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ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT

SYSTEM/SEGMENT SPECIFICATION VOLUME I of V SIMULATION SYSTEM MODULE

Loral Systems Company
12151-A Research Parkway
Orlando, FL 32826-3283

31 March 1994

Contract No. N61339-91-D-0001
ARWA - Delivery Order No. 0048
CDRL A00E

Prepared for:

Simulation Training and Instrumentation Command
Naval Air Warfare Center
Training Systems Division
12350 Research Parkway
Orlando, FL 32826-3224

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The ADST ARWA System/Segment Specification establishes the functional requirements for the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS). Volume I describes the requirements for the Simulator System Module (SSM). The SSM component provides aircraft simulation for flight dynamics, flight controls, propulsion, navigation/communication, sensors, aircraft survivability equipment, weapons, and associated simulator support systems including physical cues, environment, and simulator control.

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1. SCOPE

1.1 Identification. This specification establishes the functional requirements for the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS).

1.2 Purpose. This document is one volume of a five volume specification that defines the requirements for the ARWA Simulator Subsystem. This volume specifically defines the requirements for the Simulator System Module (SSM).

1.3 Introduction. The ARWA SS provides the capability to engage in simulated war fighting exercises within the Distributed Interactive Simulation (DIS) environment for the purpose of rapidly exploring tactics, doctrine and combat system development issues. The ARWA SS consists of a number of subsystems including an ARWA Simulator subsystem, a Session Manager subsystem, a Mission Planning subsystem, an After Action Review subsystem, a Semi-automated Forces subsystem, an Operational and Logistics and Support subsystem, and a Development Subsystem. These subsystems communicate via a DIS based Local Area Network (LAN). The basic architecture for the ARWA SS is shown in Figure 1.3-1.

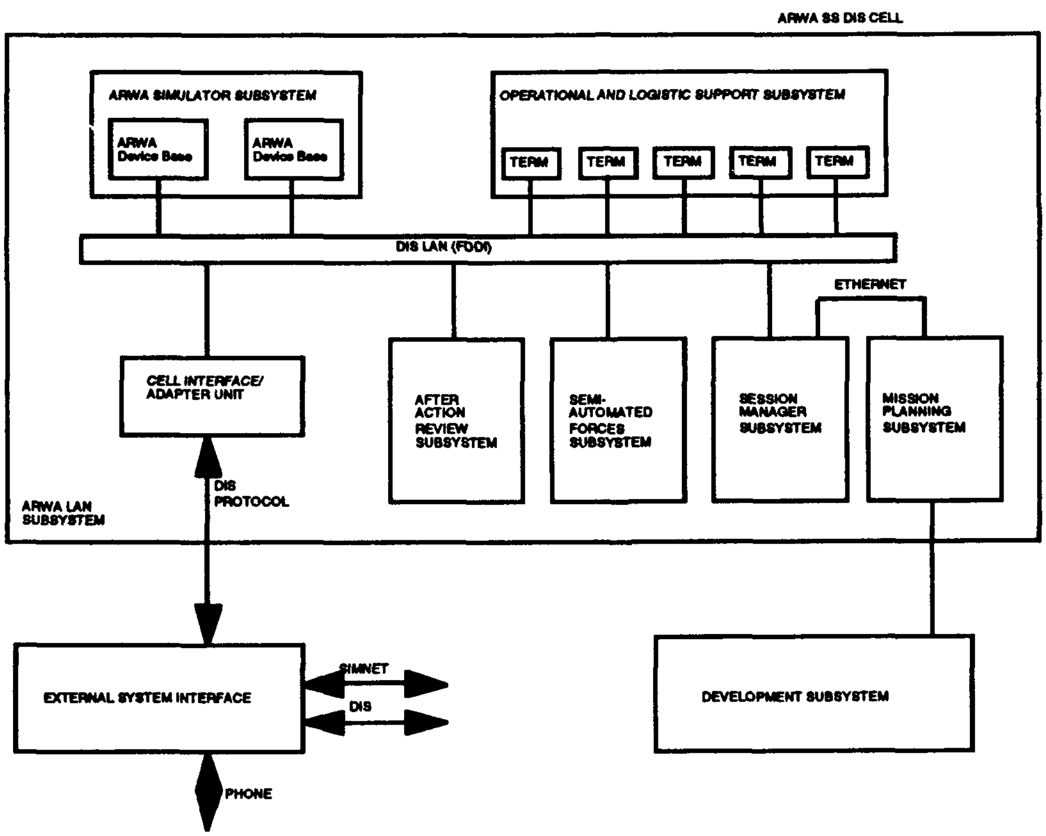

Figure 1.3-1 ARWA Simulator System Architecture

The ARWA Simulator Subsystem consists of a number of manned simulation devices which are capable of being reconfigured between AH-64D and RAH-66 rotary wing aircraft. The simulation devices are real-time, software intensive, network interoperable simulators capable of supporting both hardware and software reconfiguration to the aircraft models. The ARWA simulator devices simulate the aircraft functions needed to move, shoot, communicate, rearm, and resupply, to the level of fidelity defined in this specification. The software simulation is data driven to provide easy access to critical parameters for modification purposes in an experimentation environment. The basic architecture of the ARWA Simulator subsystem is shown in Figure 1.3-2. This architecture is based on the Modular Simulator System (MSS) design.

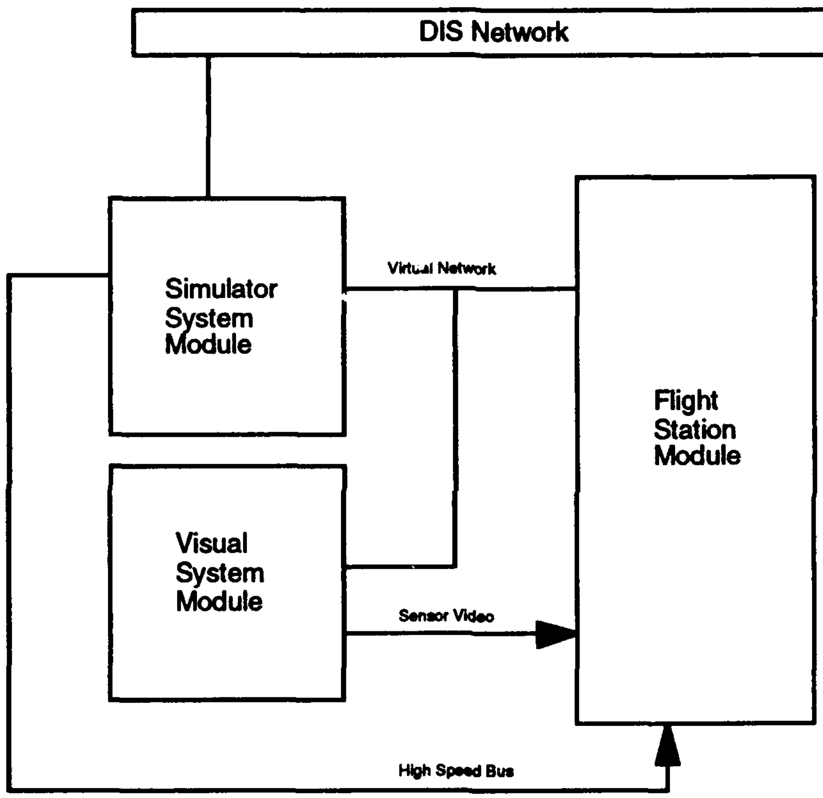

Figure 1.3-2 ARWA Simulator Subsystem Architecture

The SSM, shown in Figure 1.3-3, is one of three major components in an ARWA simulator device. The SSM component provides the aircraft simulations for flight dynamics, flight controls, propulsion, navigation/communication, sensors, aircraft survivability equipment (ASE), weapons, and associated simulator support systems including physical cues, environment, and simulator control.

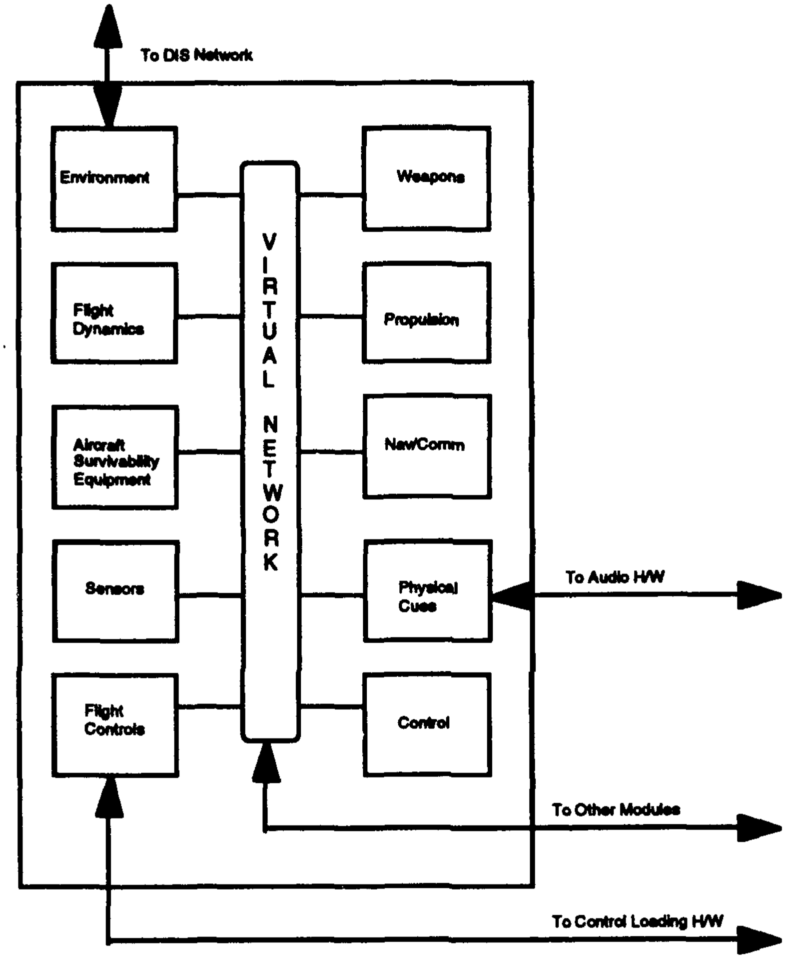

Figure 1.3-3 ARWA Simulator System Module Architecture

2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

PMT-90-W008	Statement of Work, Rotary Wing Aircraft (RWA) Experimental AIRNET Simulators
ATZQ-TDS-SM	Memorandum for PM TRADE, 5 June 1991, Captain Major
MIL-STD-1815A 1983	Ada Programming Language
MIL-STD-1777	Internet Protocol Specification
MIL-T-23991	Training Devices, Military; General Specification for
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-882	System Safety Program
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
FED-STD-595	Colors
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-STD-483	Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

ANSI X3.148-1988	FDDI-Physical Layer Protocol
ANSI X3.166-1989	FDDI-Physical Layer Medium Dependent
ANSI X3.139-1987	FDDI-Token Ring Media ._. Control
ANSI X3T9.5/84-49	FDDI-Station Management Rev 5.0 draft
D567-30991	ADST Rotary Wing Aircraft, Step 1 Final Report
IEEE 802.2	IEEE Logical Link Control Specification
IST-CR-93-15	Proposed IEEE Standard Draft, Standard for Information Technology - Protocols for Distributed Interactive

	Simulation Applications, Version 2.0, Third Draft, May28,1993
PEI 89-103 Rev 3.4	Xpress Transfer Protocol for draft copy - XTP Protocol Definition Protocol Engines, Inc. Santa Barbara, CA
S495-10400	System/Segment Specification for the Generic Modular Simulator System
7S4-1985	IEEE Floating Point Specification
	Statement of Work, Advanced Rotary Wing Aircraft (ARWA) Simulator System

3. REQUIREMENTS

3.1 System Definition. This specification defines the requirements for the development and test of the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS). This System is intended to provide the capability to engage in simulated war fighting exercises on the Battlefield Distributed Simulation-Development (BDS-D) network for the purposes of rapidly exploring current and emerging tactics, doctrine, and combat development issues. The ARWA SS shall consist of two simulator stations (ARWA devices), with each station capable of being reconfigured between an AH-64D and an RAH-66, a Simulation Manager station, a Management Command and Control station, a Data Base Maintenance station and a Software Maintenance station. Each simulator station shall allow critical experimental parameters, listed in Appendix B, to be changed without reprogramming.

3.1.1 Missions. Each of the ARWA devices shall be capable of performing the tasks identified in the following paragraphs as applicable to each configuration.

3.1.1.1 Flight Operations. Flight operations, tasks and procedures shall be simulated and performable in the ARWA devices to the level of fidelity defined herein.

3.1.1.1.1 Ground Operations. Ground operations shall include tactical resupply and rearming. Ground operations do not include engine start, engine run-up, engine and aircraft shutdown. Manual mission loading by keyboard entry or electronic media loading shall be supported. High fidelity taxi capabilities are not required.

3.1.1.1.2 Takeoff and Landing. Simulation of the transition from the ground environment to flight and from flight to the ground environment, including aerodynamic ground effects shall be provided.

3.1.1.1.3 Specific Flight Operations. The ARWA devices shall provide the capability to simulate low level, contour, map of the earth, masking and unmasking, and hovering flight to the level of fidelity defined in the System functional requirements portion of this specification, paragraph 3.1.4.

3.1.1.2 Mission Specific Operations. The ARWA devices shall simulate the aircraft functions needed to move, shoot, communicate, rearm, and resupply, to the level of fidelity defined herein.

3.1.1.3 Simulator Control Requirements. The Instructor/Operator Station (IOS) segment shall control the system modes ad states as described in paragraph 3.1.3, shall monitor simulation parameters as defined in Appendix B, and shall control timing and synchronization as defined in paragraph 3.1.4.1.9.

3.1.1.4 Network Data Logger Interface. The ARWA SS shall provide, as defined in Appendix C, the capability for interface into the Data Logger function of the Battlefield Distributed Simulation-Development (BDS-D) network.

3.1.2 Threat. This paragraph is required by MIL-STD-490 and does not apply to non-weapon systems.

3.1.3 System Modes and States. The SSM and each logical segment in the SSM shall operate within the set of system level modes and states defined in the following paragraphs. The SSM and each segment within the SSM shall be capable of transitioning among the modes as defined in the described in the mode transition diagram (Figure 3.1.3-1). The system mode and state interface definition shall be as defined in the ARWA simulation device Interface Design Documents. The command to transition between modes shall originate in the Session Manager Subsystem. The command shall be passed for implementation to the Control segment (via the Environment segment DIS interface) located within the Simulator System module, for implementation within the affected ARWA Device.

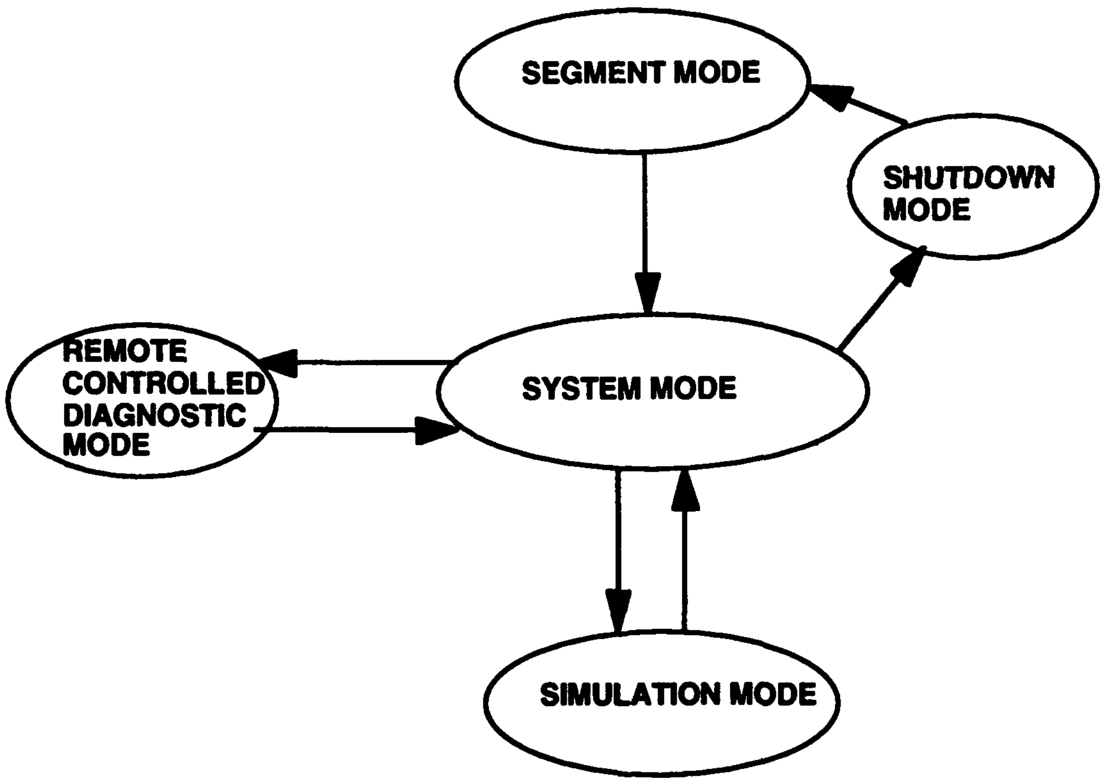

Figure 3.1.3-1 ARWA Simulator Subsystem Mode Transition Diagram

3.1.3.1 Segment Mode. Each SSM segment shall initialize, from a power off state, in the segment mode. When a segment is operating in the segment mode, it shall not cause a break or discontinuity in the virtual network (VNET). During segment mode operations, the segment shall be in an undefined state with respect to the system (i.e. it shall operate as a stand-alone entity). It shall not communicate with the VNET until the segment has transitioned to system mode via an internal segment request. The system mode transition request shall occur after the segment shall perform tasks which are internal to the local segment hardware or software diagnostics or preparation for system mode operations. Prior to transition to system mode, a segment shall perform the following tasks automatically:

a. Start-up. During the start-up sequence, segment power shall be applied. Power shall be applied to all computational system hardware components (e.g. flight deck, back-door interfaces, linkage, etc.), and peripherals, required for system mode operation.

b. Load System Software. Following completion of the start-up sequence, the software required for system level operations, shall be loaded into the segment's computational system.

c. Checkout. Following segment initialization and software loading, the segment shall perform a series of checks to ensure its integrity to support system mode operations. These checks shall be performed prior to system mode transition. A segment shall not transition to system mode with known hardware or software faults which could impair system operation.

3.1.3.2 System Mode. In the system mode, each segment shall have transitioned from segment mode and is considered to be in a ready state with respect to the system. During system mode operations, each segment shall be fully connected to the VNET. The segment shall be in a wait state and shall only perform mode transitions. Each segment shall collect data from the VNET, and respond to mode transition commands from the Control segment. The System Modes shall consist of:

a. Simulation
b. Remote Controlled Diagnostic
c. Shutdown

3.1.3.3 Simulation Mode. This mode shall cause the SSM to execute real time simulation software in support of real time simulation activities. All segments shall be in system mode prior to entering training mode. The state transition diagram for the simulation mode states shall be as shown in Figure 3.1.3.3-1. The command to transition between states shall originate in the Session Manager Subsystem. The command shall be passed for implementation to the Control segment (via the Environment segment DIS interface) located within the Simulator System Module, for implementation within the affected ARWA device. The Simulation mode shall consist of the following four states:

a. Initialization
b. Alignment
c. Total Freeze
d. Run

Each state shall be as described in the following paragraphs.

3.1.3.3.1 Initialization State. This state shall cause the real time simulation software to initialize with a predefined set of data. Default initial conditions shall be stored local to the segment. Additional initialization data or changes to the default initialization data shall be sent to each segment via the VNET if required for a simulation exercise. Changes to initialization data shall be limited to the adaptability parameters identified in Appendix B. Each segment shall transition from this state to the alignment state once initialization has completed and a request has been received from the Control segment.

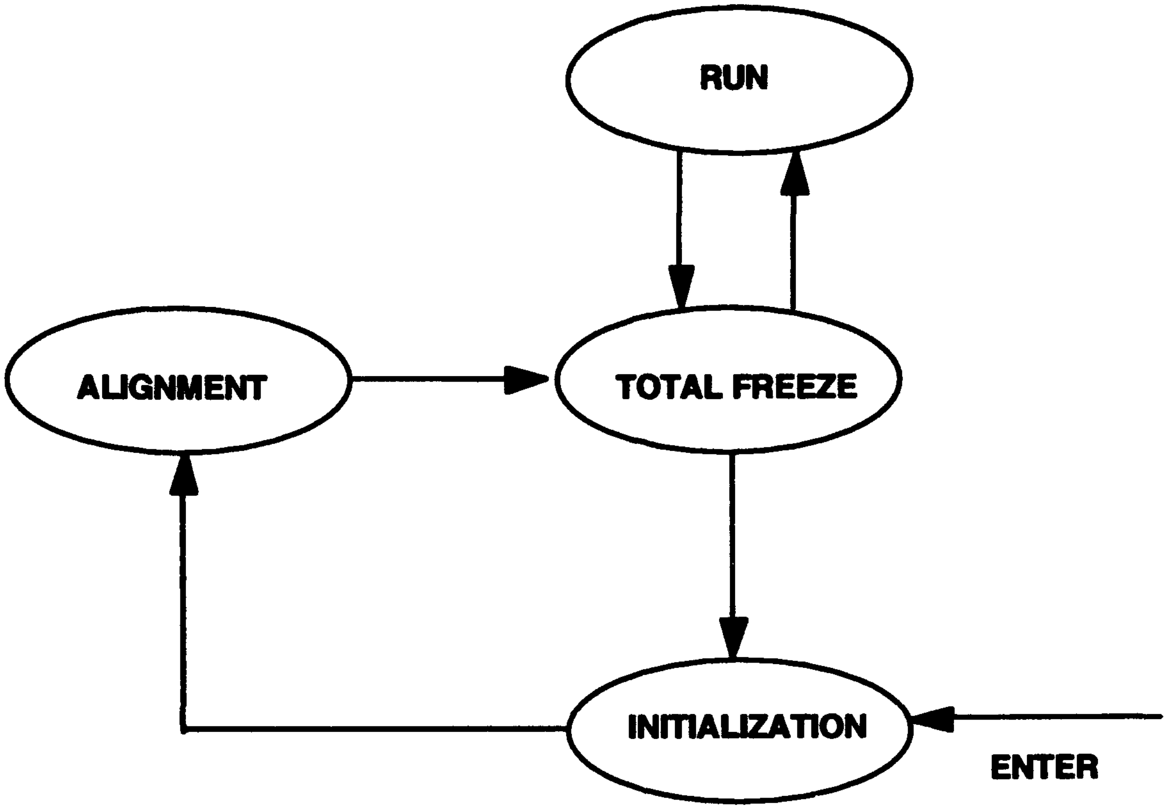

Figure 3.1.3.3-1 ARWA Simulator Subsystem State Transition Diagram

3.1.3.3.2 Alignment State. This state shall cause the SSM segments to enter a steady state condition utilizing the initial conditions data. All instruments and onboard computer systems shall be set/reset to known conditions/states. Each segment shall indicate to the Control segment when its alignment is complete. When all segments have indicated alignment complete, the Control segment shall issue a state transition into the Total Freeze State. Each module shall respond to the Total Freeze State transition command.

3.1.3.3.3 Total Freeze State. This state shall cause all system simulations to cease execution. Each module shall "freeze" the simulation by discontinuing updates of simulation variables. In the Total Freeze State, all segments shall maintain communication with the VNET. Transition to initialization, alignment, or run state shall be permitted upon receipt of a command from the Control segment.

3.1.3.3.4 Run State. This state shall cause all segments to execute real time simulation software. The system shall be capable of transitioning from this state to the Total Freeze state.

3.1.3.4 Remote Controlled Diagnostic Mode. Each module shall provide a self-test function invokable from outside the module. Each module shall provide two self-test features; an "echo-back" feature and a equipment test feature. For the echo back feature, the module shall be able to receive any ARWA global bus message expected for the particular module, and echo its contents back to the ARWA global bus. For the equipment test feature, each module shall poll every piece of equipment located within the module and report back a pass/fail status to the ARWA global bus.

3.1.3.5 Shut Down Mode. The Control segment shall command each segment to transition from system mode to shutdown mode. Each segment shall accomplish an orderly shutdown of all system level processes. Shutdown shall not require power down, unless the VNET can be maintained with segment power removed. Each segment shall send a final shutdown active mode selection reply to the Control segment immediately prior to discontinuing communication with the VNET. Upon completion of shutdown mode activities, the segment shall automatically transition to the segment mode.

3.1.4 System Functions. The ARWA SS shall adhere to the following system level requirements:

a. Interoperability with other simulators in the network shall be defined by the Distributed Interactive Simulation (DIS) protocols, Version 2.0, Third Draft.

b. Simulation of aircraft malfunctions shall be based solely as a direct consequence of simulated battle damage. There shall be no discretely selectable stochastic or operator insertable malfunctions. The approach to simulated battle damage/malfunctions shall be as defined in Appendix A of this specification.

c. The SSM shall provide the simulation adaptability parameters listed in Appendix B to be changed without reprogramming. Pre-mission access to these parameters shall be provided to allow rapid modification to support simulator experiments. Parameter modification shall not require recompilation of source software to implement changes.

d. Simulation capabilities to move, shoot, communicate, rearm, and be resupplied in a simulated war fighting environment shall be provided. Simulation for aspects involving mission pre-flight, start-up, run-up, shutdown, and post-flight procedures is not required.

e. Simulated ground operations shall include tactical resupply and rearming. Ground operations do not include engine start, engine run-up, engine and aircraft shutdown. Taxi capabilities are not required.

f. Simulation of the transition from the ground environment to flight and from flight to the ground environment, including aerodynamic ground effects shall be provided.

g. The ARWA devices shall provide the capability to simulate low level, contour, nap of the earth, masking and unmasking, and hovering flight to the level of fidelity defined in the AH-64D and RAH-66 Kit System/Segment Specifications.

h. Simulation to support equipment pre-flight, post-flight, checkout, and adjustment/calibration procedures is not required.

i. Simulation of equipment operational characteristics such as power/circuit breaker status, warm-up times, overheat/reset conditions, built-in-test, delays, and failures induced by incorrect crew member procedures is not required. Equipment power-on status shall be defined during pre-mission initialization.

j. Simulation of equipment interference effects caused by other onboard aircraft systems is not required.

An ARWA device shall be composed of three modules as delineated herein.

3.1.4.1 System Simulation Module. The System Simulation module is comprised of ten segments: flight controls, flight dynamics, propulsion, navigation/communication, weapons, sensor control, aircraft survivability equipment, physical cues, instructor/operator station and tactical and natural environment. Physical separation of the segments is not required. The control segment and tactical and natural environment segments are common segments among the two airframe configurations. These common segments are defined in the following paragraphs.

3.1.4.1.1 Control Segment. The control segment shall provide the central point of control for the ARWA Device. The control segment shall provide the capabilities for simulator control and the system parameter modification function. The control segment shall not provide any instructional features.

3.1.4.1.1.1 Simulator Control. The capability to control the high level activities which are common to all segments such as; modes and states, segment synchronization shall be provided The control segment shall also provide the synchronization and timing signal used by all other segments. The control segment shall function as the central controlling mechanism for the ARWA Device.

The simulator control function shall provide the capability to control and monitor the following high level control activities for the ARWA Device:

a. Simulator mode and state control and monitoring as defined in paragraph 3.1.3 of this specification.

b. Simulation timing and synchronization shall be initiated by the Control segment. The IOS module shall provide a synchronization message at the beginning of each frame. Synchronization and timing shall be accomplished as defined in paragraph 3.1.5.1.4.

c. The Control segment shall receive control requests from the Session Manager subsystem and allocate these requests to the appropriate simulation segments to effect the desired response.

3.1.4.1.1.2 System Parameter Modification. The Control segment shall provide the capability to modify system parameters so that the device performance can be changed. See Appendix B for a detailed listing of data requirements.

3.1.4.1.2 Environment Segment. The Environment segment shall provide simulation of the environment external to the ownship. The ARWA device shall operate only in the multi-simulator mode, therefore the Environment segment shall provide a simulated environment consistent with the networked DIS environment. This environment shall appear "seamless" to the remainder of the ARWA devices. In this context "seamless" means that the other segments in the ARWA device cannot distinguish between the internal Environment simulation and the external updated information. The fidelity of this simulation varies for each function as detailed below.

3.1.4.1.2.1 Network Interface. The network interface shall provide for information updates conforming to the Distributed Interactive Simulation (DIS) standard (Version 2.0, third draft). The Environment segment shall provide this information to the ongoing simulation of the ownship environment as appropriate. The Environment segment shall perform all necessary conversions to conform to ARWA internal data formats and units.

3.1.4.1.2.2 Atmosphere. The Environment segment shall provide for simulation of a medium fidelity atmosphere. It shall simulate air mass, global winds, and turbulence. It shall provide global definitions of temperature and pressure. It shall not simulate local area weather effects such as local thunderstorms, micro-bursts, etc. It shall not simulate precipitation effects such as rain, snow, sleet, etc.

3.1.4.1.2.3 External Entities. The Environment segment shall simulate the position and attitude of other vehicles between updates from the DIS environment. Upon receiving such updates, the Environment segment shall "seamlessly" inject the new data into the vehicle simulation.

3.1.4.1.2.4 Ownship Weapon Damage. The Environment segment shall provide to the DIS environment information regarding ownship weapon path, detonation and ordinance. This information shall be defined in the Weapon segment and shall be passed to the external simulation through the Network Interface function of the Environment segment.

3.1.4.1.2.5 Threat Weapon Dynamics. The Environment segment shall simulate the flight of threat weapons between updates from the DIS environment. This simulation is limited as defined in paragraph 3.1.4.1.2.3 above.

3.1.4.1.2.6 Threat Platform Dynamics. The Environment segment shall simulate the flight of threat platforms between updates from the DIS environment. This simulation is limited as defined in paragraph 3.1.4.1.2.3 above.

3.1.4.2 Flight Station Module. The Flight Station module shall provide the simulation of the electrical, hydraulic, and fuel systems and the crew station interfacing systems for each of the application aircraft. Pneumatic system simulation is not required. The Flight Station module shall include the crew compartment enclosure, controls and indicators. The module level physical and performance characteristics requirements are defined in Volume II of this specification.

3.1.4.3 Visual Module. The Visual module shall provide the visual and sensor cueing requirements for each of the aircraft defined in paragraph 3.1 of this specification. This shall include visual and sensor image generation, moving models, lighting, environmental scene generation, crew station interfacing and out-the-window display system. The physical and performance characteristics requirements are contained in Volume III of this specification.

3.1.4.4 Support Systems. The following-paragraphs identify the requirements for the support systems which shall be part of the ARWA SS. The support systems shall provide the system management, maintenance, and control for the ARWA SS.

3.1.4.4.1 Simulation Manager. The simulation manager shall provide centralized control of the simulation exercise. The simulation manager shall connect to the ARWA SS

Local Area Network (LAN) and shall be responsible for controlling the exercise for devices connected to the ARWA SS LAN. Functions of the simulation manager shall include the following:

a. Mode and State Control. The simulation manager shall be capable of controlling the mode and state of each ARWA connected to the BDS-D network. The modes and states shall be as defined in paragraph 3.1.3.

b. Data Logger. The simulation manager shall provide a data collection function for BDS-D network traffic. The data collection shall be possible in three formats; 1) collect all BDS-D data; 2) collect selected BDS-D messages and 3) record instances of selected messages with data of a specified value. The data logger shall be capable of collecting and storing data for future analysis.

c. Late Player Introduction. The simulation manager shall provide the capability to introduce players into an exercise which is running. Late player introduction shall be accomplished without degradation to the existing exercise.

d. System/Exercise Startup, Maintenance and Control. The simulation manager shall provide the capability to load each ARWA with the appropriate software required to execute the planned exercise and start/restart the device. The simulation manager shall also be capable of providing refuel/resupply to the devices in the exercise.

e. Parameter Editing. The simulation manager shall provide the capability to edit key simulation parameters for experimental purposes. The parameters which shall be editable shall be as specified in Appendix B. The following rules/requirements shall apply to the parameter editing function:

   (1) Each segment's editable parameters shall be defined by an initialization file. To change a parameter set, a new initialization shall be required. A default value shall be defined for each editable parameter.

   (2) Development, editing and storage of the initialization files shall be an off-line, non-real-time function.

   (3) Introduction of new parameter values (a new file) shall not cause a re-compilation or re-linking of any task.

   (4) All initialization shall be initiated by the simulation manager station.

   (5) The segments shall use the initialization file during an alignment or reposition process.

   (6) Parameters shall not change in real-time but shall be constants (data) for the affected segment. A new initialization process shall occur in order to modify parameters.

3.1.4.4.2 Management Command and Control. A Management Command and Control (MCC) station shall be provided as follows:

a. Requirements/Functionality. The Aviation MCC has been described in the AIRNET Functional specification - MCC Work Station Screens (June 91). This document describes the functions to be performed by the MCC workstation for rotary wing operations and shall be used as a guide in the design process.

b. Aviation SIMNET Command and Control (SCC). Extend the current armor MCC to incorporate aviation organization and parameters into an AIRNET MCC. The only console included in this effort is the SCC. This effort includes replacing the current AppleTalk bridge to enhance performance.

c. Aviation Admin/Log Console. Extend the current armor Admin/Log Console to be an aviation Admin/Log Console. It will include forward area rearm/refuel point (FARRP) and support any special aviation ammunition, fuel, and supplies.

d. Aviation Maintenance. Extend the Armor Maintenance Console to be an Aviation Maintenance (AVUM) console. It will support rotary wing aircraft specific repairs.

e. Aviation Fire Support. Will integrate the current Fire Support Element (FSE), Close Air Support (CAS), and place consoles with the aviation MCC. The FSEs will reflect aviation organizational structure.

f. Battalion Air Console. Implement aviation support features such as carrying vehicles by a rotary wing aircraft and will support transporting sling loads of fuel and ammunition around the battlefield.

3.1.4.4.3 System Maintenance. The system maintenance function of the ARWA SS shall provide a non-real-time capability to maintain the ARWA SS and accomplish the tasks required to maintain the System with respect to software maintenance, configuration management of hardware and software and software development.

3.1.4.4.3.1 Software Maintenance. The capability to perform software maintenance for the entire ARWA SS shall be provided. All hardware and software shall be provided for the software maintenance function. The software maintenance function shall provide the following capability:

(a) Development, modification, and configuration of all software associated with the ARWA SS. Commercial off-the-shelf software shall be excluded from this requirement.

(b) Creation and maintenance of test and experiment software including parameter editing files.

(c) Configuration management of hardware configuration of each ARWA for security purposes.

(d) Library of all system information such as security, configuration management, magnetic media documentation, and results of tests and experiments.

(e) Maintenance and storage of all databases excluding the visual database which will be provided by the Database Maintenance function.

3.1.4.4.3.2 Database Maintenance. The database maintenance function shall provide the capability to modify and maintain the visual databases for all of the ARWAs.

3.1.5 System Functional (Intermodule) Relationships. The ARWA SS design shall be implemented in a manner consistent with the rules of the Modular Simulator System as defined herein. The following paragraphs describe the intermodule requirements for an ARWA device.

3.1.5.1 Interfunctional and Intermodule Rules. The following paragraphs identify the interfunctional and intermodule rules for the ARWA device.

3.1.5.1.1 Global Bus Information Rules. Digital video data and/or graphical imaging data (streams of lines and symbols, streams of range, elevation and azimuth angles) shall not be transmitted via the ARWA global bus. Unprocessed data shall not be accessed across the ARWA global bus during real-time operation. The ARWA global bus interface shall be as described in paragraph 3.1.7 and Appendix A of the ARWA SSM Interface design Document (IDD).

3.1.5.1.2 Crew Station Interfacing Rules. The crew station hardware interface shall be accomplished as described in this specification. The following paragraphs identify the crew station hardware interfacing rules.

3.1.5.1.2.1 Raw Data Controls and Displays. Crew station control and display of raw data, or derivations thereof, shall be accomplished through the Flight Station module. All modules shall send control and display data to the Flight Station module via the ARWA global bus. Such data shall be in the form of engineering units, as given in Appendix A of the ARWA SSM IDD. The Flight Station module shall be responsible for processing such data as required to drive the control or display to the respective position or indication. Likewise, control inputs shall be processed and sent to the appropriate modules using the same methods.

3.1.5.1.2.2 Tightly Coupled Controls and Displays. Controls and displays which are tightly coupled to functions in a particular module shall interface via a dedicated interface to the associated module, and not via the ARWA global bus to the Flight Station module. Tightly coupled controls and displays are those for which control and display are both dedicated and complex and the performance of the control and display system is highly integrated with the performance of the related simulation in the associated modules. Tightly coupled also refers to those cases where transport delay must be minimized. The tightly coupled controls and displays for the ARWA shall be as follows:

a. Primary flight controls. Cyclic, collective, and directional pedals, and 3 axis cyclic as applicable.

b. Video displays. Helmet mounted displays and out-the-window displays.

c. Video Mixing. Video data from the Moving Map function and the Visual Image Generation function shall be interfaced directly to the Flight Station Symbol Generator function for the cockpit multi-function displays.

3.1.5.1.3 Coordinate System. The coordinate system utilized on the ARWA global bus shall be the earth axis coordinate system which is defined by latitude, longitude and height above mean sea level. Individual modules shall perform transformations as necessary to conform to the earth axis coordinate system.

3.1.5.1.4 Synchronization and Timing. All system level timing and synchronization shall be initiated by the IOS segment. The IOS segment shall provide a high priority broadcast synchronization message (a "clock tick" message) at the beginning of each frame. The frequency of the synchronization message shall be as defined in the subparagraphs below. The format and definition of the synchronization message shall be as defined in Appendix A of the ARWA SSM IDD. Each module shall commence execution of the appropriate software for the corresponding frame upon receipt of the synchronization message. The synchronization message shall be available to all modules when in the system mode, remote controlled diagnostic mode, simulation mode, and shutdown mode. Intra-module synchronization methodologies (internal to each module) shall not be constrained by this specification to the extent that such methodologies meet or exceed the requirements specified herein.

All cues provided by the Physical Cues and Flight Controls segments, Visual module and Flight Station module shall be properly synchronized with all other ARWA modules to the extent that there shall be no noticeable errors in time, position, velocity or acceleration. Cue correlation transport delay (delay between any synchronized cue) shall be minimized, including the inherent delay of the installed visual system. The System shall respond to abrupt pitch, roll and yaw inputs within the specified time, but not before the time when the actual application aircraft would respond under the same conditions.

The following timing requirements shall apply to all modules in the ARWA:

a. The base rate and highest iteration rate for the ARWA shall be 60 Hz. This is the rate of the synchronization message on the global bus, and the frame rate. This rate does not apply directly to module internal processing, as long as input/output is provided to the ARWA global bus at the appropriate rate.

b. Distributed message transmission within a frame via the global bus shall be mandatory. This means when a module completes the computations that would allow a message to be transmitted, the module shall send that message.

c. All message transmissions for a module in each frame shall be initiated within nine (9) milliseconds from the start of each frame. This requirement is not applicable to the synchronization message, which always starts each frame.

d. The loading or balancing of specific module processing among the available simulation frames within a cycle (a cycle being the total number of frames in one second) shall be mandatory. All modules shall be designed to allow for additional fine tuning adjustments to the specified frame assignments during system integration, so as to more evenly distribute global bus traffic throughout the simulation cycle.

3.1.5.1.5 Common Processing Simulation Functions. Each particular simulation function shall be assigned to one and only one module. Transitions or hand-offs of simulation functions shall not be allowed in real-time.

3.1.5.1.6 Common Processing Service Functions. The Inter-visibility function shall be assigned to the TNE segment, and that assignment shall not be passed to another module in real-time. A module may internally elect to provide itself the service function in lieu of the system service function for its own internal purposes. This shall be allowed as long as the fidelity of system operation is not deteriorated.

3.1.5.1.7 Simulator Initialization. Simulation initialization shall be implemented as described in paragraph 3.1.3.5.1 of this specification. Crew station setup, loading and any other ancillary configuration changes shall be performed prior to simulator initialization.

3.1.5.1.8 Partitioning. The ARWA shall be partitioned into the Flight Station, Visual and Simulation System modules. The module functions associated with this partitioning shall be as identified in Volumes I through V of this specification.

3.1.5.1.9 Diagnostic and Performance Testing. All ARWA level diagnostics and remote controlled diagnostics shall be initiated by messages from the IOS segment as defined in Appendix A of the ARWA SSM IDD. Individual module local diagnostics shall be initiated by the individual module. The results of diagnostics and performance testing shall be recorded locally by each module and stored for future retrieval and analysis. The ARWA global bus shall be capable of use in a non real-time environment for file transfer via a network file system.

3.1.5.1.10 Natural Environment. The characteristics and phenomena of the natural environment that are simulated shall include atmospheric pressure, wind, temperature, visibility, time of day, sun angle, thunderstorms, lightning, rain, hail, snow, ice, wind shears and turbulence. The tactical and natural environment (TNE) segment shall provide the natural environment modeling for the application aircraft. The environment shall be defined from initial conditions prior to the exercise and shall not be alterable during the execution of an exercise.

3.1.5.2 Malfunctions. The malfunctions defined in Appendix A of this specification shall be fully implemented by the specified segment to the extent defined in Appendix A. Malfunctions shall be limited to those that are a direct consequence of simulated battle damage and shall not be insertable by any operator. All malfunctions shall be initiated by the TNE network interface function based on weapon messages from the BDS-D network.

3.1.6 Configuration Allocation. Each module in the ARWA Simulator shall support the interconnections and interfaces shown in the System interconnect diagram (Figure 1.3-2)

3.1.7 Communication Architecture Requirements. The Bus Interface Unit (BIU) shall provide the physical and data interface between the physical media and the particular module's application layer. The BIU shall utilize the Xpress Transfer Protocol (XTP) as defined by Protocol Engines Inc. (PEI) specification 89-103 Revision 3.5 or an equivalent protocol as the transfer layer. The Fiber Distributed Data Interface (FDDI) shall be used as the physical media as defined by the American National Standards Institute (ANSI) x3.166-1989, FDDI - Physical Layer Medium Dependent specification for a single loop system (reference paragraph 3.1.7.10.2, Communication Media).

The data interfaces shall include the constructs necessary to remove messages from the global bus addressed to a particular application segment; to strip from the message the header and trailer data not needed by the application segment; to reformat the data to a form compatible with the module computational system; and to reverse these processes for messages transmitted by the module, including multiple addressee messages. The BIU shall insure that the interface is reliable and includes error and exception handling. All message data shall be formatted as specified in Appendix A of the ARWA SSM IDD.

3.1.7.1 Bus Interface Unit General Requirements. The BIU shall be comprised of four major divisions; application services layer, session layer, transfer layer and physical media layer. The application layer shall contain one or more segments which comprise the simulation math models for a module. The application segments shall communicate with other application segments through the BIU via a predefined set of application services. The application segments shall be separate from each other and the BIU, but shall interface to the BIU through a unique and distinct application layer to session layer interface referred to as the application services. The logical interface definitions for the data being transmitted and received by the module application layers shall be as defined in Appendix A of the ARWA SSM IDD. The session layer shall provide the communication link to and from the transfer layer for the application layer. A module shall be comprised of one BIU and one application layer. An application layer shall contain one or more segments.

The interface between a segment and the session layer shall be defined as the application services. The segment shall not access the ARWA global bus or another segment within the same module except through the application services for that segment.

3.1.7.2 Bus Interface Unit Start Up. The BIU shall, upon the application of power, perform a self test to verify functionality. Upon successful verification of functionality, the BIU shall attach the module to the global bus. If the BIU should fail the test, it shall not attach the module to the ring but shall provide a visual indication of a failure. The global bus shall remain intact and functional and the module shall continue to pass on traffic from other modules. An optical bypass shall be installed at each module for this purpose.

3.1.7.3 Bus Interface Unit Performance Monitoring. The performance of the BIU shall be verified using an FDDI Bus Analyzer. Message delivery statistics shall be recorded to verify performance (i.e., message transmission time, message receipt time, content errors). The BIU shall execute the session layer, transfer layer, and any necessary background housekeeping tasks, such as management of module synchronization and communication with the global bus hardware. The maximum allowable latency for the BIU shall be 550 microseconds. This is the maximum time that a BIU can take to receive a message transmission from a segment, pack the message and pass it to the global bus. It is also the maximum time that a BIU can take to receive a package message, place it in a buffer, and notify the proper segment that it is present.

3.1.7.4 File Transfer Protocol. The BIU shall support the non-real-time transfer of files between modules.

3.1.7.5 Identification Numbers for Messages. Messages shall be transferred from segment to segment and include a unique identification number. The identification number shall be a 32-bit integer. Identification numbers shall be assigned for all messages that will be transferred on the global bus for use in the address field of a transfer layer information segment. To accomplish this, a routine shall be used to automatically parse the interface specification to build a master message package consisting of all message names as an enumeration type. This shall ensure the correct configuration of messages between modules and segments in the System. The package shall reside within the BIU computational system. A particular module's segment(s) shall only have visibility or access to the inputs and outputs which are specifically identified as applicable to the module in Appendix A of the ARWA SSM IDD. When the master message package is compiled, a unique 4-byte (32 bit) integer shall be assigned by the compiler to each message name. This integer shall be the identification number. The same integer values shall be assigned to the enumerated types, regardless of compiler implementation, given that the same (Ada) package is 'withed' by each module.

3.1.7.6 Data Representation. The following paragraphs identify the requirements for data representation of information on the physical layer which shall be used in the ARWA.

3.1.7.6.1 Network Byte Order. The network byte order shall be as specified in MIL-STD-1777, Internet Protocol Specification, Appendix A. The eight bits of each byte shall be transmitted on the media in the order that would be read in a left to right fashion, going from low to high memory locations, where the left most bit shall be the Most Significant Bit (MSB) and the right most bit shall be the Least Significant Bit (LSB).

Similarly, bytes shall also be transmitted from left to right, from high order to low order. Whenever a multi-octet field represents a numerical quantity, the left most bit of the whole field shall be the most significant bit. When a multi-octet quantity is transmitted, the most significant octet shall be transmitted first. This is known in the computer industry as Big-Endian format.

The byte number shall be the offset in memory from the lowest byte or the base byte. The base byte shall be the address used when addressing the long word or half word as a single entity. Therefore, Byte 3 shall be a higher memory location address than Byte 0.

3.1.7.6.2 Basic Data Types. The following data types shall be used on the global bus:

a.	short integer	8 bit byte
b.	integer	16 bit double byte or half word
c.	long integer	32 bit quad byte or (long) word
d.	float integer	Single and double precision IEEE Floating Point (Spec No. 754-1985)

Double and single precision enumerated types on the network shall begin with 0 for the first element of the type declaration.

3.1.7.6.3 Floating Point Numbers. Numbers that are best expressed as floating point numbers shall use the floating point representation specified in paragraph 3.1.7.6.2.

3.1.7.6.4 Order of Interpretation of Complex Data Structures. Data structures shall be placed on the communication media in the order they are declared in the type definition. This order shall be defined as left-to-right and then top-to-bottom. Sub-structures shall comply with the same interpretation.

For example:

```
Type data_structure_II is record

        Latitude: Float;

        Longitude: Float;

end record;
```

Type data_structure is record

Altitude: Float;

Heading: Float;

Position: data_structure_II;

end record;

An object of type data_structure would be sent in the following order: Altitude, Heading, Latitude and Longitude.

3.1.7.7 Module Address Translation Table. In each module's BIU there shall be an input/output address for each message processed by a particular application. This address shall contain information on the originating segment and all destination segments as a bit-mapped address. These addresses shall be unique to the BIU and the particular segment of that module. The segment that originates a message and the destinations of the messages shall be as defined in Appendix A of the ARWA SSM IDD. Each module or segment BIU shall contain a Module Address Translation table, developed off-line that defines the hardware address of the source and destination of every message defined in Appendix A of the ARWA SSM IDD.

3.1.7.8 Session Layer. The session layer of the BIU shall handle the communication of data from one segment to another within the same module and between a segment and the transfer layer, and from transfer layer to the appropriate segments in each module. This is derived from the session layer of the International Standards Organization for Open System Integration (ISO/OSI) model and such parts of the presentation layer of the ISO/OSI model as may be necessary to convert from one data format to another, depending on the type of computational system running the segments' software within the application layer. The BIU session layer software shall run as a task independent of the application layer with a minimal amount of interfacing to the application layer (via the application services).

3.1.7.8.1 Memory Requirements. The amount of memory required by the BIU session layer shall be determined by the amount of buffer space required for message traffic at a module. Since each module has different numbers and sizes of messages, the required amount of buffer space can vary from module to module. The BIU shall provide memory space to handle the message traffic for the module with the highest memory requirements in the system. This shall allow for Interchangeability among modules for later system debugging and checkout. BIU memory shall also be provided for the session layer software, transfer layer, global bus board drivers and any applicable BIU support programs.

3.1.7.8.2 Data Flow. As messages are received from the global bus and processed by the session layer, the segments within the application layer shall notify the BIU of the messages to be received/sent. The segments shall process received messages as they arrive. The segments shall establish the importance of a given message. The message identification number shall be used to interpret the message contents. Messages shall be passed between a segment and the session layer in the appropriate segment format. The BIU shall perform any necessary format translations. Each segment shall have the ability to request the status of the last operation in order to make decisions on important message transfers. Each module's session layer shall have access to only to those messages used by that particular module.

Messages shall be passed between the session layer and the transfer layer in a format that is compatible with the transfer layer protocol. A context shall exist between nodes which are required to communicate prior to messages being transmitted/received on the global bus. Each segment shall establish the need for the context when the Input/Output (I/O) information is provide to the BIU. The status of transfers shall be monitored by the session layer and made available to the appropriate segment(s) upon request by the segment(s).

3.1.7.8.3 Session to Transfer Layer Interface. Any commands to/from the transfer layer shall be in the form of process operations established by a segment using the session layer. The I/O operations shall be accomplished without the loss of any data and expedited as dictated by the segment. As soon as data is received by the session layer from the transfer layer, it shall be processed for delivery to the appropriate segment(s). A receive operation shall be posted by the session layer in order to move data from the transfer layer to the session layer. A receive operation shall be posted for each expected message. A send operation shall be posted by the session layer in order to move data from the session layer to the transfer layer. When the transfer layer has completed, an I/O transaction a response message shall be written to the session layer. The session layer shall continually monitor the operational status of the transfer layer for response messages.

3.1.7.8.4 Session Layer to Application Layer Interface. Communication between the session layer and segments in the application layer shall be in the form of application service calls made by the segment. Each service shall return the status of the operation that was performed. The following services shall be provided, as a minimum, to the individual segments in the form of function or procedure calls:

a. Define_A_Message_Record_For. This service shall define a message record and attach it to the message buffer in the Session Layer for that message. The message record shall consist of the following:

(1) The status of the last operation.

(2) The age of the message.

(3) The message size in bytes.

(4) The message buffer address.

The Define_A_Message_Record_For service shall be called once for each message sent or received by a segment prior to simulation start up. An error condition shall exist if any other service is called for a message which has not been defined. The parameters for this service shall be as follows:

(5) Message_Name. This parameter shall be provided as a string as defined in Appendix A of the ARWA SSM IDD.

(6) Send_Or_Receive_Mode. This parameter shall define whether a message is an input or an output and the action, if any, to be taken. Valid modes shall be as follows:

(a) Send_And_Return

(b) Send_And_Wait_For_Acknowledgement

(c) Receive_Most_Recent_Message

(d) Receive_And_Interrupt

(7) Interrupt Handler Address. This parameter shall only be used for Receive_And_Interrupt mode.

b. Change_Send_Or_Receive_Mode_Of. This service shall enable a segment to change the mode of a message record that has already been defined for that segment. A send message shall not be changed to a receive message, the reverse shall also be true. The parameters for this service shall be as follows:

(1) The new Send_Or_Receive_Mode.

(2) Interrupt Handler Address. This parameter is only used for Receive_And_Interrupt mode.

(3) The message record.

c. Send. This service shall send the given message, using the current send mode associated with the message. An error condition shall exist if the message is marked with one of the receive modes. The parameters for this service shall be as follows:

(1) The message record.

d. Receive. This service shall receive the given message using the current receive mode associated with the message. An error condition shall exist if the message is marked with one of the send modes. The parameters for this service shall be as follows:

(1) The message record.

e. Status_Of_Node. This service shall return the status of the module's BIU. The parameters for this service shall be as follows:

(1) The segment name as specified in Appendix A of the ARWA SSM IDD.

f. Initialize. This service shall initialize the application layer services and BIU variables in preparation for starting the BIU's operation. This shall be performed prior to using any of the other

g. Start BIU. This service shall enable the BIU for the start of communication. This service shall be called after all Define_A_Message_Record_For calls and before the first call to send or receive.

3.1.7.8.5 Initialization. Before the transmission/reception of messages can be accomplished, buffer space shall be allocated to direct the transfer of information and to store the messages as they are being processed. The amount of space required shall be dependent on the maximum number of send and receive messages possible for a particular segment. These numbers shall be defined by the segment when the I/O requirements are established using the Define_A_Message_Record_For application service.

3.1.7.8.6 Receive Messages. Messages shall be received from the global bus and passed through the BIU to the application layer software. The media headers and trailers shall be removed from the messages before they are passed to the application layer. The status field of each receive message shall be monitored by the BIU until a message is found that has been transmitted correctly. When the status indicates that a message has been received correctly, the message shall be processed. If the status indicates that the transmission was terminated prematurely, a new receive operation shall be established to await another transmission of the data. Errors shall be processed as they occur without degradation of module operation.

3.1.7.8.7 Send Messages. Messages sent from the application layer software to the bus through the BIU shall comply with the particular service requested by the segment. Media headers and trailers shall be added to the messages before they are passed to the transfer layer. The status of the outstanding message transfers shall be monitored, and the appropriate action shall be taken based on this status to prevent operational failure of the module.

3.1.7.8.8 Translate Messages. Any necessary message data translations shall be performed by the session layer. The data shall be transferred to the host by means of the application services. The reverse shall be true when sending messages.

3.1.7.9 Transfer Layer. The transfer layer shall implement XTP as specified in PEI 89-103 Rev 3.5, the most current version of XTP or an equivalent protocol.

3.1.7.9.1 Transfer Layer Functions. The transfer layer relates to the ISO/OSI reference model's network and transport layers. The transfer layer shall include the interface to the session layer and the logical link control. The following functions and services shall be provided:

a. Real-time datagram service.

b. Flow/error/rate control.

c. Selective re-transmission.

d. Accommodation of multiple addressing schemes.

e. Message boundary preservation.

f. Out-of-band signaling.

g. Reliable multi-cast mechanism.

h. Traditional stream services.

The transfer layer protocol shall provide for all of these functions and services.

3.1.7.9.2 Physical Implementation. The physical implementation of the Transfer Layer shall be determined by an engineering analysis of available technical alternative for cost performance.

3.1.7.10 Physical Media Layer. The physical layer shall incorporate the Logical Link Control (LLC) and the communication media.

3.1.7.10.1 Logical Link Control. The logical link control shall specify the interface between the communication media and the transfer layer. This layer is specified by IEEE 802.2 logical link control. It shall permit upgrade changes to the communication media without reconstruction of the transfer layer.

3.1.7.10.2 Communication Media. For the ARWA, the communication media shall be the FDDI. There are four documents that shall specify the construction and use of FDDI:

a. Media Access Control - ANSI X3.139-1987

b. Physical Layer Protocol - ANSI X3.148-1988

c. Physical Layer Medium Dependent - ANSI X3.166-1989

d. Station Management - ANSI X3T9.5/84-49 Rev 5

3.1.7.10.2.1 Media Access Control. The Media Access Control (MAC) document shall be used to define the controls for access to the communication media and define a common interface between these controls and the LLC.

3.1.7.10.2.2 Physical Layer Protocol. The Physical Layer Protocol (PHY) document shall be used to describe the encoding of the data bits on the communication media. The PHY document shall also be used to define the symbols and data bit rate for the network. The PHY shall provide the connection between the data link layer and the Physical Layer Medium Dependent (PMD) and establishes clock synchronization.

3.1.7.10.2.3 Physical Layer Medium Dependent. The Physical Layer Medium Dependent (PMD) shall be used to define the fiber optic cable, wavelength of the light, power budgets, optical bypass provisions, characteristics of the fiber optic drivers and receivers, connectors and keying. The PMD shall provide all services necessary to transport a suitably coded digital bit stream from module to module.

3.1.7.10.2.4 Station Management. The Station Management (SMT) shall be used to define topology, operation of network performance data collection and analysis.

3.1.7.10.3 General Physical Layer Requirements.

3.1.7.10.3.1 ARWA Communication Media Topology. The topology of the ARWA communication media shall be a single ring. A redundant ring topology shall not be provided.

3.1.7.10.3.2 Media Access Protocol. MAC shall be the lower layer of the data link layer. The upper half of the data link layer shall be LLC. The MAC shall interface to the LLC as defined in IEEE 802.2.

3.1.7.10.3.2.1 Token Control. The token rotation timer shall be a maximum of 1.0 millisecond. The method used to set this token rotation timer in each module BIU and the actual token rotation timer value shall be determined by engineering analysis to accommodate the design.

3.1.7.11 Intermodule Interfaces. The intermodule interfaces shall be as defined in the Interface Design Documents.

3.1.8 Government Furnished Property. Government furnished property shall be identified as required for development of the ARWA SS.

3.1.9 Interface Requirements. The ARWA SSM design shall be implemented in a manner consistent with the functional allocation and interfacing rules of the generic Modular Simulator System (MSS). The following paragraphs describe the inter-segment communication requirements for the ARWA device. These requirements are applicable to all segments within the ARWA device.

3.1.9.1 MSS Segment Interfaces. The MSS interface specification is composed of interface requirements and data requirements. The interface requirements specify broad system level requirements such as synchronization, timing, protocols, and hardware interfaces applicable to all segments. The focus of the interface requirements is on inter-segment communication, which occurs via the VNET. The interface requirements also address issues relating to interfacing with hardware configuration items (HWCI). The focus of the data requirements is on inter-segment communication, specifying the various data elements (i.e., messages) passed between the segments via the VNET.

The MSS concept levies no requirements for intra-segment interfaces. However, the following general guidelines should be used:

a. Intra-segment interfaces should support the inter-segment messages,
b. Intra-segment interfaces should reflect the design partition, and
c. Intra-segment interfaces should not interfere with external interfaces or be used outside the segment.

The design of inter-segment communication is located in the ARWA IDD.

3.1.9.2 Synchronization and Timing. Each segment shall assume execution as a "black" box component, i.e., no segment design shall assume that any particular subset of segments have executed before or will execute after the segment.

3.1.9.2.1 Synchronization. All system level timing and synchronization shall be initiated by the Control segment. The Control segment shall provide a top priority broadcast synchronization message, known as "clock tick" message, at the beginning of each frame. The frequency of the synchronization message shall be 60 Hertz. The format and definition of the synchronization message shall be as defined in the ARWA device IDD. Each segment shall commence execution of the software for the corresponding frame upon receipt of the synchronization message.

The synchronization message shall be generated by the Control segment and transmitted to all segments when in the system mode, remote controlled diagnostic mode, simulation mode, and shutdown mode.

Intra-segmnet synchronization methodologies (internal to each segment) are not to be constrained by this specification so long as such methodologies meet or exceed the requirements specified herein.

3.1.9.2.2 Timing. The following timing requirements shall apply to all segments in the ARWA device:

a. The base rate and highest iteration rate for the device shall be 60 Hertz. This is the rate of the synchronization (clock tick) message on the VNET and the frame rate. Segment internal processing shall be conducted sufficient to ensure that the segment input/output is provided at the specified rate.

b. Message transmission within a frame via the VNET shall be distributed. This means that when a segment completes the computations which would allow a message to be transmitted, the segment shall send that message immediately. Segments shall not wait until the end of the frame to transmit their messages.

c. All message transmissions for a segment in each frame shall start no sooner than 1.0 milliseconds after frame start. This requirement is not applicable to the synchronization (clock tick) message, which shall always start each frame.

d. Segment processing shall be evenly loaded or balanced among the available simulation frames within a cycle (a cycle being the total number of frames in one second). The frame assignments for each segment shall be designed to allow for additional fine tuning adjustments to the specified frame assignments during system integration, so as to more evenly distribute VNET traffic throughout the simulation cycle.

3.1.9.2.3 Cue Correlation. Simulated cues for the device shall have no noticeable errors in correlatable factors such as time, position, velocity, or acceleration. As a minimum, all cues provided by the Physical Cues segment, Visual segment and Flight Station segment shall be properly synchronized with all other segments. These cues shall be correlated.

Cue correlation transport delay (delay between any synchronized cue) shall be minimal, including the inherent delay of the installed visual system. The system shall respond to abrupt pitch, roll and yaw inputs within the specified transport delay, but not before the time when the actual aircraft would have responded under the same conditions.

All visual scene changes from a steady state condition shall occur within the specified transport delay but not before the resultant physical cue onset.

3.1.9.3 Inter-Segment Communication Protocol. All inter-segment communication in the ARWA device shall be via the VNET. The VNET shall serve as the only communication path between segments. The specific implementation and design of the VNET shall be transparent to the individual segments. Each segment shall communicate with the VNET using the inter-segment interfaces and a set of common interface processing services that will allow each segment to send messages, receive messages, and perform other functions as required by the application. The VNET interface processing services are called Application Services and are fully discussed in the ARWA SSM IDD.

3.1.9.4 HWCI Interface Requirements. The ARWA device interfaces with HWCIs shall be accomplished in accordance with the rules described in the following paragraphs.

3.1.9.4.1 General Purpose Data Controls and Displays. The ARWA device general purpose controls and displays shall interface via the Flight Station segment. The Flight Station segment shall be responsible for processing such data as required to drive the displays and report status of controls. All other segments shall send and receive control and display data to and from the Flight Station segment via the VNET. Such data shall be in the form of engineering units, as specified in the ARWA SSM IDD, Appendix A. The Flight Station segment shall be responsible for processing this data as required to drive the control or display to the respective position or indication.

3.1.9.4.2 Tightly Coupled Controls and Displays. The ARWA device tightly coupled controls and displays shall interface via a dedicated back-door interface to the associated segments and not via the VNET to the Flight Station segment. The affected segment shall be responsible for processing the data necessary to drive displays and report status of controls. Tightly coupled controls and displays are those for which control and display are both dedicated and complex. The performance of the such devices are highly integrated with the performance of related simulations in the associated segments. Examples of such devices are those which are tightly coupled to a specific function in a particular segment, such as dedicated Control Display Units (CDUs), primary flight controls (stick, rudder), threat warning display computers, etc. The interface requirements for tightly coupled controls and displays shall also apply where transport delay must be minimized. Tightly coupled controls and displays applicable to the SSM include the control loading system connected to the Flight Controls segment and the sound system connected to the Physical Cues segment.

3.1.9.5 Coordinate System. The coordinate system utilized on the ARWA device VNET shall be a Flat Earth coordinate system. Individual segments which use other coordinate systems internally shall perform any transformation necessary to conform to the Flat Earth system, when communicating such information via the VNET.

3.1.9.6 Data Requirements. The following paragraphs define requirements for interfaces between ARWA device segments via the VNET. The interfacing data elements shall be "messages." A message is a data structure that bundles many separate data items into an Ada computer language record which defines a unified interface. The specific contents of each field of the data elements (messages) in the interface messages, including units, limits, ranges, accuracy , precisions, resolutions, and names shall be as defined in the ARWA SSM IDD.

3.1.9.6.1 Message Theory. The MSS segments communicate via a set of well-defined messages. The messages shall be defined by the originating segment. Appendix A of the ARWA SSM IDD captures the design details of each message. The interface messages used within the ARWA device shall meet the following general requirements:

a. The interface shall facilitate independent segment development. Independent segment development requires interfaces which contain sufficient detailed information and stability to allow each segment designer to develop and test their segment as a stand-alone unit.

b. The interface shall be well-defined. Therefore, the ARWA device shall utilize interfaces specified in compilable Ada computer language in accordance with MIL-STD-1815A.

c. All interfaces shall have only one owner. Therefore, the interface design shall assign origination responsibility of each interface message to a single segment.

d. The interfaces shall be grouped according to purpose. Therefore, the interface design shall group (or package) interfaces by assigned segment.

e. The interfaces shall demonstrate support for the synchronization and timing requirements. Therefore, the interface design shall define not only the content buy also the suggested rate of data transfer between segments.

f. The interfaces shall be flexible so as not to limit various segment designs. Therefore, the interface design shall specify the name, kind, class, and segment allocation of the messages. Appendix A of the ARWA SSM IDD shall defined the specific content of each message.

g. The interfaces shall be usable with different kinds of data transmission media and methods. Therefore, the interface design shall reuse the generic message structure stated in the MSS IDD and shall specify the instantiation of the VNET in the ARWA SSM IDD.

3.1.9.6.2 Interface Messages. The segment interface messages for the ARWA device shall be as defined by the detailed interface data for each message specified in Appendix A of the ARWA SSM IDD.

3.1.9.6.3 Excluded Data. Digital video data, graphical imaging data, and other unprocessed data shall not be transmitted via the VNET during real-time operation. Graphical imaging data includes streams of lines and symbols, streams of range, elevation and azimuth angles. All data transmitted via the VNET shall be as defined in Appendix A of the ARWA SSM IDD.

3.1.10 System Capability Relationships. The SSM system capability relationships shall be as stated in the following paragraphs. The SSM comprises a set of functions which simulates the functional and performance characteristics of the ARWA aircraft. Each simulation function shall simulate the functional and performance attributes of the aircraft in accordance with design criteria. Where design criteria is not available engineering assumptions shall be made. These assumptions shall be documented. Individual simulation functions shall be assigned to one and only one segment. Transitions, or hand-offs, of simulation functions shall not be allowed. The predefined functional allocation to segments shall be adhered to.

3.1.10.1 Common Processing Service Functions. Common processing service functions are special functions that are allocated to a specific segment. Service functions provide a common processing service for several segments in the system. The results are transmitted across the VNET for use by other segments. Each service function shall be assigned to a specific segment; that assignment shall not be transferred to any other segment. A segment may provide itself with a service function instead of utilizing the system service function. This shall be allowed as long as system fidelity is not deteriorated.

Service functions shall be assigned for the ARWA MSS, as follows:

a. Occulting Function. This function shall be provided by the Environment segment. Occulting service function requirements applicable to the ARWA SSM shall include terrain occulting only. Occulting of electronic signals and cultural features is not required.

b. Spatial Relations Function. This function shall be provided by the Environment segment. Spatial Relations service function requirements applicable to the ARWA SSM shall include a straight Line-Of-Sight (LOS) distance calculation from the ownship to the object of interest.

c. Visual Database Function.

3.1.10.2 Common Databases. Access to common databases shall be via back-door connections from the individual segments to the database. A single segment shall be assigned the responsibility for controlling the shared database. Common databases may be accessed through a back-door interface, however, they shall not be modified, except by the controlling segment, during real-time operations. This does not preclude downloading of databases between segments across the VNET or a back-door bus during non-real-time operation. Files for diagnostics may be passed in the same manner.

3.2 System Characteristics. System characteristics shall be in accordance with the contractor's best commercial practices standards and other primary references as specified herein. Military standards referenced herein shall be used only for reference and as guides in meeting the requirement.

In order to minimize cost, risk, and development time, commercial off-the-shelf equipment that is fully supported by the manufacturer shall be used whenever it meets the requirements of this specification. The use of commercial off-the-shelf equipment for processing resources shall meet the requirements as specified in paragraph 3.3 of this specification.

Commercial off-the-shelf equipment shall be exempt from the parts control and hardware standardization requirements of this specification. However, its use shall not preclude the ARWA SS from meeting all other requirements of this specification.

3.2.1 Physical Requirements

3.2.1.1 General. The ARWA SS shall be of modular construction, with the major components connected by cable assemblies and electrical lines, as required, to provide flexibility in the general arrangement of the equipment. Special tools or equipment should not be required for assembly or disassembly of the major components. If such tools or equipment are required, they shall be provided as support equipment and identified as such. A means shall be provided for leveling each major component if such components require leveling. The device shall be designed to allow maintenance accessibility for all items that will require maintenance.

3.2.1.2 Lighting. All ARWA unique lighting required for operation and maintenance of the device shall be provided. Lighting controls shall be provided for all ARWA unique lighting. Crew station functional lighting components shall duplicate those found in the simulated aircraft. Supplementary lighting shall be provided in any area where maintenance may be required and where ambient lighting is insufficient. Open bulbs shall be guarded against accidental breakage and personnel contact.

3.2.1.3 Climate Control. Heating/cooling shall be provided for ARWA SS equipment that require more than the simulator facility heating/cooling systems requirements stated in paragraph 3.2.2 of this specification. Duct work and associated equipment to tie into the System shall be provided and installed as necessary. Operational controls shall be provided for all ARWA SS heating/cooling systems as necessary.

3.2.1.4 Size. The size of the ARWA, including device dedicated computational equipment, shall be no greater than a sixteen foot cube.

3.2.1.5 Color. The paint to be used on the ARWA SS shall be from the semi gloss series of FED-STD-595. There are no specific color requirements for this particular application. All paint shall be applied using best commercial practices for durability and adhesion. Paint will be compatible with NVGs.

3.2.1.6 Nameplate And Product Markings. Nameplate and product markings shall be in accordance with best commercial practices. All components shall be part marked for easy identification. Nameplates shall be provided for each ARWA. All markings shall be of a durable nature and not easily removed.

3.2.1.7 Mechanical Design. The following paragraphs describe the mechanical design requirements which are applicable to the construction of the ARWA SS.

3.2.1.7.1 Mounting. Mounting requirements shall be in accordance with best commercial practices.

3.2.1.7.2 Protection. Protection of parts and assemblies shall be in accordance with best commercial practices and shall provide for protection of parts, chassis protection, and vibration and shock protection.

3.2.1.7.3 Enclosures. Enclosure design shall be in accordance with best commercial practices and shall include removable panels and cover plates.

3.2.1.8 Electrical And Electronic Design. The following paragraphs describe the electrical and electronic design requirements which are applicable to the construction of the ARWA

3.2.1.8.1 General. Electrical and electronic equipment design, design and construction of printed circuits and printed circuit boards, and electronic equipment thermal design shall be in accordance with best commercial practices.

3.2.1.8.2 Circuit Design. Circuit design shall be in accordance with best commercial practices.

3.2.1.8.3 Circuit Protection. Circuit protection shall be in accordance with best commercial practices and shall be designed with safety of personnel as a priority.

3.2.1.8.4 Primary Power Source. A source of primary power in the trainer facility shall be provided by the Government. The simulation device equipment shall be designed to operate from this primary power source. The ARWA SS shall not cause an excessive power surge during start-up. Distribution, internal supply voltages, and conditioning of the power within the ARWA SS shall be provided.

3.2.1.8.5 Electrical Bonding. Electrical bonding shall be designed in accordance with best commercial practices.

3.2.1.8.6 Grounding. The grounding system in the ARWA SS facility shall be supplied by the Government. All ARWA SS grounding systems shall terminate on the facility grounding system and comply with the National Electrical Code. Grounding for personnel protection shall be accomplished within the ARWA SS power distribution system.

3.2.1.8.7 Wiring And Cabling. Wiring and cabling shall comply with best commercial practices. The selection and application of interconnecting wires and cables shall be in accordance with the National Electrical Code. The wire temperature, current carrying capacity, and voltage drop requirements shall be in accordance with the National Electrical Code.

3.2.1.8.8 Connections. Connections and Wire terminations for mechanical connections shall be designed in accordance with best commercial practices.

3.2.1.8.9 Identification Of Conductors. Electrical conductors shall be identified in accordance with best commercial practices. Coding of conductors and wire terminal ends shall be in accordance with best commercial practices or the National Electrical Code.

3.2.1.8.10 Identification Of Components. Electrical components shall be identified in accordance with best commercial practices

3.2.1.9 Optical Design. Optical equipment design and optical coatings shall be in accordance with best commercial practices.

3.2.1.10 Communication Equipment Design. The simulator communication system design shall be in accordance with best commercial practices and shall replicate the communication system of the application aircraft to the fidelity required to support the simulator mission. A maintenance/emergency intercom system shall be provided. This System shall allow for priority voice communication between the Simulation Manager and each ARWA.

3.2.2 Environmental Conditions. The trainer shall be designed to operate in a controlled, stable environment where the temperature, relative humidity, and barometric pressure are maintained within the following limits:

a. Temperature
   (1) operating: 21 degrees C +/- 4 degrees C
   (2) non-operating: -29 degrees C to 54 degrees C
       (excluding visual system)

b. Relative Humidity
   (1) operating: 50% +/- 20% non-condensing
   (2) non-operating: up to 100% with condensation

c. Barometric Pressure
   (1) operating: 31.35 to 24.9 inches Hg
   (2) non-operating: 31.35 to 5.5 inches Hg

3.2.3 Nuclear Control Requirements. There are no nuclear control requirements applicable to the ARWA SS.

3.2.4 Materials, Processes and Parts. The following paragraphs describe the materials, processes and parts requirements which are applicable to the construction of the ARWA SS.

3.2.4.1 General. Neither asbestos material nor parts containing asbestos shall be used in the ARWA SS. The contractor shall have the option of using aircraft parts in the design whenever it is determined to be cost effective. Peculiar materials, parts and processes that are used in the ARWA SS shall be controlled by specifications that shall be referenced to the drawings controlling the device configuration.

3.2.5 Electromagnetic Radiation. The design of the equipment shall be in accordance with the suppliers normal practice and shall ensure that the trainer components are mutually compatible. The filtering of primary power supplies and screening shall be such that the simulator is not susceptible to an electromagnetic environment, nor emits interference sufficient to adversely effect the performance of neighboring equipment.

3.2.6 Workmanship. The contractors standard processes and procedures and requirement 9 of MIL-STD-454 shall be used as a guide for workmanship. Particular attention shall be given to neatness, thoroughness of soldering, wiring, welding, forming, machining, and assembly of parts. Units shall be thoroughly cleaned of loose, spattered, or excess solder, metal chips, and other foreign material after assembly. Burrs, sharp edges, and resin flash shall be removed.

3.2.7 Interchangeability. Mechanical and electrical subassemblies, components and parts that have identical part numbers shall be interchangeable or replaceable and shall possess both mechanical and electrical compatibility to permit their installation as interchangeable subassemblies and parts without regard to the manufacturer or supplier. Supplied parts shall not require reconfiguration or finish assembly in any manner prior to actual use with the exception of commercial off-the-shelf parts. Each part number shall be unique where configuration differences exist. The supplier shall be responsible to ensure parts replaceability for all supplied parts off-the-shelf or otherwise.

3.2.8 Safety. The trainer design shall be in accordance with MIL-T-23991 "Safety" (3.2.1.2) which shall be used as a guide for the trainer design. Safety features shall be installed in the ARWA SS to protect personnel and equipment. Fire detection and suppression systems shall be provided with an audible alarm. The fire detection system shall consist of smoke and overheat detection equipment of a low cost commercially available nature. The system shall detect smoke and overheat conditions in equipment cabinets and ARWA user areas. When a detection occurs, the affected equipment shall automatically be transitioned to a power off state. Fire suppression shall consist of overhead water sprinklers in enclosed personnel areas not already protected by existing facility fire suppression systems. Sprinkler systems shall not be used to extinguish electrical fires. For such fires the appropriate National Fire Prevention Association (NFPA) manual fire extinguisher shall be provided and placed in close proximity to the possible use area. A halon system shall not be provided.

3.2.8.1 Emergency ON/OFF Power Switches. An emergency ON/OFF power switch shall be provided for the crew station, the Simulation Manager station, every equipment rack, and any remote area where personnel may be working that is unique to the particular design. The switches shall be clearly marked and readily accessible, but protected from inadvertent actuation.

3.2.8.2 Control Loading. The control loading system shall be designed to prevent rapid or forceful uncommanded control displacements upon energizing the system, during automatic retrimming, following inadvertent start-up from an untrimmed condition, or as a result of either an electrical or mechanical system failure, to avoid injury to personnel.

3.2.9 Human Performance/Human Engineering. The principles, procedures and criteria of human engineering and life support shall be applied to the design and development of the ARWA SS to ensure that the System can perform assigned functions efficiently, reliably and safely. The design shall be in accordance with the intent of MIL-H- 46855 (applicable sections) and MIL-STD-1472 (applicable sections). The human performance and life support requirements shall consider the important aspects of operability, maintainability, safety, and cost factors.

3.2.10 Deployment Requirements. Deployment requirements indicating the number of trainer installations and operating locations shall be as defined in the contract.

3.3 Processing Resources. The following paragraphs define the processing resource requirements which are applicable to the ARWA SS.

3.3.1 General Hardware Requirements. The selection of all processors and associated peripheral devices, including their interface boards, shall be limited to established commercial off-the-shelf equipment that is fully supported by the manufacturer.

The processors selected shall have a word size and operating speed which is capable of producing cockpit indications and cockpit sensations of aircraft performance, as well as Support System displays and indications that are free of discernible stepping, oscillating, jittering, or other erratic behavior, while meeting the performance requirements and tolerance levels described in this specification. Sufficient installed memory shall be provided for each processor so that the processing system can store and execute the complete operational program or any support program, and still meet spare requirements.

Direct access mass storage equipment, with removable storage media, shall be provided as part of the System. The media shall be removable without the use of tools. The equipment shall have the capability of storing and transferring all executable operational and on-line diagnostic software without remounting storage media. The complete operational program or any support program shall be able to be transferred to installed memory within five (5) minutes.

The processing system shall incorporate power interrupt fail-safe provisions. An unexpected loss of power shall not result in any damage to the processors or associated peripheral equipment. Recovery shall be accomplished within a reasonable amount of time after power is restored.

The SSM computational system shall provide at least 50% spare processing capacity in the initial delivery baseline. Each individual processor within a module shall provide not less than 25% spare processing capacity in the initial delivery baseline. Each module shall provide for accomplishing and validating the clearing of classified data from its processors.

The SSM computational system shall provide not less than 50% spare resident RAM in the initial delivery baseline. The SSM shall provide for accomplishing and validating the clearing of classified data from its resident random access memory (RAM).

The SSM computational system shall provide sufficient mass storage capacity for the initial program load in the initial delivery baseline. The SSM shall provide empty expansion capability to double the available mass storage capacity.

The SSM computational system shall provide sufficient interface channel capability for its backdoor interfaces. The SSM computational system shall provide empty expansion capability to increase the number of interfaces by 25%. The SSM computational system shall provide for accomplishing and validating the clearing of classified data from its interface controllers.

The expansion capability requirements in the foregoing discussion shall be met by allocation of empty slots in the host computer chassis of the SSM computational system, and shall not be met by double-allocation of slots.

There is no mass storage requirement for the SSM driven by the application segments or the bus interface unit. The specific computational architecture may require embedded mass storage.

The SSM computational system shall provide for an Ethernet interface. The SSM shall provide for an FDDI interface to the ARWA VNET. The SSM shall provide for an FDDI interface to the DIS Network. The SSM shall provide for an appropriate communication and control interface to the control loading computer located in the flight station module. The SSM shall provide for an appropriate communication and control interface to the audio electronics device. The SSM shall provide for a digital voice line interface from the audio electronics to the DIS Network if required.

3.3.2 General Programming Requirements. Software developed and supported by a manufacturer for use with commercial off-the-shelf equipment, or software that is itself commercial off-the-shelf equipment shall be used whenever it is compatible with the overall design. Newly developed software and software modified greater than 50% shall be implemented in the Ada software language. Exceptions shall be documented. Support programs shall operate independently of the operational program and shall include the following:

a. Diagnostic features and diagnostic programs provided by equipment manufacturers for use on their equipment.

b. Programs to perform the software testing as required by the verification test procedures.

c. Programs required to fulfill the requirements stated for individual support systems.

d. Programs required to present a "user-friendly" interface to support systems software (e.g., configuration management, parameter editing, ...).

Validated Ada compiler(s), assemblers, linkers, and software support tools shall be used to develop Ada software.

3.4 Quality Factors. The SSM shall meet the quality factor requirements defined in the following paragraphs.

3.4.1 Reliability. The SSM shall be designed and constructed in such a manner to produce a reliable end item using the contractor's best commercial practices as a guide. Commercial off-the-shelf products of proven reliability and maturity shall be used when practical.

3.4.2 Maintainability. The SSM shall be designed and constructed to produce a maintainable end item using the contractors best commercial practices as a guide. Commercially available products shall be used in the design when practical. Design commonalty shall be considered during development to reduce the quantity of unique spares and support equipment required to maintain the SSM. Proper maintenance access shall be incorporated into the design to increase maintainability.

3.4.2.1 Software Quality. All software developed for the SSM or existing software used in the SSM that is modified more than 50% shall be developed in the Ada software language in accordance with MIL-STD-1815A. Ada programming language requirements are not applicable to unmodified manufacturer's software or commercial off-the-shelf software.

3.4.2.2 Ada Programming Support Environment. Validated Ada compilers, assemblers, linkers, and software support tools shall be used to develop Ada software for the SSM.

3.4.3 Flexibility And Expansion. The top level design philosophy for this device shall include features which will facilitate future changes and updates to remain current with the application aircraft.

3.4.4 Availability. The ARWA SS shall be designed and constructed to minimize maintenance and repair time.

3.4.5 Portability. The device shall be designed to withstand transportation in a commercial padded van over representative U.S. highways.

3.5 Logistics. There are no specific logistics requirements applicable to the ARWA SS.

3.6 Precedence. In the event of a conflict between the requirements in documents referenced herein, the requirements of this specification shall take precedence. In the event of a conflict between requirements internal to this specification, the overriding requirement(s) shall be determined by mutual agreement between the Government and the ARWA SS prime contractor.

3.7 Qualification. Formal qualification testing is not required for the SSM. The SSM test program shall be based upon sequential testing which minimizes redundant testing, and reduces the probability of test failure at the system level. The test concept shall include disciplined control of test configuration, timely conduct of test events, and verification of test results prior to beginning the next phase of testing. Testing of the SSM performance characteristics shall be in accordance with the tests identified in the following paragraphs. Details of the test program shall be contained in the ARWA System Test Plan (STP). Test configuration shall be controlled as specified in the ARWA Configuration Management Plan.

3.7.1 Segment Testing. Each segment shall be individually tested, prior to SSM level integration testing, to ensure the requirements of Section 3 have been satisfied. The following testing shall be accomplished at the segment level.

a. Segment Development Test. At the completion of segment development, a set of segment development tests shall be performed for each segment within the SSM. Each segment shall be tested as a stand-alone software product at the external interface level. Segment development tests shall be completed prior to advancing into the next phase of testing. The segment development test phase shall be an informal test phase conducted solely to verify compliance with Section 3 performance requirements for the applicable segment.

3.7.2 Integrated Simulator System Module Testing. Integrated SSM testing shall be accomplished to ensure the requirements of Section 3 are satisfied by the SSM as an integrated entity. The following tests shall be accomplished at the integrated SSM level.

a. Integrated SSM Development Test. Integrated SSM development testing shall consist of a dry run of all SSM acceptance tests. Integrated SSM testing shall focus on compliance with the SSM external interfaces integrated SSM development testing shall be an informal test phase and shall be conducted prior to advancing into the formal SSM acceptance test phase.

b. SSM Acceptance Test. SSM acceptance testing shall consist of the SSM procuring activity accomplishing the acceptance tests formally for SSM acceptance.

4. VERIFICATION REQUIREMENTS

4.1 General. The following paragraphs define the general verification requirements for the ARWA SS.

4.1.1 Philosophy of Testing. Testing of the ARWA SS shall consist of in-plant verification testing to determine specification compliance of the ARWA subsequent to shipment. Verification testing shall be accomplished by performing functional and performance evaluations against predefined verification criteria. Performance evaluations shall be specific tests designed to verify subsystem performance. Acceptance testing shall consist of an installation and checkout activity and a retest period. The retest shall be accomplished by performing a limited subset of the test procedures used during the verification testing functional evaluations.

4.1.1.1 Testing Events. Scheduled testing shall take place sequentially in the following phases.

4.1.1.1.1 Verification Test. Verification testing shall be accomplished prior to integration of the ARWA SSM, VSM, and FSM. The testing shall ensure that the System meets the functional and performance requirements of each volume of this specification.

4.1.1.1.2 Acceptance Test. Site acceptance testing shall consist of installation and checkout of the System at the Government facility, and accomplishment of one or more of the simulated missions conducted during verification test. Acceptance tests and associated acceptance criteria shall be mutually agreed upon by the contractor and procuring activity.

4.1.2 Location of Testing. Verification Testing shall be accomplished at the Loral facility in Orlando, FL, and acceptance testing at the Government facility..

4.1.3 Responsibility for Tests. The responsibility for testing in each phase of testing.

a. Verification phase. The prime contractor and module contractors shall conduct verification testing. Any discrepancies requiring resolution, as determined by mutual agreement, shall be corrected by the prime contractor or the module contractor, as appropriate.

b. Acceptance phase. The prime contractor, or the Government at its discretion, shall conduct acceptance testing. Any discrepancies shall be analyzed for simulator performance impact and appropriate corrective action agreed to by the Government and the prime contractor.

4.1.4 Verification Methods. Verification testing shall be accomplished by one or more of the following methods:

a. Analysis. This method consists of examining engineering design data such as specifications, drawings, documented customer and contractor evaluations, etc., in order to determine that the design will satisfy physical and functional requirements. Analysis is performed to verify performance characteristics of the system, module, or configuration item. Presentation of prior test results and presentation of analysis demonstrating applicability to the current system, module, or configuration item shall be considered a valid analysis technique.

b. Inspection. This method consists of visual examination of the complete System or any of its components, in order to determine that specified physical requirements have been satisfied. Inspection may occur during any stage of the development process, up to and including a complete system.

c. Demonstration. This method consists of operating the complete System, or any of its components, in order to collect data to determine that functional requirements have been satisfied. Demonstrations may occur during any stage of the development process, up to and including a complete system.

d. Test. This method consists of operating the complete System, or any of its components, in order to collect data to determine that performance requirements have been satisfied. Tests may occur during any stage of the development process, up to and including a complete system.

4.2 Formal Test. Formal test shall consist of functional and performance evaluations.

4.2.1 Functional and Performance Evaluations. Evaluations that verify the functionality of the integrated system shall be performed to ensure that the design of the System is as specified in paragraph 3.1.1 of this volume of this specification. Functional evaluations shall consist of analyses and demonstrations as described in paragraph 4.1.4 above. Verification of the design requirements shall be accomplished by operating the System in the appropriate system modes and states. During the verification event, the ARWA SS functional evaluations shall be conducted. Test procedures defining mission scenarios and evaluation criteria shall be developed and used to verify System acceptability.

Tests shall be conducted to verify the performance of critical System elements as defined in the applicable volumes of this specification. Performance evaluations shall consist of analyses, inspections and tests as described in paragraph 4.1.4 above. Test procedures including detailed verification criteria shall be developed and used to verify System performance.

4.2.2 Reliability and Maintainability. Reliability and maintainability demonstrations shall not be performed.

4.2.3 Verification Cross Reference. Table I, ARWA SSM Verification Cross Reference Matrix, provides a requirements/verification cross reference guide for the ARWA SS using the definitions provided in paragraph 4.1.4.

Legend: NA-Not Applicable I-Inspection D-Demonstration A-Analysis T-Test						
Section 3 Requirements Reference	Qualification Method(s)					Section 4 Qualification Requirement Reference
	NA	I	A	D	T	
3.	NA					
3.1	NA					
3.1.1	NA					
3.1.1.1	NA					
3.1.1.1.1				D		4.2.1
3.1.1.1.2				D		4.2.1
3.1.1.1.3				D		4.2.1
3.1.1.2				D		4.2.1
3.1.1.3				D		4.2.1
3.1.1.4				D		4.2.1
3.1.2				D		4.2.1
3.1.3	NA					
3.1.3.1				D		4.2.1
3.1.3.2				D		4.2.1
3.1.3.3	NA					
3.1.3.3.1				D		4.2.1
3.1.3.3.2				D		4.2.1
3.1.3.3.3				D		4.2.1
3.1.3.3.4				D		4.2.1
3.1.3.4				D		4.2.1
3.1.3.5				D		4.2.1
3.1.4	NA					
3.1.4.1	NA					
3.1.4.1.1	NA					
3.1.4.1.1.1				D		4.2.1
3.1.4.1.1.2				D		4.2.1
3.1.4.1.2	NA					
3.1.4.1.2.1				D		4.2.1
3.1.4.1.2.2				D		4.2.1
3.1.4.1.2.3				D		4.2.1
3.1.4.1.2.4				D		4.2.1
3.1.4.1.2.5				D		4.2.1
3.1.4.1.2.6				D		4.2.1
3.1.4.2				D		4.2.1
3.1.4.3				D		4.2.1
3.1.4.4	NA					
3.1.4.4.1				D		4.2.1
3.1.4.4.2				D		4.2.1
3.1.4.4.3	NA					
3.1.4.4.3.1				D		4.2.1
3.1.4.4.3.2				D		4.2.1
3.1.5	NA					

Table 1. SSM Verification Cross Reference Matrix

Legend: NA-Not Applicable I-Inspection D-Demonstration A-Analysis T-Test						
Section 3 Requiremens Reference	Qualification Method(s)					Section 4 Qualification Requirement Reference
	NA	I	A	D	T	
3.1.5.1	NA					
3.1.5.1.1				D		4.2.1
3.1.5.1.2	NA					
3.1.5.1.2.1				D		4.2.1
3.1.5.1.2.2				D		4.2.1
3.1.5.1.3				D		4.2.1
3.1.5.1.4				D		4.2.1
3.1.5.1.5				D		4.2.1
3.1.5.1.6				D		4.2.1
3.1.5.1.7				D		4.2.1
3.1.5.1.8				D		4.2.1
3.1.5.1.9				D		4.2.1
3.1.5.1.10				D		4.2.1
3.1.5.1.2				D		4.2.1
3.1.6				D		4.2.1
3.1.7	NA					
3.1.7.1				D		4.2.1
3.1.7.2				D		4.2.1
3.1.7.3				D		4.2.1
3.1.7.4				D		4.2.1
3.1.7.5				D		4.2.1
3.1.7.6	NA					
3.1.7.6.1				D		4.2.1
3.1.7.6.2				D		4.2.1
3.1.7.6.3				D		4.2.1
3.1.7.6.4				D		4.2.1
3.1.7.7				D		4.2.1
3.1.7.8	NA					
3.1.7.8.1				D		4.2.1
3.1.7.8.2				D		4.2.1
3.1.7.8.3				D		4.2.1
3.1.7.8.4				D		4.2.1
3.1.7.8.5				D		4.2.1
3.1.7.8.6				D		4.2.1
3.1.7.8.7				D		4.2.1
3.1.7.8.8				D		4.2.1
3.1.7.9	NA					
3.1.7.9.1				D		4.2.1
3.1.7.9.2				D		4.2.1
3.1.7.10	NA					
3.1.7.10.1				D		4.2.1
3.1.7.10.2	NA					

Table 1. SSM Verification Cross Reference Matrix
[Continued]

Legend: NA-Not Applicable I-Inspection D-Demonstration A-Analysis T-Test						
Section 3 Requiremens Reference	Qualification Method(s)					Section 4 Qualification Requirement Reference
	NA	I	A	D	T	
3.1.7.10.2.1				D		4.2.1
3.1.7.10.2.2				D		4.2.1
3.1.7.10.2.3				D		4.2.1
3.1.7.10.2.4				D		4.2.1
3.1.7.10.3	NA					
3.1.7.10.3.1				D		4.2.1
3.1.7.10.3.2	NA					
3.1.7.10.3.2.1				D		4.2.1
3.1.7.11				D		4.2.1
3.1.8		I				
3.1.9	NA					
3.1.9.1				D		4.2.1
3.1.9.2	NA					
3.1.9.2.1				D		4.2.1
3.1.9.2.2				D		4.2.1
3.1.9.2.3				D		4.2.1
3.1.9.3				D		4.2.1
3.1.9.4	NA					
3.1.9.4.1				D		4.2.1
3.1.9.4.2				D		4.2.1
3.1.9.5				D		4.2.1
3.1.9.6	NA					
3.1.9.6.1				D		4.2.1
3.1.9.6.2				D		4.2.1
3.1.9.6.3				D		4.2.1
3.1.10	NA					
3.1.10.1				D		4.2.1
3.1.10.2				D		4.2.1
3.2	NA					
3.2.1	NA					
3.2.1.1		I				4.2.1
3.2.1.2		I				4.2.1
3.2.1.3		I				4.2.1
3.2.1.4		I				4.2.1
3.2.1.5		I				4.2.1
3.2.1.6		I				4.2.1
3.2.1.7	NA					
3.2.1.7.1		I				4.2.1
3.2.1.7.2		I				4.2.1
3.2.1.7.3		I				4.2.1
3.2.1.8	NA					
3.2.1.8.1		I				4.2.1
3.2.1.8.2		I				4.2.1
3.2.1.8.3		I				4.2.1

Table 1. SSM Verification Cross Reference Matrix
[Continued]

Legend: NA-Not Applicable I-Inspection D-Demonstration A-Analysis T-Test						
Section 3 Requiremens Reference	Qualification Method(s)					Section 4 Qualification Requirement Reference
	NA	I	A	D	T	
3.2.1.8.4		I				4.2.1
3.2.1.8.5		I				4.2.1
3.2.1.8.6		I				4.2.1
3.2.1.8.7		I				4.2.1
3.2.1.8.8		I				4.2.1
3.2.1.8.9		I				4.2.1
3.2.1.8.10		I				4.2.1
3.2.1.9		I				4.2.1
3.2.1.10		I				4.2.1
3.2.2				D		4.2.1
3.2.3				D		4.2.1
3.2.4	NA					
3.2.4.1				D		4.2.1
3.2.5				D		4.2.1
3.2.6				D		4.2.1
3.2.7				D		4.2.1
3.2.8	NA					
3.2.8.1				D		4.2.1
3.2.8.2				D		4.2.1
3.2.9				D		4.2.1
3.2.10				D		4.2.1
3.3	NA					
3.3.1				D		4.2.1
3.3.2				D		4.2.1
3.4	NA					
3.4.1				D		4.2.1
3.4.2	NA					
3.4.2.1				D		4.2.1
3.4.2.2				D		4.2.1
3.4.3				D		4.2.1
3.4.4				D		4.2.1
3.4.5				D		4.2.1
3.5				D		4.2.1
3.6			A			4.2.1
3.7	NA					
3.7.1				D		4.2.1
3.7.2				D		4.2.1

Table 1. SSM Verification Cross Reference Matrix
[Continued]

5. PREPARATION FOR DELIVERY

5.1 Preserving and Packaging. Best commercial practices shall be used to preserve and package the device in order to ensure that there will be no damage or degradation of performance during shipment.

5.2 Marking. Marking of assemblies shall be in accordance with the intent of MIL-STD-129 (applicable sections). Commercial equipment will not be remarked.

6. NOTES

6.1 Acronyms.

ADS	Air Data Subsystem
ADSS	Air Data Sensor Subsystem
ADST	Advanced Distributed Simulation Technology
ADF	Automatic Direction Finder
ARWA	Advanced Rotary Wing Aircraft
AFCS	Automatic Flight Control System
AHRS	Attitude and Heading Reference System
AM	Amplitude Modulation
ASE	Aircraft Survivability Equipment
ATHS	Automatic Target Handover System
BDS-D	Battlefield Distributed Simulation - Development
C	Centigrade
CADC	Central Air Data Computer
CDU	Computer Display Unit
CG	Center of Gravity
CNAV	Coupled Navigation System
CPG	Copilot/Gunner
CWS	Chemical Warning System
db	decibel
D/F	Direction Finding
DIS	Distributed Interactive Simulation
DNS	Doppler Navigation System
DOD	Department of Defense
DTV	Day Television
DVO	Direct View Optics
ECS	Environmental Control System
ETL	Engineering Topographic Laboratory
FDDI	Fiber Distributed Data Interface
FD/LS	Fault Detection/Location System
FLIR	Forward Looking Infrared
FM	Frequency Modulation
FOR	Field of Regard
FOV	Field of View
GFP	Government Furnished Property
GPS	Global Positioning System

HARS	Heading and Attitude Reference System
Hg	Mercury (Barometric Pressure)
HF	High Frequency
HOL	High Order Language
HWCI	Hardware Configuration Item
ICS	Intercom System
IDD	Interface Design Document
IFF	Identification Friend or Foe
IFFC	Integrated Fire/Flight Control
I/O	Input/Output
IOS	Instructor/Operator System
IR	Infrared
LAN	Local Area Network
LF	Low Frequency
LOS	Line of Sight
LPRF	Laser Pulse Repetition Frequency
LPW	Laser Pulse Width
LRF/D	Laser Range Finder/Designator
LST	Laser Spot Tracker
LWR	Laser Warning Receiver
MCC	Management Command and Control
MFD	Multi-function Display
MMS	Mast Mounted Sight
MSE	Multiple Simulator Environment
MSS	Modular Simulator System
NATO	North Atlantic Treaty Organization
NOE	Nap of Earth
NVG	Night Vision Goggles
NVPS	Night Vision Pilotage System
OTW	Out the Window
PNVS	Pilot Night Vision System
PRF	Pulse Repetition Frequency
PW	Pulse Width
RADIAC	Radiological
RAM	Random Access Memory
RF	Radio Frequency
RFD	Remote Frequency Display
RWA	Rotary Wing Aircraft
RWR	Radar Warning Receiver
RWS	Radiological Warning System
SAD	Situational Awareness Display
SCAS	Stability and Control Augmentation System
SOW	Statement of Work
SS	Simulator System
SSM	Simulator System Module

STP	System Test Plan
TADS	Target Acquisition Designation Sight
TAS	Target Acquisition System
TBD	To Be Determined
TBR	To Be Resolved
TBS	To Be Supplied
TIS	Thermal Imaging System
TNE	Tactical and Natural Environment
TOC	Tactical Operations Center
TVS	Television Sensor
UHF	Ultra High Frequency
V	Version
VHF	Very High Frequency
VNET	Virtual Network

6.2 Intended Use. The SSM is one of three modules comprising a manned simulation device based on the Modular Simulator System (MSS) architecture. The manned simulation device(s) consist of AH-64D and RAH-66 rotary wing aircraft simulations used to explore tactics, doctrine and combat system development issues in a DIS environment. The devices are not intended to be used for training aircrews.

6.2.1 Missions. The ARWA devices are not required to support specific missions. The devices will be used for experimentation purposes. The adaptability parameters identified in Appendix B will be used to modify characteristics of the device as required by the experiment. A default value shall be defined for each of these parameters to allow for system initialization. The default values shall represent a nominal aircraft configuration.

6.2.1.1 Aircraft Operations. Aircraft operations, tasks and procedures, as applicable to the models within the SSM, shall be simulated to the level of fidelity and functional performance defined in the following paragraphs.

6.2.1.1.1 Ground Operations. Ground operations shall include tactical resupply and rearming. A complex ground handling model is not required. Ground handling shall consist of landing the aircraft with no movement along the ground. Ground operations such as engine start, engine run-up, engine and aircraft shutdown, mission loading, pre-flight and post-flight checkout and adjustment/calibration procedures shall not be provided.

6.2.1.1.2 Takeoff/Climb/Cruise. Simulation of the transition from the ground environment to flight, including aerodynamic ground effects, shall be provided. All regimes of aircraft flight within the flight envelope of the aircraft shall be modeled.

6.2.1.1.3 Approach and Landing. Simulation of the transition from flight to ground environment, including aerodynamic ground effects, shall be provided. Simulation of emergency landing operations is not required.

6.2.1.1.4 Application Specific Flight Operations. Simulation of the low level, contour, nap of the earth, masking and unmasking, and hovering flight shall be provided to the level of fidelity defined in section 3 of this specification, as applicable to the segments within the SSM.

6.2.1.2 Mission Specific Operations. The SSM shall support the ARWA device requirement to simulate the aircraft functions needed to move, shoot, communicate, rearm, and resupply to the level of fidelity defined in section 3 of this specification.

6.2.1.3 Multiple Simulator Operations. The SSM shall provide an interface to allow the interoperability/networking of the ARWA device to other simulation devices. The interface shall comply with the Standards for Distributed Interactive Simulation, version 2.0.3. The ARWA devices to the DIS network shall be via the Environment segment.

APPENDIX A

10. BATTLE DAMAGE AND SYSTEM MALFUNCTIONS

10.1 Introduction. This paragraph defines the requirements for segments in the ARWA for the simulation of battle damage.

10.2 General Damage Processing. Damage shall arise from either of two sources. First, damage may result from collision with terrain, culture, or other vehicles. In the ARWA, collision shall result in a crash and loss of vehicle. Second, damage may result from the impact and detonation of ordinance on or near the airframe. The ARWA shall simulate the effects of these combat caused damages.

The Environment segment shall filter the impacts and detonations occurring in the DIS Environment to remove from consideration those which cannot affect the ARWA. The Weapons segment shall evaluate the remaining impacts and detonations for effect upon the ARWA device. The Weapons segment shall assign a location and severity percentage (01 to 100) for each impact and detonation judged to have affected the ARWA device. The Weapons segment shall broadcast this Damage Assessment message to all segments. Each segment shall simulate the effect of that damage assessment upon the aircraft systems and mission equipment packages associated with it. The Flight Dynamics segment shall generate an impact and detonation force based on the damage assessment message. This impact and detonation force shall affect the flight path of the vehicle accordingly.

The two types of damage classifications in the ARWA are total and fractional system failures. Total system failures shall be a complete loss of capability for the system. The largest incidence of total system failures is for the aircraft electronic systems. Each segment shall inspect the damage assessment message for potential damage to some portion of the electronic system (antennas, black boxes, etc.). The fractional system failures shall simulate a partial loss of capability determined by the segment upon receipt of the damage assessment message. The specific degree of lost capability will not directly be the damage assessment's percentage. Each segment shall independently model the effect of damage in a particular location. This modeling shall appropriately address the potential physical or mechanical manifestations in the aircraft or mission equipment which are the segment's responsibility and located in the affected airframe zone.

10.3 Damage Location Requirements. The Weapons segment shall determine the affected location on the airframe of an impact and detonation of ordinance. These locations shall represent the extremities of the aircraft (main rotor, tail rotor, and landing gear) and a breakdown of the airframe into localized "cubes." The cubes shall result from indexing along the three airframe axes (length, height, and width). The length indices shall be nose, fuselage, and tail. The height indices shall be high and low. The width indices shall be starboard and port (from the pilot's perspective). More specific information shall not be required. The Weapons segment shall generate a severity of damage expressed as a percentage, according to the specific weapon, warhead, and airframe. Specific knowledge by other segments of this damage assessment process shall not be required.

10.4 Segment Battle Damage Requirements. The following paragraphs detail the damage simulation requirements for each segment.

10.4.1 Flight Station Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the damage via the effects described by the following:

(a) Electrical System Failure

(b) Hydraulic System Leak

(c) Hydraulic System Failure

10.4.2 Flight Controls Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Main Rotor Flight Controls Failure (01 to 100%)

(b) Tail Rotor Flight Controls Failure (01 to 100%)

10.4.3 Flight Dynamics Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Nose Airframe Distortion

(b) Tail Airframe Distortion

(c) Fuselage Airframe Distortion

(d) Landing Gear Airframe Distortion

(e) Stub Wing Airframe Distortion

(f) Tail Rotor Blade Damage (01 to 100%)

(g) Main Rotor Blade Damage (01 to 100%)

10.4.4 Propulsion Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Fuel System Leak (01 to 100%)

(b) Fuel System Failure

(c) Transmission Damage (01 to 100%)

(d) Turbine Damage (01 to 100%)

10.4.5 Navigation/Communication Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Doppler Navigation System Failure

(b) Intercom System Failure

(c) Radio Systems (VHF, UHF, HF) Failures

(d) Air Data Sensors Failure

(e) Airborne Target Handover System Failure

10.4.6 Weapons Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Incidental Detonation (Ownship weapons)

(b) Incidental Jettison (Ownship weapons)

(c) Fire Control System Failure

(d) Gun Turret System Failure

10.4.7 Sensor Control Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Night Sight Sensors System Failure

(b) Day Sight Sensors System Failure

(c) Laser Sensors System Failure

(d) Integrated Helmet Display System Failure

(e) Autotracker System Failure

(f) Turret Steering System Failure

10.4.8 Aircraft Survivability Equipment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Radar Warning System Failure

(b) Laser Warning System Failure

(c) Radiological Warning System Failure

(d) Chemical Warning System Failure

(e) Radar Jamming System Failure

(f) Infra-red Jamming System Failure

(g) Chaff System Failure

(h) Flares System Failure

0.4.9 Physical Cues Segment Damage Requirements. This segment shall receive the damage assessment message from the Weapons segment for simulation of the resulting damage to its aircraft systems. This segment shall simulate the effects described by the following:

(a) Wind Noise from Airframe Damage (01 to 100%)

(b) Impact and Detonation Noise (01 to 100%)

10.4.10 Control Segment Damage Requirements. Simulation of damage shall not be required for this segment.

10.4.11 Environment Segment Damage Requirements. This segment shall translate the damage assessment message to describe to the DIS the effect of the impact and detonation on the ownship.

APPENDIX B

20. SIMULATOR ADAPTABILITY

20.1 Introduction. The ARWA SS adaptability requirement is to support convenient modification of significant simulation parameters in order to permit experiments with different weapon system characteristics. The adaptability problem may be divided into five levels of scope:

(a) Parameter Tuning (during simulation),
(b) Parameter Estimation (off-line),
(c) Model Modification (new baseline), and
(d) New Model (off-site).

This appendix only addresses parameter tuning and parameter estimation. Model modification and new model creation involves the editing of simulation source code, and therefore is the domain of the ARWA Development subsystem.

20.2 Parameter Adaptability. The following paragraphs detail the requirements for parameter-oriented adaptability, i.e., parameter tuning and parameter estimation. Parameter estimation shall be the process by which an experimenter defines a baseline set of simulation parameters for later execution. It shall be an off-line process, i.e., access to an ARWA Device shall not be required. Parameter tuning shall be the process by which an experimenter refines his initial parameter estimates while the simulation is in progress. Parameter estimation and parameter tuning shall permit access to the same set of editable parameters. Parameter tuning shall provide a superset of the parameter estimation functions. A specific set of parameter values for the simulation shall be identified for initialization of the ARWA device. These values shall serve as default values for the adaptability parameters. Each segment shall initialize to these default values unless requested to do otherwise by the Control segment. The default values shall represent a normal or nominal value for the aircraft.

20.3 Session Manager Adaptability. This paragraph shall address the specific role of the Session Manager in parameter adaptability.

The Session Manager shall provide an interface for users to access and edit the parameters defined in paragraph 20.4 for each ARWA Device. This interface shall provide convenient tools that permit the user to access and modify adaptability parameters for a given ARWA device. The interface shall permit the user to uniquely create, name, rename, and delete adaptability parameters individually or as a set. The Session Manager shall query the user about saving parameter data sets upon shut down of the affected ARWA Devices for future experiments.

The Session Manager shall display default values and the current value for every parameter to the user. The Session Manager shall permit the user to edit from these, or load a saved data set to insert new values into an exercise. The Session Manager shall provide a structured interface to the parameters to ease the experimenter's task in selection and editing of the parameters. In the case of parameter tuning, the Session Manager shall not implement a given parameter edit immediately. The Session Manager shall record the series of edits (for estimation or tuning) during a edit session. The Session Manager shall permit undoing the edits via reload of the last parameter data set. The Session Manager shall permit the user to save the edited data set at any time. In the case of parameter tuning, the Session Manager shall permit the user to introduce the edit series into the simulation. Introduction of changes to adaptability parameter values shall require a freeze and realignment of the affected ARWA Device. The Session Manager shall allow the user to freeze the entire simulation exercise or just the ARWA Device affected by the parameter tuning, for the purposes of introducing the new data set. Introduction of the data set shall consist of sending the data set to the affected ARWA Device's Environment segment via the DIS Network, and issuance of a freeze and a alignment state transition command. All DIS data transmissions shall use the simulation management Protocol Data Units (PDUs) as defined in DIS standard 2.0, version 3.

20.4 ARWA Device Adaptability. The requirements for parameter adaptability vary from segment to segment within the ARWA Device. The following paragraphs detail the parameter adaptability requirements by segment.

20.4.1 Flight Station Segment Adaptability Requirements. The flight station segment shall provide parameters for adaptability. The parameters shall allow for the adjustment of fuel capacity and fueling time.

20.4.2 Flight Controls Segment Adaptability Requirements. The flight controls segment shall provide parameters for adaptability. The parameters shall allow for the sensitivity adjustment for the cyclic control and collective control.

20.4.3 Flight Dynamics Segment Adaptability Requirements. The flight dynamics segment shall provide parameters for adaptability. The parameters shall allow for the adjustment of pitch limits, roll limits, yaw limits, turning radius, main rotor lift performance, tail rotor lift performance, and weight limits.

20.4.4 Propulsion Segment Adaptability Requirements. The propulsion segment shall provide parameters for adaptability. The parameters shall allow for the adjustment of fuel burn rate and maximum turbine speed.

20.4.5 Nav/Comm Segment Adaptability Requirements. The navigation/communication segment shall provide parameters for adaptability. The parameters shall allow for the adjustment of position error, bearing error, and attitude error for the navigation system.

20.4.6 Weapons Segment Adaptability Requirements. The weapons segment shall provide parameters for adaptability. Figure 20.4.6-1 illustrates the weapons segment parameters.

20.4.7 Sensor Segment Adaptability Requirements. The sensor segment shall provide parameters for adaptability. The parameters shall allow for the adjustment of NVPS and TAS turret slew rates; NVPS and TAS gimbal limits; NVPS, TAS TV, and TAS FLIR FOV limits; maximum target detection range; maximum target classification range; and laser range error.

20.4.8 ASE Segment Adaptability Requirements. The aircraft survivability equipment segment shall provide parameters for adaptability. Figure 20.4.8-1 illustrates the aircraft survivability equipment segment parameters.

Parameters	Stinger	Hellfire	Hydra 70	20mm Gun
System				
Stores Limits	X	X	X	X
Selection	X	X	X	X
Load Time	X	X	X	X
Thrust				
Accelerations	X	X	X	NA
Burn Times	X	X	X	NA
Turning Radius	X	X	NA	NA
Jink Radius	X	X	NA	NA
Warheads				
Type	X	X	X	X
Fusing	X	X	X	X
Seeker/Tracker				
Type	X	X	NA	NA
Frequency	X	X	NA	NA
Style	X	X	NA	NA
Effectivity	X	X	NA	NA
Launch Criteria				
Range	X	X	X	NA
Elevation	X	X	X	X
Azimuth	X	X	X	X
Lock	X	X	NA	NA
Uncage	X	X	NA	NA
Launch Rate	X	X	X	X

Figure 20.4.6-1 Weapons Segment Adaptability Parameters

Parameters	Radar Warning	Laser Warning	Radiation Warning	Chemical Warning	Radar Jammer	IR Jammer	Chaff	Flare
Frequency	X	X	NA	NA	X	NA	NA	NA
PRF	X	X	NA	NA	X	NA	NA	NA
PW	X	X	NA	NA	X	NA	NA	NA
FOV	X	X	NA	NA	X	NA	NA	NA
Detection Range	X	X	X	X	X	NA	NA	NA
Direction Finding	X	X	NA	NA	NA	NA	NA	NA
Frequency	NA	NA	NA	NA	X	X	X	X
Power	NA	NA	NA	NA	X	Joules	NA	NA
Technique	NA	NA	NA	NA	X	X	Type	Type
Jam Range	NA	NA	NA	NA	X	NA	NA	NA
Dispense Program	NA	NA	NA	NA	NA	NA	X	X
Bloom Rate	NA	NA	NA	NA	NA	NA	X	X

Figure 20.4.8-1 Aircraft Survivability Equipment Adaptability Parameters

20.4.9 Physical Cues Segment Adaptability Requirements. The physical cues segment shall not be required to provide any parameter adaptability.

20.4.10 Visual Module Adaptability Requirements. The visual segment shall provide parameters for adaptability.

20.4.11 Control Segment Adaptability Requirements. The control segment shall not be required to provide any parameter adaptability. However, the control segment is the central controller of parameter adaptability for the ARWA Device. The control segment shall receive requests to change adaptability parameter values from the Environment segment. These requests will be received from the Session Manager subsystem by the Environment segment via the DIS network interface. The Environment will pass these requests to the Control segment via the VNET. The Control segment shall control the insertion of the new adaptability parameter value into the exercise to affect the desired result.

20.4.12 Environment Segment Adaptability Requirements. The Environment segment shall not be required to provide any parameter adaptability. The Environment segment shall receive DIS Data PDUs from the Session Manager subsystem when an adaptability parameter change is required. The Environment segment shall pass the adaptability parameter change request to the Control segment for implementation.

APPENDIX C

30. SIMULATION DATA LOGGER

30.1 Introduction. The ARWA SS data logger shall provide an after-action capability to analyze the results of a simulation game. The only requirement for data logging shall be recording of BDS-D Network traffic. The BDS-D Network provides the information flow between and about entities in the simulation game.

30.2 Simulation Manager Data Logger. The simulation manager shall provide the ARWA SS data logger function. Initiation of a data logging session shall require the specification of the level of messages to record as well as specification of the group of simulation entities.

The data logger function shall support the recording of BDS-D network traffic at three levels. The function shall permit the all BDS-D messages. The function shall permit the user to record all BDS-D messages of a specified type. The function shall permit the user to record all BDS-D messages all a specified type when a specified field within the message takes on a specified value.

The data logger function shall support the recording level specification for three different groups of BDS-D network traffic in three different groups. The function shall permit the user to specify the group of all entities. The function shall permit the user to specify the group of all entities of a certain class(e.g., AH-64D, RAH-66, etc.). Finally, the function shall permit the user to specify the group of a single entity.

The simulation manager shall provide a convenient mechanism for specifying the various components of the data logger specification. It shall mark each set of recordings with an identification of the kind of recordings. It shall provide the necessary memory for storing the recording messages. It shall provide tools for inspection and analysis of the recorded messages. The specific requirements for the simulation manager are found in Volume I of this specification.

30.3 ARWA Device Data Logger. The ARWA SS requirement to support data logging is to record BDS-D network traffic. This requirement is entirely allocated to the Simulation Manager. Therefore, there is no data logging requirement specified for the individual ARWA Devices.