #	Action	Event	Pass/Fail
The following steps verify the Sector and Area Blanking functionality while running VSTARS.			
55.	From the RDR MGT Push-Button Menu, select the Sector Blanking Service Request (SBSR) area. Input a fixed ground point location , an azimuth width of 5 , and a duration of 0 . Press ENTER . (Ensure that SGI scenario is running and that sector is located over targets.)	The Sector Blanking Request is sent to the RSR QUE for approval.	Pass ☐ Fail ☐
56.	<i>Approve</i> the SBSR in the <i>RSR QUE</i> .	A 3° sector is displayed on the GD that inhibits all radar transmissions in this area. Verify that targets in the sector are not displayed.	Pass ☐ Fail ☐
57.	<i>Delete</i> the SBSR .	The blanked sector is deleted and MTI appears again in the area.	
58.	From the RDR MGT Push-Button Menu, select the Area Blanking Service Request (ABSR) area. Input a center position location that is over virtual targets and a duration of 0 . Press ENTER .	The Area blanking Service request is sent to the RSR QUE for approval.	Pass ☐ Fail ☐
59.	<i>Approve</i> the ABSR in the <i>RSR QUE</i> .	A 10x 10 ABSR is displayed on the GD. Target detections in this area are not processed.	Pass ☐ Fail ☐
60.	<i>Delete</i> the ABSR .	The blanked sector is deleted and MTI appears again in the area.	
Notes:			
The following steps verify pull down-menu functionality.			
61.	Access modes and utilize bearing and range and free form functions.	Bearing and range and free form object are displayed on the GD.	Pass ☐ Fail ☐

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Step #	Action	Event	Pass/Fail
62.	Access locate entity and select RSR and input number.	A large arrow on the GD points to selected entity.	Pass ☐ Fail ☐
63.	Select the point option and send a point to the other JADS station.	A large arrow is displayed on both JADS GDs.	Pass ☐ Fail ☐
64.	Select Cur Coord and input a position on the GD and press enter .	The Cur Coord TD is displayed and the position is converted to different coordinate systems in the TD.	Pass ☐ Fail ☐

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V&V PROCEDURE WITNESS CERTIFICATION

DATE

PROCEDURE TITLE: VSTARS Operator Interference Verification

This acknowledges that the V&V procedure, VSTARS Operator Interference Verification was performed as documented.

V&V Conductor (SBMS-M)
Date

Date

V&V Witness (Government)

DOCUMENT NO: C99SR090
APPENDIX E
DATE: 4 June 1998

APPENDIX E

ANIU and GNIU Verification

4.4 ANIU and GNIU Verification -

4.4.1 Test Case #1: Verify that the GNIU receives and processes DIS 2.0.4 Entity State Protocol Data Units (ESPDU) from the ETE Test DIS network at a rate of 100 ESPDUs/second. Demonstrate that the GNIU can process ESPDUs at a rate greater than 350 ESPDU/second. Verify that the VSTARS data packet is than 192 bits.

Step #	Action	Event	Pass/Fail
The following steps verify GNIU processing rate at greater than 350 ESPDUs per second.			
1.	If a scenario is running, select CTRL-C in the <i>SGI window</i> to stop the SGI scenario.	SGI JADS Logger aborted and stopped.	
2.	In <i>DISNIU</i> > Type ZKKJRM K	DISNIU and DIS monitor are brought down.	
3.	In <i>DISNIU</i> > Type KKJR PBK JADS01	Sets up playback for JADS01 and JADS02.	
4.	In <i>DISNIU</i> > Type KKJR SMAX 310	Establishes a 5 minute processing time.	
5.	In <i>DISNIU</i> > Type KKJR PBKT0 360	Offsets the start of the scenario to 360 seconds.	
6.	In <i>DISNIU</i> > Type KKJR PBKX 250	Set a playback ratio of 250 to 1	
7.	In <i>DISNIU</i> > Type KKJR CNFG 766	JADS02 is selected to be the external playback unit and JADS01 the ground and air units,	
8.	In <i>DISNIU</i> > Type KKJR LOG 2	Log mode 2 is selected to record PDUs.	
9.	In <i>DISNIU</i> > Type KKJR PBK R TEST100	Selects a playback run of the file in DISPBK and also establish log and recording file names.	
10.	In <i>DISNIU</i> > At prompt, X=abort/quit/exit, s=skip, else=continue Press Enter	Runs the scenario playback.	

Step #	Action	Event	Pass/Fail
11.	In <i>DISMON</i> > "Up arrow" to appropriate command if previously activated, if not follow procedures in Appendix A.	Allows for monitoring of DIS information.	
12.	After playback is complete, in <i>DISNIU</i> , type KKJF	Fetches DIS buffer files.	
13.	In <i>DISNIU</i> > Type ZKKJRM K	<i>DISNIU</i> and DIS monitor are brought down.	
14.	In <i>DISNIU</i> > Type KKJZ JADS01 4 766 5 0	Sets DIS up for an analysis run.	
15.	In <i>DISNIU</i> > Type KKJR PBKFNM DKB300:[DISPBK]DATE_TEST100_INDY3. LOG	Selects the file for analysis.	
16.	In <i>DISNIU</i> > Type KKJR PBKX 0	Identifies this playback as an analysis.	
17.	In <i>DISNIU</i> > Type ZKKJR	Runs DIS analysis	
18.	Open the analysis file and note average PDUs per second.	Will show number of PDUs per second..	Pass ☐ Fail ☐
Notes:			

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Step #	Action	Event	Pass/Fail
The GNIU receives and processes DIS 2.0.4 ESPDUs from the ETE test DIS network at a rate greater than 350 ESPDUs per second.			Pass ☐ Fail ☐
The following confirms the total bandwidth requirements between GNIU and ANIU			
9.	Multiply the maximum ESPDU rate of 350 ESPDUs/sec times the ESPDU data packet size of 192 bits <u>$350 \times .192 = 67.2 \text{ Kbits per second}$</u>	This equation confirms that the total bandwidth requirements for the link between the ANIU and the GNIU are less than 256 Kbits/sec and that the bandwidth is no less than 19.2 Kbits/sec.	Pass ☐ Fail ☐

4.4.2 Test Case #2: Verify that the ANIU provides the necessary data required by the GNIU, and that the GNIU prepares and transmits an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.

The following steps verify that the GNIU prepares and transmits an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.			
1.	In <i>DISNIU</i> window > Type ZKKJRM K to kill any DIS processes currently running.	DIS processes are terminated.	
2.	In the <i>SGI</i> window > Type cd /usr/local/bin and press ENTER .	Points to the directory containing the JADS logging tool.	
3.	In the <i>SGI</i> window > Type ./jads_logger 3000 0 /disk2/logfiles/date_e8pdu_indy3.log and press ENTER .	Prepares the SGI to record files coming across the DIS network.	
4.	In <i>DISNIU</i> window > Type kkjz jads01 3 766 5 1	The DIS network interface will be set up to run on jads01 in the run mode, and the monitor showing the GNIU data for entity 1.	
5.	In <i>DISNIU</i> window > Type KKJR log 6 .	Logs the E-8C PDU.	
6.	In <i>DISNIU</i> window > Type ZKKJR.	Runs DISNIU	
7.	In <i>DISMON</i> > type @user\$disk:[util]start_disniu_monitor.	B. Spalding login file executes to set up symbols and logicals. Brings up the DISNIU monitor.	
8.	In <i>DISNIU</i> window > Type ZKKJRM P 2	Turns on the E-8C PDU generator so it will run regardless of external PDU input.	
9.	Note time: _____. Keep running for 5 minutes .	E-8C PDU data is logged to the SGI log.	
10.	In the <i>SGI</i> window > Monitor window to verify that the PDU count is increasing.	Verifies that the SGI is logging the E-8C PDU.	
11.	In <i>DISNIU</i> window > Type ZKKJRM K	Kills the scenario that is running.	

12.	On the <i>SGI</i> , logon as root and sign logbook.	Provides access to the JADS Logger Tool.	
13.	In the <i>Desk1 menu</i> located in the upper left corner of the SGI display, click on the JADS Toolbox and slide cursor over to open .	Opens the JADS Toolbox.	
14.	In the <i>Test Program Selection Box</i> , highlight ete and click OK .	Selects ete as the test program.	
15.	In the <i>Select Logger Type</i> window, select jads and OK	Displays Test Program Selected and Logger Typed Selected as ete and jads in the JADS Analysis Toolbox.	
16.	Select the Dump option from the JADS Analysis Toolbox window and click on select entity parameters .	Opens two windows, one describing the selections functions, and the other that allows for file selection.	
17.	In the <i>Select JADS Log File</i> window, go to the Filter Box and clear everything after the / and type in disk2/* after the /	Shows available files for analysis in the disk2 directory.	
18.	From the list of available files select the e8pdu file with today's date and select OK .	The Entity State Data Items window is displayed.	
19.	Highlight the following parameters for analysis: Log time, Entity ID, Lat/Long, Velocity x, y, z (m/s)	An information window is displayed stating "Logfile processing complete"	
20.	In the information window, click on OK .	The window is closed, and the analysis file has been created.	
21.	Go to the /usr/data/results/(date of log) directory to access the E-8 PDU file.	A .jprm file with today's date and the logfile name is displayed.	
22.	Double click on the e-8pdu jprm file to open file.	A log file is opened displaying E-8C PDU information.	
23.	In > Verify the presence of E-8C PDU data in the file.	The presence of ESPDUs verifies that the GNIU prepares and transmits an ESPDU reflecting the entity state of the E-8C based on data received from the ANIU.	Pass ☐ Fail ☐

4.4.3 Test Case #3: Verify that the GNIU performs a coordinate transformation upon entities selected for transmittal to the ANIU and prepares a VSTARS data packet, containing all entity data required by the RPSI, for transmittal to the ANIU. In addition, verify that the ANIU stores entity data received in an ANIU Target Database, and conducts dead reckoning upon moving targets at a minimum rate of 1/second.

The following steps confirm			
1.	In <i>DISNIU</i> > Type KKJR JADS01 3 966 5 0	The DIS network interface will be set up to run on jads01 in the run mode, with the SGI providing external input, and the monitor showing the GNIU data.	
2.	In <i>DISNIU</i> > Type LOGFNM DKB300:[DISLOG]ECEF_TCS	Selects ECEF_TCS as the default logfile.	
3.	In <i>DISNIU</i> > Type KKJR LOG 7	Selects logging of Earth Center Earth Fixed (ECEF) and Topocentric coordinate system for ESPDUs.	
4.	In <i>DISNIU</i> > Type ZKKJR.	Runs DISNIU.	
5.	In <i>DISMON</i> > Type @user\$disk:[util]start_disniu_monitor.	B. Spalding login file executes to set up symbols and logicals. Brings up the DISNIU monitor.	
6.	In <i>DISMON</i> > Look at the field beside log to verify that log-mode is set to 7.	Logger will log both GNIU and ANIU data to show ECEF and TCS data.	
7.	In <i>SGI</i> > at grumman 1# prompt, type cd /usr/local/bin	Brings up JADS Logger.	
8.	In <i>SGI</i> > Type ls	Directory is displayed.	
9.	In <i>SGI</i> > Type ls /disk2/v_v_logfiles depending on file location for specified scenario.	List of directories under either v_v_logfiles are displayed.	
10.	In <i>SGI</i> > Type jads_player* 3000 1 /disk2/ v_v_logfiles /050498_test100_indy3.log	Selected pre-recorded file is played back on the SGI and transmitted to JADS. Opens selected JADS Logger file.	

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11.	Ensure that there are targets displayed on the GD, and that the DISMON is updating. Let the scenario play for 15 minutes .	The file is playing back appropriately.	
12.	In <i>SGI</i> > Press Ctrl-C	Stops the SGI playback of the scenario.	
13.	In <i>DISNIU</i> > Type ZKKJRM K .	Kills DIS	
14.	In <i>DISNIU</i> > Type KKJF	Fetches data from the circular buffer.	
15.	In <i>DECterm</i> > Type set def dkb300:[dislog]	Changes the default directory to the location of the newly recorded log files.	
16.	In <i>DECterm</i> > Type PRINT AXTN_ ECEF_TCS	Prints the external NIU log to the default printer.	
17.	In <i>DECterm</i> > Type PRINT BGND_ ECEF_TCS	Prints the ground NIU log to the default printer.	
18.	In <i>DECterm</i> > Type PRINT CAIR_ ECEF_TCS	Prints the air NIU log to the default printer.	

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V&V PROCEDURE WITNESS CERTIFICATION

DATE

PROCEDURE TITLE: ANIU and GNIU Verification

This acknowledges that the V&V procedure, ANIU and GNIU Verification was performed as documented.

V&V Conductor (SBMS-M)
Date

Date

V&V Witness (Government)

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APPENDIX F

TURING TEST

Turing Test - The Turing Test will be performed by Northrop Grumman and the Joint STARS Joint Test Force with JADS ETE V&V team oversight. The purpose of the Turing Test is to ensure that there are no major distinguishable differences to Joint STARS operators between VSTARS and the actual Joint STARS radar picture. The following areas will be validated:

- Operational behavior characteristics of the virtual targets shall not differ noticeably from the operational characteristics of real targets and have minimal impact upon the radar timeline.
- Validate that ARIES visually matches the fidelity for Joint STARS SAR images, and that ARIES has minimal impact upon the radar timeline.

Step #	Action	Event	Pass/Fail
1.	VSTARS will be started in accordance with Appendix A. JADS JTF coordinator will indicate which mission center to choose.	VSTARS is up and operational; mission center for this mission is selected and distributed.	
2.	Joint STARS JTF will provide Air Force operators and they will take their assigned positions.	Simulation is manned with Air Force operators in both the OCTL and JADS Lab area.	
3.	Air Force operators will be briefed on mission scenario.	Operators ready to start simulated mission.	
4.	JADS JTF will initiate the appropriate scenario.	Mission scenario is started.	
5.	JADS psychologist will interview all operators to verify VSTARS has no major distinguishable differences with Joint STARS on the E-8C.	Via interviews with the Joint STARS operators, JADS psychologist determines that the characteristics of virtual targets and ARIES SARs do not differ noticeably from real targets and SARs; ARIES has minimal impact upon the radar timeline.	Pass Fail

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V&V PROCEDURE WITNESS CERTIFICATION

DATE _____

PROCEDURE TITLE: Turing Test

This acknowledges that the V&V procedure, Turing Test was performed as documented.

V&V Conductor (SBMS-M) Date

V&V Witness (Government) Date

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APPENDIX G
Procedures for performing JADS Shutdown

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5. Procedures for performing JADS Shutdown

Step #	Action	Event	Pass/Fail
1.	In the Session Window under <i>Applications</i> > Select Stop JSTARS On this OWS .	This brings down Joint STARS and DecMessage Que.	
2.	In <i>ARIES</i> > Press Ctrl-C	SAR SIM aborted and stopped	
3.	In <i>SGI</i> > Press Ctrl-C	SGI JADS logger aborted and stopped. Use this option to interrupt SGI during file playback.	
4.	In <i>SGI</i> > Press Ctrl-]	SGI JADS logger exit	
5.	In <i>SGI</i> > At <i>telnet prompt</i> , type exit	Telnet exit	
6.	In <i>DISNIU</i> > Type zkkjrm k	Kills DISMON	
7.	In <i>DISNIU</i> > Type lo	Log off the DISNIU window.	
8.	In <i>DISMON</i> > Type Ctrl-C	Interrupts DISMON.	
9.	In <i>DISMON</i> > Type lo	Log off the DISMON window.	
10.	In <i>NSE</i> > Use the cursor to select " exit " and press return.	NSE/RDI configuration widow displayed.	

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Step #	Action	Event	Pass/Fail
11.	In <i>NSE</i> > Use the cursor to again select "exit" and press return.	Window display reverts to original NSE/RDI version 3.5 window.	
12.	In <i>NSE</i> > type exit	NSE processes shut down.	
13.	In <i>NSE</i> > Type lo	NSE window logs off.	
14.	Log off the OWS.	The Start Session window is displayed.	

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Table 3 Requirements Cross-Reference Paragraphs for VSTARS Phase II V & V

JADS JTF TAP REQUIREMENT	NG ENGINEERING DESIGN REPORT
5.3.1 a	3.2.2. [23]
5.3.1 b	3.2.1.1.1 [6,7]
5.3.1 c	3.2.3 [42]
5.3.1 d	3.1.1 [3]?
5.3.1 e	3.2.2 [23]?
5.3.2 a	3.2.1.3.4 [20]
5.3.2 b	3.2.1.3.3 [17,18]
5.3.2 c	3.2.1.3.4 [19]
5.3.2 d	3.2.1.3.6 [22]
5.3.3 c	3.2.1.3 [12]
5.3.3 d	3.2.1.3.5 [21]
5.3.3 e	3.2.4.3 [46]
5.3.4 b	3.2.2.1.3 [26], 3.2.2.1.4 [27]
5.3.4 c	3.2.2.1.5 [28]
5.3.4 d	3.2.2 [28]?
5.3.4 e	3.2.3 [42]
5.3.4 f	3.2.3 [42]?
5.3.5 b	3.2.4.2 [45]
5.3.5 b	3.2.2.2 [29]
5.3.5 d	3.2. 2 [24]
5.3.6 b	3.2.3 [42]
5.3.6 c	3.2.3 [41]

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5.3.6 d	3.2.3 [42]?
5.3.7 a, b, c	3.2.4.2 [45]
5.3.8 a	3.2.4.3 [46]

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Appendix B
Motorola Test Plan

Software Test Plan for the JADS

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SOFTWARE TEST PLAN

for the

JADS

Ground Data Terminal 1553 Bus Interface Unit

CONTRACT NO. DAAB07-96-C-S201

CDRL SEQUENCE NO. (NONE)

Prepared for:

Joint Advanced Distributed Simulation
Joint Test & Evaluation
1951 2nd Street SE
Kirtland AFB, NM 87117-5617

Prepared by:

MOTOROLA

Space and Systems Technology Group
8201 E. McDowell Road
P.O. Box 1417
Scottsdale, AZ 85252

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1. SCOPE

1.1 Identification.

This software test plan (STP) applies to the computer software configuration item (CSCI) portion of the Ground Data Terminal (GDT) 1553 Bus Interface Unit (1553 BIU). The development of the GDT 1553 BIU is under the direction of the Joint Advanced Development Simulation (JADS) Joint Test and Evaluation (JT&E) End-to-End Test (ETE) organization at Kirtland AFB in New Mexico.

1.2 System overview.

The JADS JT&E organization is charged with developing the capability to test and evaluate the Joint STARS system performance through a hardware-in-the-loop simulation. One element of this simulation is the interface between the Common Ground Station (CGS) and the E-8C aircraft. This interface is normally an RF link. The link is to be simulated by sending link data over a dedicated T1 line. This requires the development of interface software at both ends of the T1 line to make the data look like it had traversed the Surveillance Control Data Link (SCDL) rather than a WAN based digital connection. The specific software under test here is the interface software for the CGS end of the T1 line.

1.3 Document overview.

This STP describes the formal qualification test plans for the GDT 1553 BIU. It identifies the software test environment resources required for formal qualification testing (FQT) and provides schedules for FQT activities. In addition, it identifies the individual tests that shall be performed during FQT.

1.4 Relationship to other plans.

There are no other plans related to this particular activity at the current contract level.

2. REFERENCED DOCUMENTS

Document Number	Document Title	Document Date
JADS-ICD-002	Interface Control Document for the Ground Station Module T-1 LAN Interface of the Radar Processor and Integrator for Joint STARS	January 1997

C99ICDVA331	Interface Control Document (ICD) for Ground Station Module (GSM) Target Acquisition Subsystem to Ground Data Terminal (GDT) Group OZ-64/GRY Containing LRU's Nomenclatured (V)3/G	15 April 1996
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3. SOFTWARE TEST ENVIRONMENT

3.1 Software items.

The software items necessary to perform the FQT activities include:
 Sun Solaris operating system,
 Sun C++ compiler,
 EDT 1553 device driver,
 GDT 1553 BIU application code,
 CGS 1553 test drivers, and
 ADT 802.3 test drivers.

3.2 Hardware and firmware items.

The computer hardware, interfacing equipment, and firmware items that will be used in the software test environment include:

Sun SPARC 5 computer (the application host),
 Sun computer (the 802.3 interface emulator),
 Sun computer (the 1553 interface emulator),
 Joint STARS Common Ground Station (CGS),
 JADS supplied IDNX,
 JADS supplied KIV-7HS, and
 JADS supplied CSU/DSU.

The test environment for CSCI testing will be unclassified. The test environment for system level testing may include classified information. Whether or not the system level test information is classified, the testing will include encryption / decryption equipment as part of the test setup.

3.3 Proprietary nature and government rights.

There are no proprietary rights on the developed software, hardware, or firmware.

3.4 Installation, testing, and control.

The GDT 1553 BIU application code will be installed on the Sun SPARC 5 computer prior to test. The application code and all test software will be maintained under Configuration Management Version Control (CMVC) prior to and during the tests.

4. FORMAL QUALIFICATION TEST IDENTIFICATION

4.1 GDT 1553 BIU CSCI.

4.1.1 General test requirements.

The formal qualification of the GDT 1553 BIU CSCI shall involve the use of nominal input values. Testing with erroneous input values will not be included.

4.1.2 Test classes.

The formal qualification testing of the GDT 1553 BIU CSCI shall include functional tests and timing tests.

4.1.3 Test levels.

The formal qualification testing of the GDT 1553 BIU CSCI shall be performed at two levels:

- a. CSCI level--to evaluate compliance with CSCI requirements. These tests include test definitions 4.1.4.1 through 4.1.4.9.
- b. System level--to validate that the SCDL interface performs properly in the absence of the real GDT. These tests will be similar in nature to the tests performed for CSCI testing, but they will generally be performed with real 1553 and 802.3 interfaces rather than the interface emulators used in the CSCI testing. These tests include test definitions 4.1.4.10 through 4.1.4.14

4.1.4 Test definitions.

4.1.4.1 GDT Initial Status.

- a. Test objective: Verify that the initial GDT status reports indicate that the uplink and downlink are not enabled and that the other status report elements are correct for this condition.
- b. Special requirements: For this test, the 1553 emulator must not send a control message that enables the uplink or downlink.
- c. Test level: CSCI.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: GDT Status Reports.
- g. Assumptions and constraints: None.

4.1.4.2 GDT Initial Status Message Blocking.

- a. Test objective: Verify that uplink and downlink traffic are not passed through the GDT 1553 BIU.
- b. Special requirements: For this test, the 1553 emulator must not send a control message that enables the uplink or downlink.
- c. Test level: CSCI.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Presence or absence of uplink messages at the 802.3 interface or downlink messages at the 1553 interface.
- g. Assumptions and constraints: The 1553 interface emulator is sending uplink messages

and the 802.3 emulator is sending downlink messages.

4.1.4.3 GDT Initial Status Transition.

- a. Test objective: Verify that the GDT status reports indicate that the uplink and downlink are enabled after receipt of the uplink and downlink enabling control messages from the 1553 emulator.
- b. Special requirements: For this test, the 1553 emulator must first enable the downlink and then enable the uplink.
- c. Test level: CSCI.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: GDT Status Reports.
- g. Assumptions and constraints: The GDT 1553 BIU must start this test in the Initial Status Mode of paragraph 4.1.4.1.

4.1.4.4 GDT Uplink Messages.

- a. Test objective: Verify that uplink traffic is correctly passed through the GDT 1553 BIU.
- b. Special requirements: For this test, the 1553 emulator must have already enabled the uplink and downlink.
- c. Test level: CSCI.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Uplink messages at the 802.3 interface.
- g. Assumptions and constraints: The 1553 emulator is providing periodic uplink messages.

4.1.4.5 GDT Uplink Message Latency.

- a. Test objective: Verify that uplink traffic is correctly passed through the GDT 1553 BIU with a latency of less than 100 milliseconds.
- b. Special requirements: For this test, the 1553 emulator must have already enabled the uplink and downlink.
- c. Test level: CSCI.
- d. Test type or class: Timing.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Time of Uplink message appearance at the 1553 and 802.3 interfaces.
- g. Assumptions and constraints: The 1553 emulator is providing periodic uplink messages.

4.1.4.6 GDT Downlink Messages.

- a. Test objective: Verify that downlink traffic is correctly passed through the GDT 1553 BIU.
- b. Special requirements: For this test, the 1553 emulator must have already enabled the uplink and downlink.

- c. Test level: CSCI.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Downlink messages at the 1553 interface.
- g. Assumptions and constraints: The 802.3 emulator is providing periodic downlink messages.

4.1.4.7 GDT Downlink Message Latency.

- a. Test objective: Verify that downlink traffic is correctly passed through the GDT 1553 BIU with a latency of less than 100 milliseconds.
- b. Special requirements: For this test, the 1553 emulator must have already enabled the uplink and downlink.
- c. Test level: CSCI.
- d. Test type or class: Timing.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Downlink messages at the 1553 interface.
- g. Assumptions and constraints: The 802.3 emulator is providing periodic downlink messages.

4.1.4.8 GDT Aircraft Location Messages.

- a. Test objective: Verify that the Aircraft Location Message is correctly converted and passed through the GDT 1553 BIU in the GDT Status Report.
- b. Special requirements: For this test, the 1553 emulator must have already enabled the uplink and downlink.
- c. Test level: CSCI.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: GDT Status Reports at the 1553 interface.
- g. Assumptions and constraints: The 802.3 emulator is providing periodic aircraft location messages.

4.1.4.9 GDT Traffic Capacity.

- a. Test objective: Verify that GDT 1553 BIU traffic capacity is sufficient to pass 28 Downlink messages and one Uplink message, to process one Aircraft Location message, to provide one GDT Status message and two Transmit Vector Words messages during a 100 millisecond time interval.
- b. Special requirements: For this test, the 1553 emulator must have already enabled the uplink and downlink.
- c. Test level: CSCI.
- d. Test type or class: Timing.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Time of Uplink message appearance at the 1553 and 802.3 interfaces; time of Downlink message appearance at the 802.3 and 1553 interfaces; time of Aircraft Location messages appearance at the 802.3 interface; and time of GDT Status and TVW messages appearance at the 1553 interfaces.

- g. Assumptions and constraints: All required messages are provided to the GDT 1553 BIU CSCI at the proper rates.

4.1.4.10 GDT Initial Status.

- a. Test objective: Verify that the initial GDT status reports indicate that the uplink and downlink are not enabled and that the other status report elements are correct for this condition.
- b. Special requirements: For this test, the CGS must not send a control message that enables the uplink or downlink.
- c. Test level: System.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: GDT Status Reports.
- g. Assumptions and constraints: None.

4.1.4.11 GDT Initial Status Transition.

- a. Test objective: Verify that the GDT status reports indicate that the uplink and downlink are enabled after receipt of the uplink and downlink enabling control messages from the 1553 emulator.
- b. Special requirements: For this test, the CGS must first enable the downlink and then enable the uplink.
- c. Test level: System.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: GDT Status Reports.
- g. Assumptions and constraints: The GDT 1553 BIU must start this test in the Initial Status Mode of paragraph 4.1.4.7.

4.1.4.12 GDT Uplink Messages.

- a. Test objective: Verify that uplink traffic is correctly passed through the GDT 1553 BIU.
- b. Special requirements: For this test, the CGS must have already enabled the uplink and downlink.
- c. Test level: System.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Uplink messages at the E-8C interface at Northrop / Grumman.
- g. Assumptions and constraints: The CGS is providing periodic uplink messages.

4.1.4.13 GDT Downlink Messages.

- a. Test objective: Verify that downlink traffic is correctly passed through the GDT 1553 BIU.
- b. Special requirements: For this test, the CGS must have already enabled the uplink and downlink.

- c. Test level: System.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: Downlink messages at the CGS.
- g. Assumptions and constraints: The E-8C is providing periodic downlink messages.

4.1.4.14 GDT Aircraft Location Messages.

- a. Test objective: Verify that the Aircraft Location Message is correctly converted and passed through the GDT 1553 BIU in the GDT Status Report.
- b. Special requirements: For this test, the CGS must have already enabled the uplink and downlink.
- c. Test level: System.
- d. Test type or class: Functional.
- e. Qualification method: Demonstration.
- f. Type of data to be recorded: GDT Status Reports.
- g. Assumptions and constraints: The E-8C is providing periodic aircraft location messages.

4.1.5 Test schedule.

The testing of the GDT 1553 BIU CSCI shall be accomplished as soon as practical after this STP receives JADS ETE approval and dry-run testing verifies that the software passes the tests in paragraphs 4.1.4.1 through 4.1.4.9 of this STP. The system level testing of the GDT 1553 BIU CSCI shall be accomplished as soon as practical after completion of the CSCI level testing. The system level tests are defined in paragraphs 4.1.4.10 through 4.1.4.14.

5. DATA RECORDING, REDUCTION, AND ANALYSIS

The data reduction and analysis required during and following the tests identified in this STP will be comparison of GDT Status Reports, Uplink Messages, and Downlink Messages with their respective expected values and evaluation of appropriate timing entries for message transmit and receipt. No data retention will be required other than logbook entries and printouts generated during the tests.

6. NOTES

None.

JADS BIU Qualification Test Procedure

Three test configurations are identified herein to support the test levels and definitions described by the previously submitted Software Test Plan. This procedure describes each test configuration, tests conducted for that configuration, and a brief procedure for each test. All test definitions from the Software Test Plan are included within this procedure; however, they will be executed in accordance with the test configuration order presented below.

Test Configuration I

Software Emulation of CGS running on JADS BIU workstation

JADS BIU Software running on JADS BIU workstation

Software emulation of T1 Link running on "Kong" workstation

Triax termination on Primary 1553 connector which links the CGS emulation software to the JADS BIU software via 1553 bus.

Ethernet Link between JADS BIU and "Kong" network

When each of the three software components have been initiated, the CGS Emulator will send control messages and uplink messages (rate = 0.1 Hz) to the BIU over the 1553 bus, automatically triggering the GDT status transitions. The T1 link emulator software, upon receiving the first uplink message from the BIU over the Ethernet link, will respond by sending downlink messages (rate = 80 Hz) and aircraft location messages (rate = 1 Hz). When the JADS BIU software transitions to the downlink enabled mode, it will pass the messages through the 1553 bus where they will be detected by the CGS Emulator software. Results of the tests will be verified by examination of log files generated as the above scenario is executed.

Test Configuration I Coverage

a) GDT Initial Status (STP Paragraph 4.1.4.1)

Verify Control Word portion of initial GDT Status Report from CGS Emulator Log File

b) GDT Initial Status Message Blocking (STP Paragraph 4.1.4.2)

Examine JADS BIU Log File to verify that Uplink messages are counted only when Uplink is enabled, and that Downlink messages are counted only when downlink is enabled.

c) GDT Initial Status Transition (STP Paragraph 4.1.4.3)

Examine JADS BIU Log File to verify that Uplink Enabled and Downlink enabled mode transitions take place.

d) GDT Uplink Messages (STP Paragraph 4.1.4.4)

Examine T1 Emulator Log File to verify the indication of test uplink messages passed through the JADS BIU and transmitted via Ethernet to the "Kong" workstation.

e) GDT Uplink Message Latency (STP Paragraph 4.1.4.5)

Examine JADS BIU Log File to record maximum and average Uplink latency values in milliseconds.

f) GDT Downlink Messages (STP Paragraph 4.1.4.6)

Examine JADS BIU Log File to record maximum and average Uplink latency values in milliseconds.

g) GDT Aircraft Location Messages (STP Paragraph 4.1.4.7)

Examine CGS Emulator Log Files to verify the indication of Aircraft Location data updating the appropriate fields of the GDT Status message.

Test Configuration II

CGS Server 1553 connection to provide downlink data request

JADS BIU Software running on JADS BIU workstation

Software emulation of T1 Link running on "Kong" workstation

Cable connection between Primary 1553 connector which links the CGS server to the JADS BIU software via 1553 bus.

Ethernet Link between JADS BIU and "Kong" network

Requests for downlink data are generated periodically (20 Hz) by the CGS Server. The T1 link software emulation generates aircraft location & downlink messages at a rate which is comparable to that supported by the actual T1 link maximum. Uplink messages will be generated from the CGS workstation console, and when the first message is passed through the JADS BIU to the T1 emulation software, downlink and aircraft location message transmission will begin. Results of the

tests will be verified by log files generated on the JADS BIU workstation.

Test Configuration II Coverage

a) GDT Downlink Latency (STP Paragraph 4.1.4.7)

Examine JADS BIU Log File to record maximum and average Downlink latency values in milliseconds.

b) GDT Traffic Capacity (STP Paragraph 4.1.4.9)

Examine JADS BIU Log File to record maximum throughput rate in messages per second.

Test Configuration III

CGS Server 1553 connection to JADS BIU workstation

E8 Aircraft Simulator Connection to JADS BIU workstation (T1/ IDNX)

The workstation will require re-configuration and re-boot to incorporate new IP address and port data , which are necessary to support its operational configuration.

Test Configuration III Coverage

a) GDT Initial Status (STP Paragraph 4.1.4.10)

Capture GDT Status report at CGS Console using Bus Monitor Log facility.

b) GDT Initial Status Transition (STP Paragraph 4.1.4.11)

Use CGS Manage Links controls and periodic status displays on JADS BIU console to verify the status transitions.

c) GDT Aircraft Location Messages (STP Paragraph 4.1.4.14)

Use CGS Workstation Imagery window to display the simulated E - 8C flight path.

d) GDT Uplink Messages (STP Paragraph 4.1.4.12)

Generate RSR & Freetext messages using CGS Workstation and confirm receipt at Grumman facility.

e) GDT Downlink Messages (STP Paragraph 4.1.4.12)

Use CGS Message Alert facility to display Freetext message originated from the simulated E - 8C
; use imagery window to display MTI & SAR imagery patterns.

Appendix C - V&V Techniques

The following is a description of verification and validation (V&V) techniques that will be used during the conduct of the End-to-End Test V&V. This listing is not all inclusive and where a technique is used that is not included herein, a description of that technique will be described within the V&V task plan and/or the V&V task report. These techniques are taken from the DoD Verification, Validation and Accreditation (VV&A) Recommended Practices Guide, November 1996, Office of the Director of Defense Research and Engineering Defense Modeling and Simulation Office.

Inspections

A team with four to six members inspects any modeling and simulation (M&S) development phase such as M&S requirements definition, conceptual model design, or M&S detailed design. To inspect M&S design, for example, the team might consist of a moderator who manages the inspection team and provides leadership; a reader who narrates the M&S design and leads the team through the inspection process; a recorder who produces a written report of detected faults; a designer who represents the design developer; an implementer who translates the M&S design into an executable form; and a VV&A agent.

An inspection goes through five distinct phases: overview, preparation, inspection, rework, and follow-up (Schach, 1996). In Phase 1, the designer summarizes the M&S design to be inspected. Characteristics such as problem definition, application requirements, and the specifics of software design are introduced and related documentation is distributed to all participants to study. In Phase 2, the team members prepare individually for the inspection by examining the documents in detail. The success of the inspection rests heavily on the conscientiousness of the team members in their preparation. The moderator arranges the inspection meeting with an established agenda and chairs it in Phase 3. The reader narrates the M&S design documentation and leads the team through the inspection process. The inspection team is aided during the fault-finding process by a checklist of queries. The objective is to find and document the faults, not to correct them. The recorder prepares a report of detected faults immediately after the meeting. In Phase 4, the designer resolves all faults and problems identified in the report. In the final phase, the moderator ensures that all faults and problems have been resolved satisfactorily. All changes must be examined carefully to ensure that no new errors have been introduced as a result of a fix.

Turing Test

Turing test is based upon the expert knowledge of people about the system of interest. The experts are presented with two sets of output data, one obtained from the model and one from the system, under the same input conditions. Without identifying the data set, the experts are asked to differentiate between the two. If they succeed, they are asked to describe the differences. Their responses provide valuable feedback for correcting model representation. If they cannot differentiate between the two, confidence in the model's validity is increased (Schruben, 1980; Turing, 1963; Van Horn, 1971).

Cause-Effect Graphing

Cause-effect graphing addresses the question of what causes what in the model representation. It first identifies causes and effects in the system being modeled and then examines their representation in the model specification. For example, in a simulation of a traffic intersection the following causes and effects may be identified: (a) the change of a light to red immediately causes the vehicles in the traffic lane to stop (except in Albuquerque, New Mexico), (b) an increase in the duration of a green light causes a decrease in the average waiting time of vehicles in the traffic lane, and an increase in the arrival rate of vehicles causes an increase in the average number of vehicles at the intersection.

As many causes and effects as possible are listed, and the semantics are expressed in a cause-effect graph. The graph is annotated to describe special conditions or impossible situations. Once the cause-effect graph has been constructed, a decision table is created by tracing back through the graph to determine combinations of causes that result in each effect. The decision table is then converted into test cases with which the model is tested (Myers, 1979; Pressman, 1996; Whitner and Balci, 1989).

Acceptance Testing

Acceptance testing is conducted by either the M&S application sponsor and the sponsor's VV&A agents or the developer's quality control group in the presence of the sponsor's representatives. The model is operationally tested with the actual hardware and data to determine whether all requirements specified in the legal contract are satisfied (Perry, 1995; Schach, 1996).

Execution Monitoring

Execution monitoring reveals errors by examining low-level information about activities and events that take place during model execution. It requires the instrumentation of a model or simulation to gather data to provide activity- or event-oriented information about the model's dynamic behavior. For example, a model of air travel can be instrumented to monitor the arrivals and departures of aircraft within a particular city, and the results can be compared with the official airline guide to judge model validity. The model also can be instrumented to provide other low-level information such as the number of late arrivals, the average passenger waiting time at the airport, and the average flight time between two locations.

Functional Testing

Functional testing (also called *black-box* testing) assesses the accuracy of model input-output transformation. It is applied by feeding inputs (test data) to the model and evaluating the accuracy of the corresponding outputs.

It is virtually impossible to test all input-output transformation paths for a reasonably large and complex simulation because the number of these paths could be in the millions. Therefore, the

objective of functional testing is to increase confidence in model input-output transformation accuracy as much as possible rather than to claim absolute correctness.

The generation of test data is a crucially important but very difficult task. The law of large numbers does not apply here. Successfully testing the model under 1,000 input values (test data) does not imply high confidence in model input-output transformation accuracy just because of the large number. Instead the number 1,000 should be compared with the number of allowable input values to determine the percentage of the model input domain that is covered in testing. The more the model input domain is covered in testing, the more confidence is gained in the accuracy of the model input-output transformation (Howden, 1980; Myers, 1979).

Data Verification

Data verification assesses the adequacy, sufficiency, and usability of the input data and databases. Data verification will evaluate the ability of shared data (e.g., terrain, force structure, environmental data) to address the operational requirements and produce an appropriate synthetic environment; compare M&S component and exercise data applications to ensure a high degree of consistency in the data exchanged; assess key data elements for appropriate use and consistent valuation; ensure data transfers and manipulations do not violate exercise security policies; and review the suitability of special data requirements resulting from the testing and data collection.

Appendix D - References

Air Force Instruction (AFI) 16-1001 *Verification, Validation, and Accreditation Policies and Procedures*.

Army Regulation (AR) 5-11 *The Army Model and Simulation Management Program*

Department of the Army Pamphlet (DA PAM) 5-11 *Verification, Validation, and Accreditation of Army Models and Simulation*.

Department of Defense Directive (DoDD) 5000.59: *DOD Modeling and Simulation (M&S) Management*.

Department of Defense Directive (DoDD) 5000.61: *DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A)*

DoDD 5010.19 DoD Configuration Management Program.

Navy Interim Policy Guidance (IPG) - *Verification, Validation, and Accreditation (VVA) Policies, Procedures, and Guidelines.*

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