SIMULATION NETWORKING AT KIRTLAND AFB

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ABSTRACT

Under the sponsorship and direction of the 542d Crew Training Wing at Kirtland AFB and the Department of the Air Force Headquarters, Ogden Air Logistics Center (AFMC) at Hill AFB, Utah, Martin Marietta has implemented a real-time network for multi-device interactive simulation. Currently this network is on contract to interface the following air crew training devices and facilities: MH-53J Weapon System Trainer (WST)/Mission Rehearsal System (MRS), MH-60G WST, TH-53A Operational Flight Trainer (OFT), and the 542d Training Observation Center (TOC). The network designated SOF-NET, was integrated and ready for training (RFT) in 1993. In the near future, the network will expand to include the HC-130P, MH-60G OFT, Aerial Gunner and Scanner Simulator (AGSS), and an external Distributed Interactive Simulation (DIS) network node. The external node will be used to link the SOF-NET with other Government networks and facilities. To date, the MH-60G, MH-53J, and TH-53A helicopter simulators have been successfully tested for network interactions; in support of an accident investigation, key information was provided through a networked simulation of a multiple ship mission.

This paper examines the Kirtland network architecture and the implementation approach which links the varied computational platforms, Image Generators, Radar and EW Systems. The SOF-NET results to date and potential future projects suggest that this facility is a pathfinder site for the resolution of several thorny DIS issues such as data base correlation, EW simulation, virtual/ constructive interfaces and aggregation/deaggregation. The successful resolution of these issues as applied at Kirtland AFB may impact future revisions of the DIS specification and provide a basis for future interactive network applications.

ABOUT THE AUTHORS

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Kevin Curley is Martin Marietta's Project Engineer for the Training Observation Center (TOC) at the Kirtland AFB 542d Crew Training Wing facility. He is responsible for the technical functionality of the TOC as it provides overall command and control environments for the four fully functional Weapons Systems Trainers utilizing the SOF-NET at the 542d. Previous to being assigned to Mission Support Systems Programs, Kevin was a hardware design and development engineer and lead systems engineer in large, parallel processing, environments for several major programs. Kevin holds a BS in Electrical Engineering from the University of Florida and a MS in Engineering from the University of Pennsylvania.

John Little is a Chief Engineer working with Business Development for Martin Marietta's Mission Support Systems Programs in Daytona Beach, Florida. He is currently responsible for developing solutions to technical challenges for new and current flight simulation programs. John's previous position was Chief Engineer for the MH-60G Weapon System Trainer (WST) program, under which the SOF-NET system was originally installed in the 542d training facility. John holds a BS in Computer Science from Arkansas State University.

Frank Magee is the Systems Engineer developing DIS application requirements and various inter-simulation demonstration scenarios. Frank worked extensively on the 542d's local Inter-Simulator Network requirements and design control effort. Frank, a former Marine officer, holds bachelor's and master's degrees in mathematics from Temple University and Villanova University, respectively.

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INTRODUCTION

An unprecedented capability in the high fidelity arena of helicopter crew training and mission rehearsal has been developed at the 542d Crew Training Wing located at Kirtland AFB. This capability centers around three helicopter training devices: the MH-60G Weapon System Trainer (WST), the MH-53J WST and the TH-53A Operational Flight Trainer (OFT). These trainers include full fidelity simulation of subsystems such as Forward Looking Infrared (FLIR), Digital Radar Landmass (DRLMS), Night Vision Goggles (NVG), Electronic Warfare (EW), and a fully realistic cockpit with an Out-The-Window (OTW) display driven by an eight-channel COMPU-SCENE V Image Generator (IG). The training capability of this facility has been further enhanced by the development of a state-of-the-art Data Base Generation System (DBGS) which currently provides high fidelity, fully correlated (OTW visuals with FLIR with NVG with radar and EW) data bases for each of the trainers. This combination of fully realistic training devices coupled with high fidelity data base production has enabled a unique training and mission rehearsal capability in support of SOF missions for individual crews.

This training/mission rehearsal capability has been significantly expanded with the introduction of the SOF-NET network, as shown in Figure 1. This network will allow SOF teams to train and rehearse for multiple ship missions. The hub of the SOF-NET network is the Training Observation Center (TOC). The TOC is a multi-media center which supports role playing, review, and replay of networked training and mission rehearsal exercises.

Future network expansion will support team training in joint exercises against highly realistic threats provided by other DoD facilities. This paper summarizes (1) design considerations for the SOF-NET, (2) the TOC, (3) the SOF-NET hardware implementation, (4) the SOF-NET software implementation, and (5) future SOF-NET expansions.

SOF-NET DESIGN CONSIDERATIONS

The training devices linked via SOF-NET are the MH-53J WST, MH-60G WST, TH-53A OFT, and the TOC. These devices represent a variety of computational platforms and a distributed processing environment which shaped SOF-NET's architecture and implementation. Figure 2 shows a block diagram representative of a typical helicopter trainer at Kirtland AFB. The block diagram emphasizes the major computational platforms including the SOF-NET interface. The specific computational platforms for each trainer are listed in Table 1.

The table illustrates that while the IG and basic instructor-operator systems are identical for the three systems, the host computational platform and underlying software approach for each of the systems are significantly different. Therefore, the key issue for the SOF-NET network architecture was to provide a common system capable of linking disparate trainer host systems. This posed unique challenges for software data structure designs and hardware interfaces between varying host computational platforms and a single network structure.

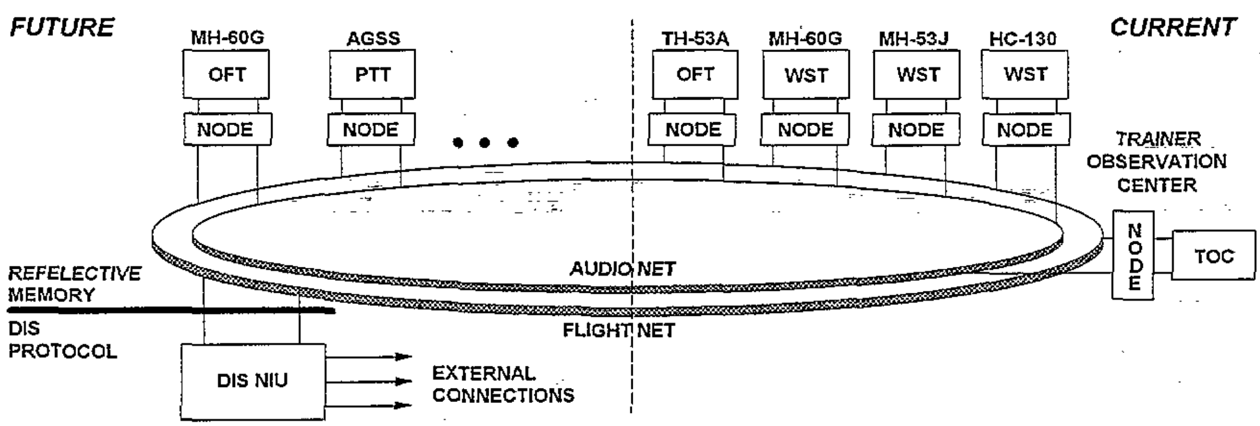

Figure 1. 542d CTW SOF-NET With Future Expansions

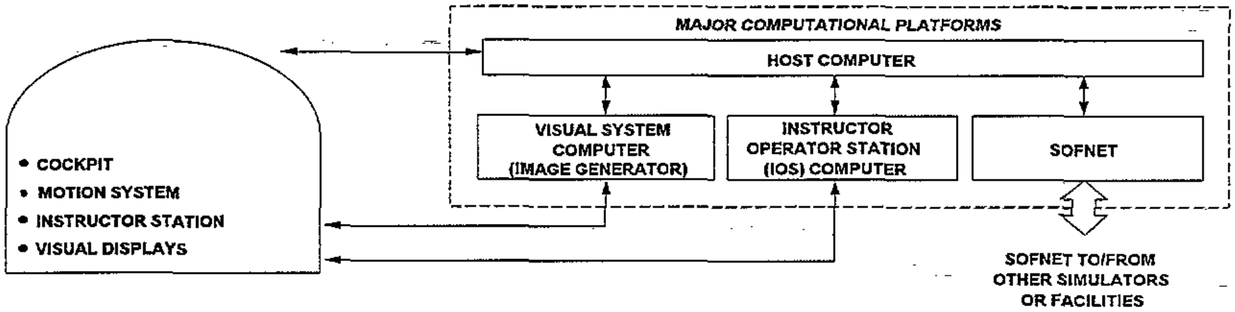

Figure 2. Typical SOF-NET Integrated Trainer Block Diagram

Training Platform Commonality

Each training system was developed with differing technology levels along with different contractors and differing design philosophies. While there were many issues to resolve in networking these trainers, the most fundamental issues were:

1) Basic host iteration rates
2) Intercommunication system capability
3) Host software fidelity

Intercommunication System Capability

The intercommunication systems construction varied widely, along with the flexibility and capabilities of each system. The TH-53A contains a strictly analog system from the 1970's, while the MH-53J and MH-60G both contain digital systems. The digital systems were different between the MH-60G and MH-53J, however, until late 1992 when a modification was placed in the MH-53J to adapt a system similar to the MH-60G onto the simulator. The interface design between the SOF-NET and the simulator had to be generic enough to allow for integration of a common design to interface with each of the three audio designs.

Table 1. Kirtland Trainer Major Computer Platforms

MAJOR CPU	MH-60G	MH-53J	TH-53A
HOST	Force Harris (DRLMS)	Encore Multi-Sel	Harris 500 w/Force Interface
IOS	Silicon Graphics	Silicon Graphics	Silicon Graphics
IG	Encore COMPU-SCENE V	Encore COMPU-SCENE V	Encore COMPU-SCENE V
ISN	Force	Force	Force

Basic Host Iteration Rates

For this element of the problem, the TH-53A executes at 16 Hz, the MH-53J executes at 60 Hz and the MH-60G executes at 30 Hz. Each simulator had its own timing scheme, and own system hardware limitations. This made the challenge of integrating a standard network with the hosts a real challenge. The basic approach is to update the network at high rates. This drove the requirement for a high bandwidth network which was implemented with the SCRAMNet™ reflective memory architecture.

SCRAMNet is a registered trademark of SYSTRAN Corporation.

Host Software Fidelity

The simulation system is only as good as its hardware and software components, and the diversity between the three simulators varied widely. Along with the differing iteration rates comes the differing levels of fidelity in the calculations associated with the visual interface, flight equations and instructor interfaces. Each of the three devices, being of differing heritage, had a different slant on the same problem. For example, the TH-53A is compiled in Harris Assembler, while the MH-60G and MH-53J are written in Fortran. Here was the largest challenge, and where the most emphasis has been placed to balance between commonality in the network interface units, while minimizing modifications to the host systems.

Level of Fidelity

As the designs for each WST and the TOC have evolved, the requirements for the SOF-NET have matured and stabilized. The key SOF-NET design goals were to support the highest levels of fidelity while minimizing modifications to the individual WST's. The focus was to allow for two elements to be fully supported: 1) Visual correlation and 2) audio integration. Any peculiar element associated with network operation which was unique to a device was left to that device to either enhance or ignore. The SOF-NET integration requirement has evolved into the support of an interface which can generally be met by almost all simulators on the market today along with a direct correlation with the DIS standard.

Trainer interaction became a simplified set of primitives: one set for each trainer. Each data set contains all that is required to be known about that entity on the network. There have been some simplifications due to the fact that the helicopters which have been dealt with so far do not emit items such as missles or gun fire. (The SOF-NET will be updated to support these types of entities when the AGSS is integrated onto the network.) The data supplied in the entity blocks is sufficient to drive moving models and special effects for representation of the information on the visual systems of each of the WST's. Along with the ownship information, each entity block also contains all model information for any moving models driven by that ownship.

TRAINING OBSERVATION CENTER (TOC)

The TOC, as shown schematically in Figure 3, is a facility designed specifically to support the Kirtland SOF-NET. The TOC has several missions: 1) provide an electronic classroom which supports multi-media academic training such as computer-based training (CBT) materials, and live or pre-recorded audio and visual data from the simulators operating on the SOF-NET, 2) provide the capability for interactive role playing during multi-ship training scenarios involving audio communications with each training device, 3) provide the capability for flight tracking utilizing a map-based situational display, and 4) provide the capability to selectively monitor simulator visual data.

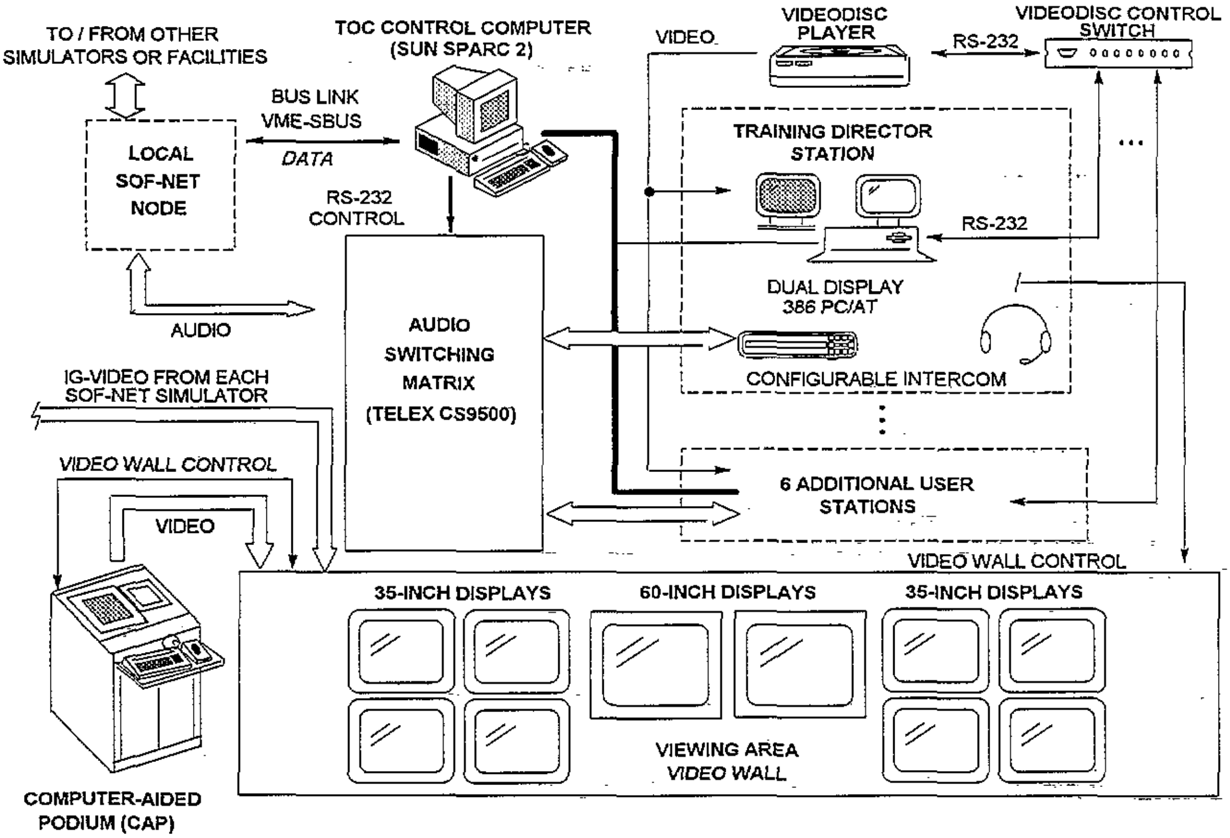

Figure 3. Training Observation Center (TOC) Block Diagram

Electronic Classroom

The TOC's *electronic classroom capability centers around the* Computer-Aided Podium (CAP). The CAP provides a user friendly, tailorable multi-media control interface. The CAP user can select a variety of visual options for video wall displays such as CBT, live video from any of the simulators on the SOF-NET, or pre-recorded video from a tape played on any one of the four VCR's available in the TOC. In addition, the TOC has an *audio/visual recording capability which allows recording of any* classroom or training activity conducted in the TOC for later review. The CAP is the control center for the TOC's electronic classroom.

Interactive Role Playing

The TOC has seven user stations each providing the capability for interactive role-playing during multi-ship SOF-NET missions. Each user has a 386PC/AT and a configurable intercom unit. The user PC provides a Microsoft Windows based interface for configuring the user's communications selections and accessing the Fulcrum situation display system. The user's intercom allows selection of any UHF, HF, or FM radio and frequency combination. Radio communications operate much the same as in the real-world in that the user will be connected for communications with any other TOC user and/or simulator crew position on the SOF-NET based upon radio/frequency matching. In addition to the three radios channels, each TOC user has a configurable instructor channel which allows private communications with a single simulator instructor or common connection to all instructors.

Situational Display

Fulcrum is a map-based mission tracking capability allowing the use of Videodisc or CD-ROM based maps. The user's Fulcrum situation display is automatically fed overlay data extracted from the SOF-NET by the SparcStation 2 acting as the TOC control computer. The extracted data consists of pertinent model, position, and support information for each player on the network. *The user selects the desired map resolution and* geographic region of interest. Fulcrum filters the overlay data based upon the user's selections and displays icons in the area being viewed (representing ownships, moving models, threats, and aircraft tracks). Fulcrum is operated by each user in a networked mode which allows the use of a single videodisc or CD-ROM drive to provide a map source while at the same time *allowing each user to view the mission tailored to specific user* interest.

The TOC control computer acts as the Ethernet LAN server, controls the audio switching matrix and provides a bridge to the SOF-NET data. The Ethernet LAN allows automatic distribution of SOF-NET situational data to each user station and access to user radio configuration information. The user radio configuration information is combined with simulator radio configuration data taken off the SOF-NET to configure the audio switching matrix.

Viewing Area Video Wall

The TOC video wall is configurable for a wide variety of display options. Video selections include VCR tapes, CBT video from the CAP, Out-The-Window (OTW) views from the IG of any of the SOF-NET connected simulators, NVG video or radar. The Fulcrum situation display from the Training Director's user station is selectable for viewing on one of the two 60-inch monitors *allowing the TOC audience to monitor the multi-ship training* mission. In addition, mission audio is selectable on the room speakers allowing the audience to fully track the mission.

SOF-NET HARDWARE

The SOF-NET is made up of multiple VME-based SOF-NET nodes and interconnecting cables (Figure 4). A node is defined as all hardware and software elements which provide an interface between the network and a single host training system. The hardware architecture of SOF-NET was driven by the two interfaces which exist at each node, 1) the host system interface consisting of data and audio, and 2) the network interface. In addition, security considerations required that each node be physically disconnectable from the network. As such, the hardware consist of five major functional components, 1) the Node CPU, 2) the network interface, 3) the host data interface, 4) the host audio interface, and 5) the optional EW system interface.

SOF-NET Node CPU

The SOF-NET Node CPU is actually a pair of Force CPU's, a Force 30 and Force 33. Two CPU's were needed to ensure time critical data transfers to/from the host could be met while still maintaining the required spare CPU capacity called out by the contract. The Force 33 acts as the VME bus arbiter and handles most of the calculation intensive computing such as interpolation of environments and distance and bearing calculations. The Force 30 acts as a real-time executive, provides an Ethernet interface used for booting both CPU's, and moves data between the host system and the SCRAMNet memory.

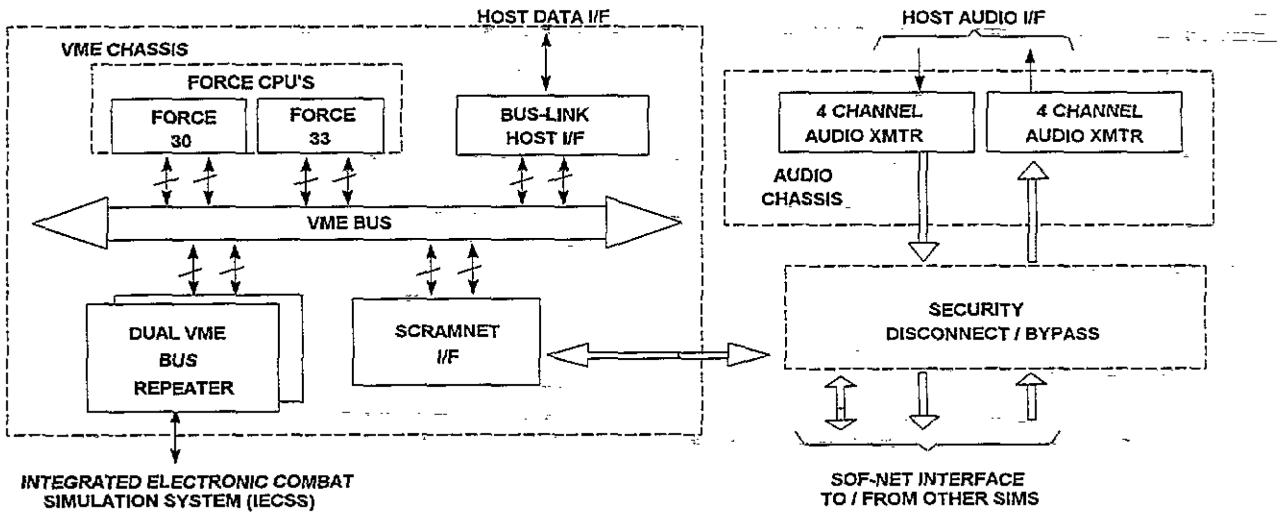

Figure 4. SOF-NET Node Hardware Block Diagram

Network Interface

The network interface functional component provides the means for each networked device to share data as rapidly as possible. This interface is facilitated with a reflected, shared memory scheme using SCRAMNet hardware provided by the SYSTRAN Corporation. The SCRAMNet board uses a fiber optic local area network configured as a ring, to provide high speed data transfers between each SOF-NET Node. Data is transferred across the network using deterministic processing and automatic retransmissions. The SCRAMNet on-board memory is parsed such that each training device is allocated a portion of the memory space which is "reflected" to all other nodes. At any given node, pertinent operating parameters and environmental data from the host training device are extracted and put into appropriate SCRAMNet memory locations. The SCRAMNet reflective-memory hardware makes this information available at each of the other SOF-NET nodes by sending it around the network.

Host Data Interface

The host data interface was selected to solve the need to minimize changes at each host system while satisfying a need for real-time access to the host system data pool. This interface was implemented using a Bus-Link subsystem which connects the SOF-NET Node VME bus directly to the Host system bus. The Bus-Link hardware selected is provided by Computer Products, Inc. (CPI). This connectivity allows the SOF-NET CPU access to a defined portion of the host system physical memory as a Remote Memory Interface (RMI). The SOF-NET CPU can move data in and out of the host memory as needed, allowing the host to operate independent of the SOF-NET connection while the SOF-NET Node CPU does the work to keep the host current with network mission model and environment data. The advantage of the Bus-Link is that the host side of the link is available in VME and Encore formats, allowing the implementation to be used at all three simulators. In addition, the bus-link technology was available for a VME-to-Sbus connectivity which was used in the TOC since the TOC has a Sun Microsystems SparcStation 2 as its control computer or host.

Host Audio Interface

The host audio interface was driven by the need to pass audio data securely over fiber optic cables and a desire to keep the implementation consistent with industry standards for line-level audio communications. The implementation uses COTS analog to optical audio equipment adhering to commercial standards which provide flexibility and the capability for future growth. Each SOF-NET node has a two board set of audio equipment except for the TOC. The TOC has a two board set for each of the other nodes. The overall SOF-NET audio architecture is a star with the TOC in the center. Each node passes audio to the TOC where it is mixed and routed according to audio configuration data received from each node via the SCRAMNet reflective memory. The TOC has an audio switching matrix which acts as the central switch for all SOF-NET audio. After audio is mixed according to the radio/frequency matching algorithm, appropriate audio is passed back to each node from the TOC. The result is broadcast quality audio in each of the radios and a flexible interface at each host which only requires compatibility with a balanced 2.2 Vptp audio input and output format.

EW System Interface

The SOF-NET interfaces externally with the Integrated Electronic Combat Simulation System (IECSS) built by TRW under subcontract to Martin Marietta for the MH-60G and MH-53J. This interface allows the EW system to actively monitor each player's movements and control threat to ownship interactions accordingly. The interface is implemented using two VME Bus repeater links. One link allows the EW system to access the SOF-NET node SCRAMNet memory without having to go through the node CPU and the second link allows direct access to the simulator host data pool via the SOF-NET node bus-link. The design minimizes the impact on both the simulator host and the SOF-NET node computers while facilitating the most direct and timely access to the needed data for the EW system. The EW access to the local host system allows control of the host on-board EW systems and threat encounters. Access to the SCRAMNet allows the EW system to use the SOF-NET as a means to pass pertinent EW data around the network. The result is a rich shared threat environment.

SOF-NET SOFTWARE

The software functions, distributed between Force CPU boards at each SOF-NET node, drive the SOF-NET's interactive simulator capability. Figure 5 depicts the SOF-NET software functional flow. Modular in design, this software is built for portability and commonality between SOF-NET nodes and executes asynchronously. SOF-NET operational software is structured into the following three independent CSC's.

1) Master/Slave
2) Network Moving Model/Control
3) Environmental Interpolation

All SOF-NET interfaces between the various SOF-NET CSC's are accomplished via shared memory. While the SOF-NET does share IECSS data between its various nodes, the software which writes/reads this data to /from the SCRAMNet resides on the hosts' IECSS's.

Master/Slave CSC

The Master/Slave CSC provides initialization, executive control, master/slave designation, ability of the master to select the common data base and control relocateable models. Relocateable model control allows the master to control the flow of model data to the network. This model data includes; navigation aids, ships, tanker aircraft, SOF teams, universal features, and IG special effects. The Master/Slave CSC player management function keeps account and control over the role being played by each simulator on SOF-NET, i.e., master or slave.

This CSC also provides for the implementation of other network management tasks. For example, the master player controls the environment of all trainers, while the slave player can control its own environment only when an override is selected. This CSC also calls the software units within the Environmental Interpolation CSC.

Network Moving Model Control CSC

The purpose of this CSC is twofold: 1) to transfer data associated with the host and its moving models to the network, and 2) to synthesize all data for active network moving models for the local simulator host. Each network host can donate its ownship and six other moving models to the network. This CSC extracts the appropriate data from the host data pool to sufficiently define the moving models to the network. The extracted data is inserted into the network reflected memory

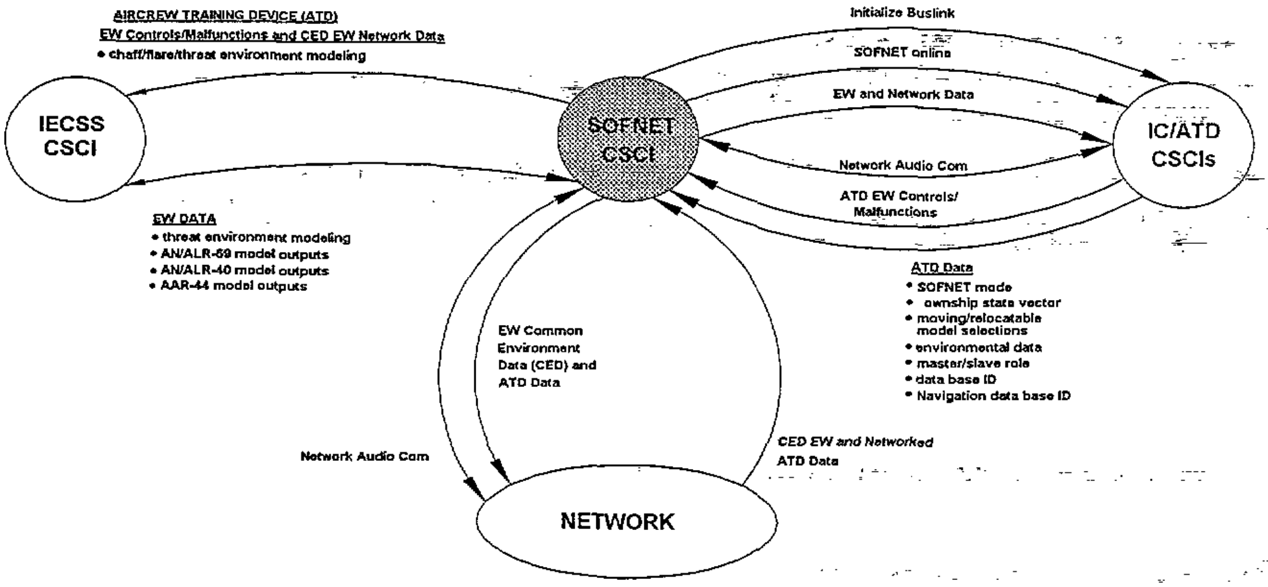

Figure 5. SOF-NET Functional Interfaces

space and subsequently available at all network nodes. Since each node can donate up to seven moving models to the network, each host must synthesize the model data to determine which models are most relevant to the ownship immediate environment. The synthesis algorithm is a sort by position relative to the host ownship. The 16 closest models are passed to the host computer for additional processing; the host will pass the six closest to its IG for display. The continual processing of all active network models ensures each player has the same model pool from which to build its visual environment and determine simulation impacts based on each host's unique capabilities for on-board systems such as EW, radar, and FLIR.

Environmental Interpolation CSC

The Environmental Interpolation CSC provides a means for a slave network player to smoothly transition into or out of the master environment by sharing the master's environment data across the network. As the slave passes within a distance threshold of the master's ownship position, the interpolation routine begins to linearly change the environmental state of the slave ownship to that of the master's. This interpolation is executed after the ownship comes on the net or after the slave comes out of environmental override. Some examples of the environmental state parameters are; precipitation, haze visibility, surface wind speed and other SOF/aviation related conditions.

FUTURE EXPANSION

In the near future, the SOF-NET network will be expanded to the nodes shown in Figure 1. The added nodes will include the MH-60G OFT (Operational Flight Trainer), the Aerial Gunner and Scanner Simulator (AGSS) and an external DIS Network Interface Unit.

The MH-60G OFT will support MH-60G Pave Hawk training. The OFT is a highly realistic non-motion simulator with seat shakers to provide motion cueing. The system will support day, night, dusk, and NVG flight operations in the existing high resolution data bases produced by the 542d's data base generation system (DBGS).

The AGSS is a part task trainer which will train SOF crew members in NVG scanning techniques and aerial gunnery for .50 caliber machine guns and 7.62mm mini guns. In the standalone mode, the AGSS will use a low cost small image generation system. When the AGSS is integrated into the SOF-NET network, the TH-53A OFT (COMPU-SCENE V) image generator will provide the visuals. This image generator switching will enable full crew operation between the AGSS and either the MH-53J WST or the MH-60G.

The eighth SOF-NET node is reserved for external Wide Area Network (WAN) integration with other simulation and simulator facilities. This node will be compliant with the design principles, goals and specifications promulgated by the current DIS (Distributed Interactive Simulation) protocol and future evolutions of the protocol. At this time, several government facilities and networks have expressed interest in linking with the SOF-NET network. The facilities of interest perform functions in two main areas: theater air defense with command and control nets and theater level constructive simulation for joint exercises.

The goal of the SOF-NET architecture is to provide a single node which will service all of these heterogeneous and diverse network connections. Effectively linking these simulation facilities with the SOF-NET network will focus on the challenges of integrating virtual man-in-the-loop simulators with a high degree of fidelity and high real-time update rates (as exemplified by the SOF simulators) with constructive upper level, nonreal-time wargaming simulations. A key aspect for the successful linkage of virtual and constructive simulations is the generation of a "common" data base for both levels of simulation.

Network Interface Unit (NIU) Implementation

The NIU will provide the connection to external facilities and networks. The implementation of the SOF-NET NIU is driven by the design guidelines of the DIS standard, as well as the implementation features of the individual WST's and the SOF-NET local area network. In the DIS architecture terminology ("Strawman Distributed Interactive Simulation Architecture Description Document," Volume I, 31 March 1992, ADST/WDL/TR-92-003010), the SOF-NET may be considered to be a cell of more or less homogeneous simulator entities connected by a network. In the two-tier model espoused by the strawman architecture, the SOF-NET NIU is considered to be a Cell Adapter Unit because it links a nonstandard cell of high fidelity simulators with a virtual inter-cell DIS network.

The NIU consists of a host computer, interface with the SOF-NET local area network, long haul communication equipment, and encryption devices. The choice of communications equipment and encryption devices will vary with specific network communications media and exercise security requirements.

A notional block diagram for a classified T1 connection is shown in Figure 6. In this application, a KG-94 acts as an encryption device. The TL 12-slot chassis provides growth potential for additional T1 circuits and expanded audio capability. Another desirable feature of the unit shown is that it will support technology upgrades to T3 lines (45 Mbps) and Synchronous Optical Network (SONET) (at 50 Mbps to 2.4 Gbps). The outputs of the T1 chassis include four audio channels which are connected to the SOF-NET audio channels (HF, UHF, VHF, and IOS). The other output is a serial data link via Ethernet to the node host. The key requirements for the host processor are a real time, multitasking operating system, VME environment, SCRAMNet interface and growth potential for expanded network traffic, additional network connections and evolution of the DIS protocol. The chassis shown contains a single CPU board with 40 MIPS throughput and 32 MB local memory, a SCRAMNet board and a Force 40 board for a COTS (commercial off the shelf) software package.

The NIU will be required to perform the following functions:

1) Translate data for the nonDIS LAN to/from DIS-compliant messages
2) Perform dead reckoning (remote entity approximation)
3) Encryption
4) Compression/decompression to facilitate network bandwidth requirements
5) Data shuffling to transfer data between reflective memory locations in the SCRAMNet architecture and the NIU memory buffer
6) Message filtering based on entity data and message content in order to prevent processing overload and minimize bandwidth requirements.

The software flow of these functions is shown in Figure 7. Our approach to the NIU has been to use third party vendor packages to the greatest possible extent. In the flow diagram, the functions with asterisks indicate functions which require application specific software. The selected third party package is the Advanced Interface Unit (AIU), developed by Naval Command and Control Oceans Surveillance Center RDT&E Division (NRAD) in conjunction with ETA Technologies Corporation.

Network Applications

Future plans call for integrating the SOF-NET with an advanced theater air defense facility. This facility provides a total integrated air defense simulation (both weapons and C3I) with several operator-in-the-loop, real time consoles. Its scenario capacity supports:

simultaneous tracks
emitters
ECM emitters
types of jammers
types of aircraft
terrain followers
controllable aircraft
active "threat" interceptors

This capability enhances SOF training for nap of the earth, stealth penetration into enemy air defenses. Also, communications systems such as TADIL-J will allow SOF teams to participate in command and control scenarios which may involve joint missions such as the location and defeat of critical mobile targets.

This SOF-NET project can serve as a testbed for several EW and tactical communications issues. The EW arena is driven by highly sophisticated, smart sensors and munitions which perform complex seeker, acquisition, tracking, jamming, and counter-jamming functions. High fidelity training exercises involving these types of systems will require high volume, high speed data transactions. These simulations will need to develop and incorporate sophisticated data compression techniques and imaginative preloaded data bases to limit network traffic to current state of the art bandwidth limits. Another issue which will be addressed is the issue of the shooter determining that he has scored a hit while the target registers a miss. These discrepancies can be caused by network latencies and by

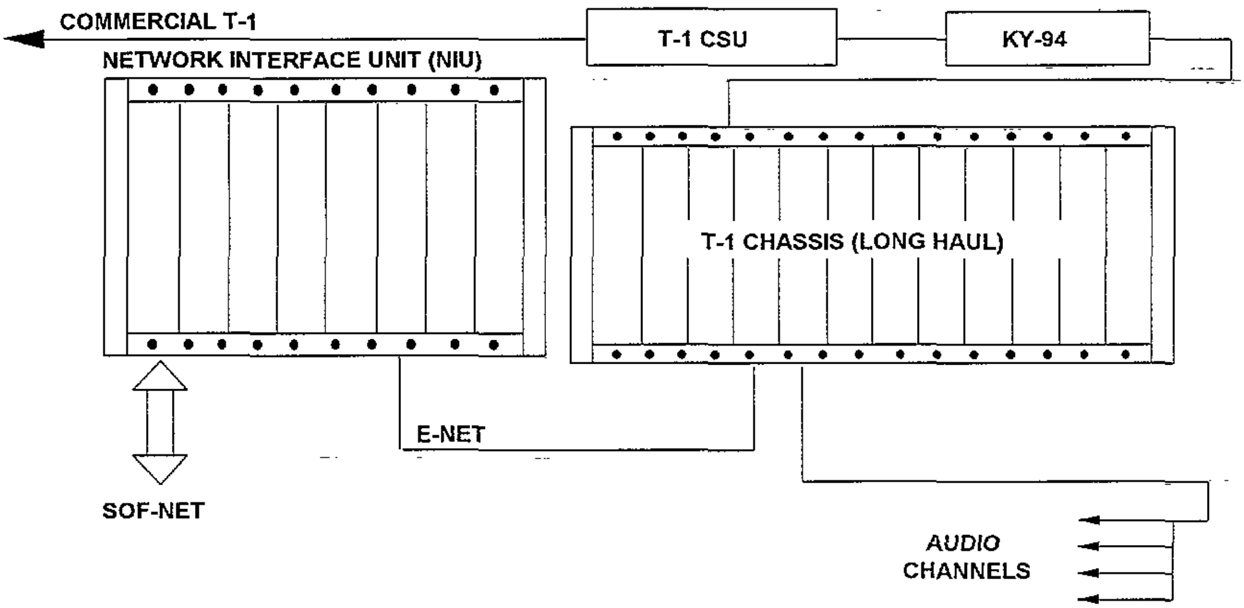

Figure 6. External NIU Block Diagram

improperly correlated EW data bases. These issues will be tackled by the proposed SOF-NET integration project. The resolution of these issues will provide guidance for the evolving DIS standards.

A second noteworthy future application is the linkage between SOF-NET and theater level constructive simulations. This effort will allow SOF-NET role players to participate in joint, theater level exercises. This SOF-NET integration will advance the state of the art in the area of virtual simulator/constructive simulation interfaces. The proposed integration effort will focus on the linkage of the SOF-NET with theater level simulations. This project will focus attention on the following DIS issues: Aggregation/deaggregation techniques between unit level simulations and platform (helicopter) level simulators; time coherence between faster than real time or asynchronous event driven simulations with real time simulators; DIS/ALSP protocol interfaces; and construction of correlated data bases for high fidelity, 3-D simulators playing in lower fidelity, 2-D simulation space.

CONCLUSION

The networking of the training devices via the SOF-NET has greatly enhanced the training and mission rehearsal capability of the 542d Crew Training Wing at Kirtland AFB. This training capability has expanded to coordinated team formation exercises. Future expansion to external facilities and networks will introduce training and mission rehearsal in joint service theater level exercises and in rich, man-in-the-loop threat environments. These applications will provide new insights to the interactive community and the evolving DIS protocol.

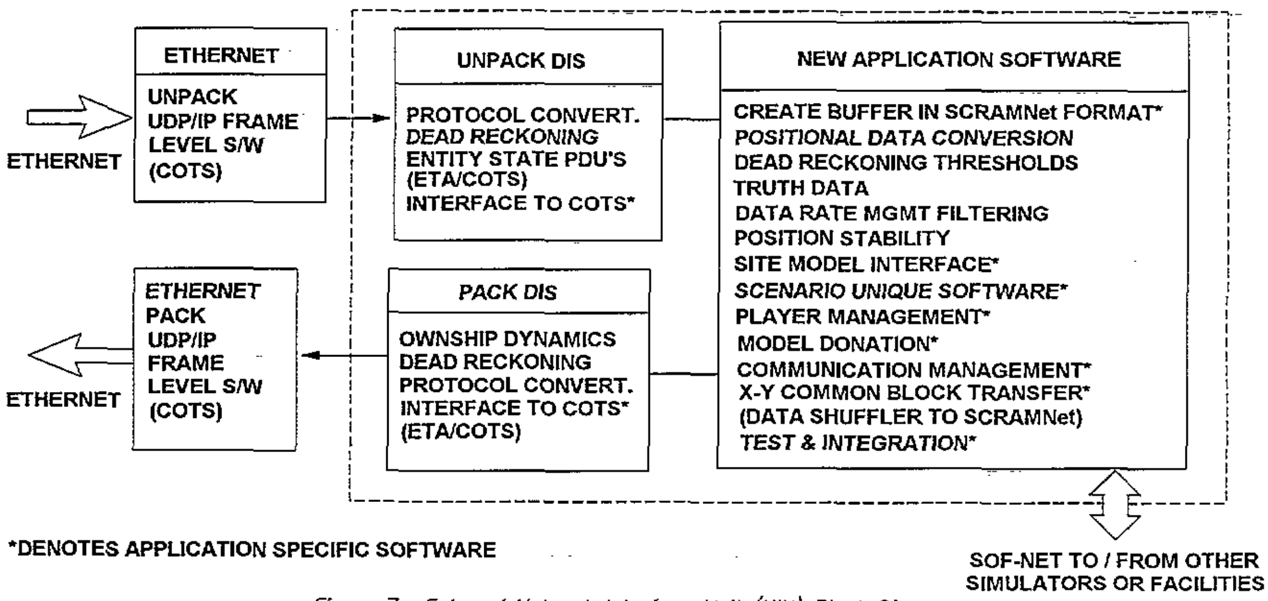

Figure 7. External Network Interface Unit (NIU) Block Diagram