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Report developed under SBIR contract. This report investigates the current methods used by various aircrew training device software support organizations to maintain concurrency between the Operational Flight Programs (OFP) and related aircrew simulators, and provides recommendations for improving those processes. The goal of this investigation is to identify a cost effective approach towards developing an interface unit and accompanying process that facilitates the timely transfer of OFP (Tactical Tapes) changes from aircraft software support activities to their respective aircrew simulators.

The F-14 suite of aircrew simulators operated by the United States Navy was chosen as a representative candidate for implementation of the interface unit solution due to the nature of the trainer support organization processes, and the physical locations of training devices. The investigation produced recommendations for a standard interface unit accommodating online configuration management practices, remote site software testing, and rapid movement of software data and secure communications between software development facilities and trainer sites. When implemented this interface unit will enhance software development capabilities within government software development facilities and contractor facilities, allow more efficient control and movement of data between trainer sites, and enhance management's ability to monitor trainer support and testing activities.

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PER: PRINCIPAL INVESTIGATOR

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REV A

U.S. DEPARTMENT OF DEFENSE

SMALL BUSINESS INNOVATION RESEARCH PROGRAM

TOPIC N96-053

PHASE I

FINAL REPORT

FOR THE

INTERFACE UNIT ENABLING UTILIZATION OF AIRCRAFT TACTICAL TAPE IN AIRCREW SIMULATORS

CDRL SEQUENCE NO. A002

TECHNICAL REPORT 9617.005

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I. INTRODUCTION

This report is prepared under Naval Air Systems Command Contract N00019-96-C-2040 and summarizes the investigation, findings, solutions, and recommendations provided by Dual, Incorporated (Dual) personnel during the 27 June to 27 November 1996 time period. This project is a Phase I effort of the Small Business Innovation Research (SBIR) Topic N96-053 of Naval Air Systems Command. This document is the final report submitted for the project.

The original scope of this investigation was to identify a cost effective approach towards developing an interface unit used to facilitate the timely transfer of Operational Flight Program (OFP) software (Tactical Tapes) from aircraft software support activities to the respective aircrew simulators. In the current training environment, maintaining the functional concurrency of the training device's computer driven aircraft hardware with the parent aircraft is a costly and time consuming effort. Presently, transition of new or modified data from aircraft to cockpit simulators require redundant or overlapping development efforts by the weapon software and trainer software support engineers. When training devices are not in the same revision configuration as the aircraft, training sessions are less effective, since the displays and/or aircraft responses may not be consistent with what will be observed in the aircraft cockpit. The negative training resulting from not maintaining aircraft to trainer concurrency can include poor mission performance or even catastrophic events.

II. PHASE I OBJECTIVES

The objective of this SBIR is to investigate and identify a cost effective approach for the transfer of new or updated OFP and related software from the developer activity to the aircrew simulators.

During this Phase I effort, Dual has focused on the Navy F-14 aircrew training devices, as directed by the sponsor. Additionally, our investigation sought to identify methods used by other training device users that may prove germane to moving OFP data from its origin to the end user, and rendering this information usable in training devices.

Specific Phase I Technical Objectives are as follows:

1. To determine functional requirements of a standard interface unit for the "simulation" and "stimulation" approaches.
2. To identify current or evolving technologies to be used to accomplish the task.
3. To identify hardware and/or software development required to accomplish the task.
4. To define the technical design requirements of the interface unit.
5. To analyze the feasibility of developing an interface unit and/or process to accomplish the task.

III. WORK PERFORMED

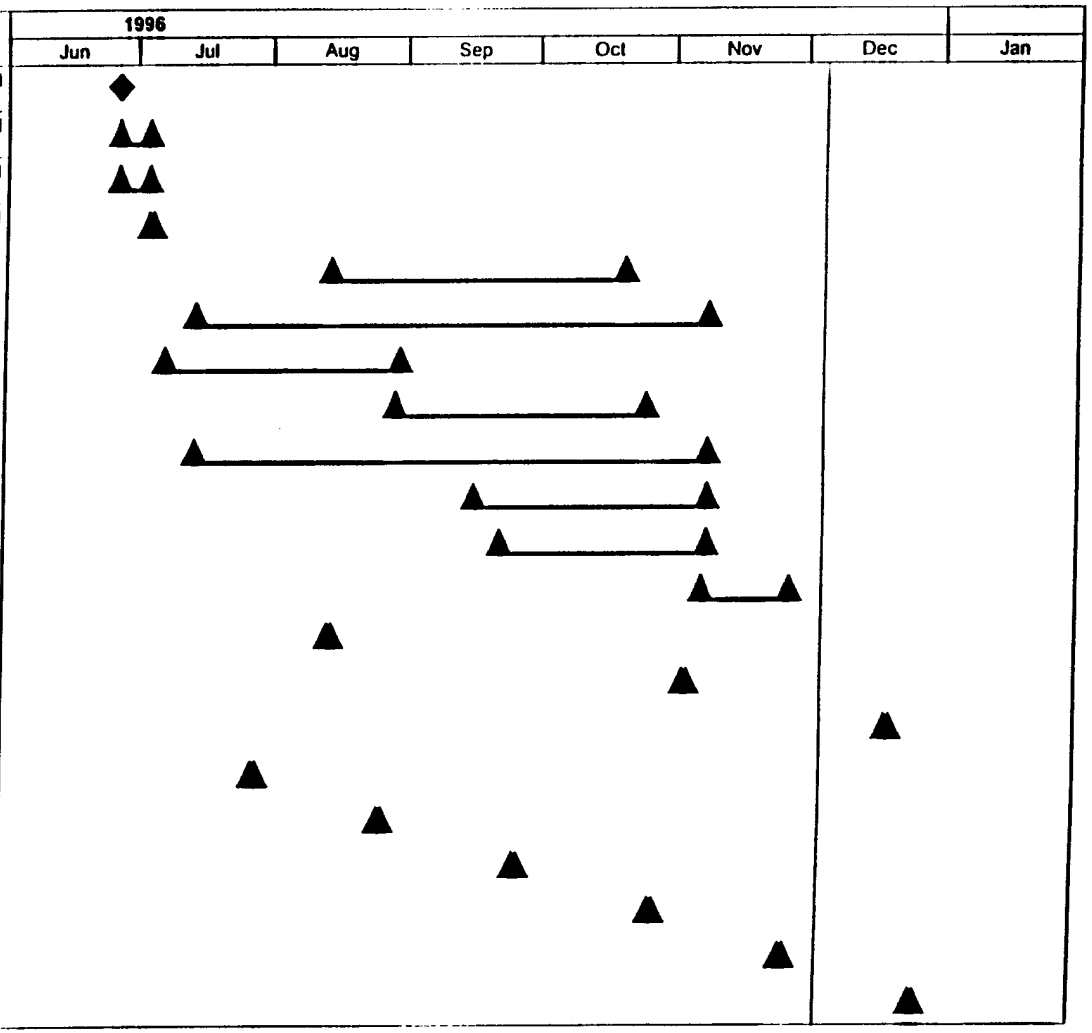
Figure III-1 presents the overall milestones for the project. Dual's first task was to determine the current methods used in the training community to accomplish trainer upgrades and commonality between the actual operational equipment. Our data search included Navy, Air Force and NASA training devices. The purpose was to assess the current state of the art and identify methods that could be applied to Navy training. In parallel with our visits and general inquiries, a search was commenced for literature with reference to Operational Flight Programs and the problems of portability to training devices, and the networking or transfer of data between computers. The U.S. Department of Commerce's National Technical Information Service database was consulted and a number of report summaries as well as full reports were reviewed.

The investigation began with site visits to several Naval Air Warfare Center facilities including the Training and Simulation Division (NAWCTSD) in Orlando, Florida; the Manned Flight Simulator (MFS) group in Patuxent River, Maryland, and the F-14 Trainer Software Support Activity (TSSA) at Pt. Mugu, California.

At NAWCTSD information was obtained on F-14 aircrew training devices, their locations, and an overview of the trainer software support system. Through their assistance, Dual gained access to a NAWC library containing data on Device 2F169 which the Grumman Corporation is currently modifying from the F-14D to F-14B configuration.

The visit to Manned Flight Simulator (MFS) resulted in the SBIR Sponsor providing additional guidance on the direction that this investigation should progress. It was noted that the last tactical tape upgrade for the F-14D cost over 3 million dollars, with an additional 1.3 million to clear the major discrepancies that resulted in that upgrade. The primary goal of this investigation should be to

ID	Task Name	Duration
1	Contract Award	0d
2	Document Local Knowledge	5d
3	Document Travel and Interview Schedule	5d
4	Arrange Navy Interviews/Inspections	1d
5	Travel to Navy-specific Sites	47d
6	Interview Subject Matter Experts	85d
7	Define Preliminary Requirements	40d
8	Produce Functional Requirements	41d
9	Research Technologies	85d
10	Produce Feasibility Study	39d
11	Produce Trade Studies	35d
12	Produce Final Report	14d
13	Kickoff Meeting	1d
14	Progress Review	1d
15	Final Briefing	1d
16	Monthly Status	1d
17	Monthly Status	1d
18	Monthly Status	1d
19	Monthly Status	1d
20	Monthly Status	1d
21	Final Report	1d



PROJECT MILESTONE CHART

FIGURE III-1

REV A

provide recommendations on streamlining the overall trainer upgrade process and determining how to save money on future trainer updates. The identification of a specific hardware solution may not be of prime importance at this time. Rather, a cost effective system concept for the trainer software upgrade process must be defined. At this point, our investigation shifted from a purely tactical tape transfer/software modification problem, to an overall trainer system upgrade concept. The MFS Project Support Team Leader, who played a major role in building the AH-1W Aircrew Procedure Trainer (APT) currently installed at Camp Pendleton, briefed Dual on the role of MFS in simulator design, and provided an overview on the AH-1W simulator. MFS is currently building two more APTs for delivery to the Marine Reserves in Atlanta and New Orleans.

At the F-14 TSSA in Pt. Mugu, Dual received an extensive briefing concerning the mission, recent activities, and tour of the Trainer Software Design Facility (TSDF).

Dual expanded it's inquiry to other organizations to determine if techniques applicable to trainer software concurrency were used elsewhere. Through our Dual-Houston office and a personal visit to Houston, information was obtained from NASA about the methods used to maintain currency between the Shuttle Mission Simulators and the actual space hardware. The Air Force Agency for Modeling and Simulation provided information on the F-16 trainer program based at Hill AFB and provided a configuration management manual for F-16 series of training devices.

Once the literature review, data collection, discussions with designers, users and key management personnel were accomplished, the data was assessed to identify the general and unique functional requirements that an interface unit or process would need to address in order to support the overall goal of streamlining the aircraft to trainer upgrades.

IV. RESULTS OBTAINED

A. **Subject:** **Navy F-14 Aircraft/Simulator Deployment** - Dual sought information on the current and future locations of the target aircraft and simulator communities in order to access the communication and travel requirements needed to support the change and testing process.

Results: The WSSA that supports the F-14 Aircraft changes is located at Pt. Mugu, California. The TSSA that supports the F14 suite of trainers is also located at Pt. Mugu. The trainers supported are the Mission Trainer (15C9A), Operational Flight Trainer (2F95), Mission Flight Trainer (2F153), Weapon Systems Trainer/Tactical Environment System (2F154), and the Weapons Systems Trainer(2F169). Locations for these trainers

currently include Ft. Worth, Texas; Miramar, California; Pt. Mugu, California; Oceana, Virginia, Patuxent River, Maryland, and Atsugi, Japan. Dual was briefed on the plans for re-deployment of the Navy's F-14 aircraft and trainers. By 14 November 1996, all of the Navy's F-14s will have executed a homeport change to NAS Oceana. Fighter Wing Pacific will be formally decommissioned on 16 December 1996. The current plans include some variant of the F-14 aircraft remaining in service through Fiscal Year 2010. The present configurations of the F-14 aircraft include the "A", "B", "B Upgrade", and "D" models. There are eleven F-14 squadrons and a training squadron (VF-101) stationed at NAS Oceana and a single F-14A Squadron (VF-154) permanently deployed to Japan in support of the USS Independence. Three of the eleven squadrons, VF-2, VF-11 and VF-31 will fly the "D" model aircraft. Due to a lesser number of "D" model aircraft, and pending aircraft rework initiatives; composite squadrons consisting of 8 "B" and 6 "D" model aircraft each will be formed commencing in Fiscal Year 1998. These squadrons, VF-2, VF-11, VF-31, VF-143 and VF-102, while having relatively similar airframes, will be considerably different from an avionics and weapons system perspective. In this manner, the Pilot and Radar Intercept Officer (RIO) will be challenged to maintain currency in two considerably different aircraft weapons systems operations. Squadron VF-14 will commence the transition to the F/A-18E in Fiscal Year 2000, with all remaining F-14 transitions completed to the F-18F by Fiscal year 2010. Refer to Appendix A for a table showing planned F-14 aircrew simulator deployment.

Conclusion: The TSSA at Pt. Mugu currently provides baseline and change support for five types of trainers in six different locations throughout the United States and Japan. Planned relocation of simulators will bring the number of simulator locations to three, with the Pt. Mugu TSSA location bringing the total of remote locations to four. Collocation of the TSSA with the WSSA facilitates coordination of changes and work in a WSSA/TSSA team environment. Considering the remote locations of trainers, and the different types of simulators, an automated configuration management tool with the capability to store all the trainer software on-line, along with the ability to move data rapidly from TSSA to the trainer would be a desirous goal.

B. **Subject: Literature Search** - A search was conducted for literature pertaining to training systems engineering, problems of OFP portability to training devices, and networking/transfer of this data. The U.S. Department of Commerce's National Technical Information Service database was consulted and a number of report summaries as well as full reports were reviewed.

Result: Most of the papers found within the database were directed towards implementation of synthetic battlefield simulation. Methodologies addressed better modularization and object definitions of elements of the synthetic battlefield, more efficient means of task distribution among networked simulators, and improved network topologies. Additional research was conducted at the University of Central Florida Library; again the information obtained was generally oriented to meeting selected business objectives, such as intranets.

Conclusion: The topic of streamlining software/system updating relating to OFP portability has not been researched (and reported) in any substantial manner.

C. **Subject: <u>Marine Corps AH-1W Helicopter Simulator Design Approach</u>**- The AH-1W APT is a new design. Dual sought to determine the latest trainer design approaches used by the Navy to better understand what has worked, and seek ideas about the aircraft to trainer concurrency issue from subject matter experts. MFS personnel briefed Dual on the AH-1W simulator. Also, a set of questions (see Appendix B) was sent to the MFS point of contact which opened a continuing dialog.

Results: The AH-1W APT was designed using the maximum amount of commercial off the shelf items, and was developed without the restriction of military standards (see Appendix C for trainer block diagrams). The APT software is block structured, and organized by directory. Of particular interest was a reference made that APT software updates had been transferred via modem from the development facility at Patuxent River to the trainer site at Camp Pendleton and that a software configuration management tool was being utilized for engineering change tracking and control. The AH-1W simulators use the "hybrid" design approach (see Appendix D for a discussion of trainer design approaches). A set of actual aircraft computer hardware is "stimulated" by the host computer through an interface system, with other black box functions emulated by software residing strictly within the host computer. APT 1 has five black boxes, and APT 2 has eight black boxes that contain software programs. These boxes are initially procured with the latest version of software available, and are updated prior to delivery of the trainer if needed. The OFP data on the black boxes is maintained by the AH-1W Weapon System Software Activity (WSSA) at NAWCWD, China Lake; while the Trainer Software Support Activity (TSSA) for the Aircrew Procedure Trainer is located with the first delivery device at Camp Pendleton. The method used by MFS to obtain new OFP data on the black boxes, is to return the units to the WSSA where the software is loaded and then are sent back to MFS. Once the trainer is fielded, the

TSSA undertakes this responsibility. When software updates to the black boxes have occurred, no software or hardware modifications were required by MFS to the APT host or black boxes. Dual requested clarification on the movement and support of OFP or other software from MFS to the APT1 at Camp Pendleton via remote data link. Dual was advised that the process previously understood to be a feature of the trainer design was actually a one time occurrence, and not the normal mode of operation. The only time anything similar to this process occurred was during the course of the APT 1 installation. The MFS personnel used a modem and a terminal emulator to log on to the host computer, edit a file, and then compile and link with the main program. At no time was OFP data manipulated or transferred in this manner.

Conclusion: The AH-1W trainer has many unique instructional and design features, however, the basic design is a standard hybrid approach. No special method or capability was included in the trainer design that would allow for the movement of OFP or program data. The tactical tape loading of trainer black boxes is currently performed by the WSSA on an as needed basis at the China Lake facility. Although no host software changes were required to accommodate the last several black box OFP updates, it was unknown if future changes to them would be necessary.

D. **Subject:** **NASA Space Shuttle Simulator Design Approach** NASA was questioned about the methods used to maintain currency between the Shuttle Mission Simulators and the actual space hardware. Were there any use of data links, or special methods to move OFP type data or other software modifications quickly from the Shuttle Software Support to the simulators?

Results: NASA uses its simulators not just in training roles, but also as engineering test beds. When a new mission is to be supported, any changes to hardware or software are tested on the simulators thoroughly before any modifications to the actual equipment are authorized. In this manner, it is the actual hardware that attempts to keep up with the simulator's changes, instead of the normal process of the simulator lagging the operational equipment. Therefore, any need of rapid trainer software updates is not necessary.

Conclusion: The NASA example cited is the same as that of "Engineering Simulators" in the military. Usually a Weapon System Software Activity will have an engineering simulator with which to develop new software or check out hardware modifications prior to introduction to the fleet. The engineering simulators do not serve the same purpose as the training simulators, hence their design is often quite different. Training simulators use approximation methods and other "short-cuts" in design.

Often updates to OFP data or host software simulations are not suitable for direct use from one to another. This approach was ruled out for further study because the simulators are updated prior to modifying the actual flight hardware, and no special data transfer or conversion methods for this process were identified.

E. **Subject:** **Air Force F-16 Simulator Change Process**- The F-16 is a mature design. Dual sought to determine the current processes used by the Air Force to perform trainer update, and to determine if any new standards or procedures were available across various F-16 training devices.

Results: The response from the Air Force was that no standard for trainer updates existed across all simulators in its inventory. However, the F-16 community did provide Dual with a document titled F-16 A/B AIRCREW TRAINING DEVICES (ATD) OPERATIONAL/SUPPORT CONFIGURATION MANAGEMENT PROCEDURES (O/S CMP) REV I dated 15 January 1992 (see Appendix E). This document details the basic management and configuration control procedures used to support the computer resources on the F-16 training simulators. An emphasis is placed on the identification, tracking, solution, and oversight of problems and upgrades on the trainer system including the delegation of specific configuration control responsibilities to the Trainer Software Support Center (TSSC) and individual trainer sites. Figure 4-1, page 20, of the manual (see Appendix E) depicts an overview of the process used to effect, track, and implement changes to the trainer software. Requirements Reporting (block 4.1) is where the change process begins. Operational changes to the aircraft, new training requirements and deficiencies are identified by the aircraft program manager, the field commands, and the trainer support elements. These changes are evaluated for relevance to the Aircrew Training Device (ATD) by the F-16 Product Team (block 4.2) with assistance from the TSSC. Changes that potentially impact the ATD are evaluated for cost impact, priority and are assigned numbers for tracking purposes. Emergency and Urgent Priority changes (block 4.3) are immediately tasked to the TSSC and are coordinated by phone or message. Changes of a routine nature are evaluated as either being design related or attributed to coding/implementation errors. The F-16 Product Team also prepares and distributes a quarterly newsletter to ATD users regarding changes and plans. The Weapon System (Trainer) Users Group (WSTUG) (block 4.5) is attended by both end users and the F-16 Project Team/TSSC. The purpose of the WSTUG is to allow the Project Team and TSSC to relay the impact of identified changes to the device users, to provide responses the inquiries received from user review of the quarterly newsletters, and to assist the users in screening, prioritizing, and establishing a candidate list

for block upgrades. The users are responsible for informing the F-16 Product /TSSC team of the need, priority, and implementation method desired for the identified changes. Routine changes are delegated as candidates for the annual block upgrade process, or are sent to the TSSC as temporary changes until they can be incorporated into the block upgrade at a later time if needed. Once changes are identified and agreed to by the WSTUG, they are forwarded to the Configuration Control Boards (block 4.6) for final approval. The TSSC (block 4.7) is now tasked with implementing the approved temporary changes that have been determined to be in scope of their organizational mission. The TSSC is charged with maintaining the product baseline and distributing the temporary changes to the field unit via magnetic media, to include installation instructions. Temporary changes do not require baseline documentation changes, however these will be included and documented in block upgrades. The TSSC is also responsible for providing software baselines and documentation to outside contractors that are servicing the block upgrade changes at the direction of the F-16 Product Team. The TSSC participates in the design, in-process document reviews, program management reviews and validations of block upgrade activities (when performed by a contractor other than the TSSC's current contract company). Once a block upgrade is complete, the TSSC is responsible for the integration/retrofit of temporary changes that occurred during the interim build cycle, and to assure that all documentation and software is updated, distributed, and configured. The trainer changes that were delegated to block upgrades are accomplished under a separately procured modification (block 4.8) cycle that is scheduled annually. These changes are competitively bid, and once the contracts are awarded, are monitored by the F-16 Product Team in conjunction with the TSSC. Once complete, all baselines and documentation are returned to the TSSC for configuration, inclusion of authorized temporary changes, and distribution to the field units. Throughout the previously described process the F-16 Product Team is responsible for the tracking of change requests relative to status, approvals of trainer software including the digital land mass radar and visual databases. Since portions of the F-16 computer program software are classified up to and including Secret, the F-16 WST and TSSC operation, including IOS displays and hardcopy printouts are considered classified until reviewed for unclassified determination. Coordination of changes via telephone requires the availability of STU III equipment using the Defense Switched Network (DSN), and AUTODIN for transfer of text messages.

While analyzing the software support approach used by the Air Force, we were advised that the Unit Training Devices (UTDs) were designed without the aircraft operational (mission) computer. Through close coordination between the aircraft and trainer design organizations, the

aircraft software is written in Jovial and translated to Ada for application directly to the trainer host computer. This concept has been expanded now to include maintenance trainers.

Conclusion: The method currently used by the Air Force provides a coordinated procedure for the identification, tracking, authorization, implementation, and baseline control of changes to the F-16 aircraft trainers. The various user facilities and engineering elements are in separate locations throughout the US and at world wide NATO sites requiring secure communications capability for data and voice transmissions for TSSC to trainer site coordination activities. Tracking and control of baseline is done using computer based lists and magnetic media data is hand carried. The approach used on the UTDs would be worth investigating further for possible application to new aircrew trainers.

F. **Subject:** **Navy F-14 Fighter Simulator Design Approach**- Dual sought to assess the original design approach and obtained background data to better understand the complexities faced by the TSSA organization and contractors in performing the routine maintenance and upgrade activities of these devices.

Results: Dual reviewed the Software Design Document and Trainer Engineering Design Document for the F-14B trainer (Device 2F169) that the Grumman Corporation is presently converting from an F-14D configuration. The F-14B trainer uses a hybrid design approach. The aircraft on- board computer is stimulated by the host computer through a "Digital Conversion Equipment" or DCE. The DCE serves as the prime interface for moving data to/from the host to the GFE equipment. The design rationale mentioned in the TEDR for using the hybrid approach ..."was largely due to the F-14B WST requirement to stimulate the 5400B CEM On Board Computer, thus providing the WST with tactical tape drop in capability". Included within the trainer functionality was a Radar Simulator System (RSS). This device runs separately from the host computer, and utilizes Defense Mapping Agency digital terrain data for its operation. Reference was also made to a Database Maintenance Subsystem (DMS) on the trainers. Additional information was obtained at the TSSA concerning the design approach of other F-14 trainers. (See Appendix F for examples of trainer block diagrams).

Conclusion: The F-14 family of trainer design is a standard hybrid design approach. No method or capability was include in the trainer design that would allow for the movement of OFP or program data from the TSSA to the simulator sites. From design information obtained it was noted that a "drop in tape" capability was desired, but from discussions and information gathered on current upgrade processes, this does not

occur without significant host software modification efforts. In addition to the OFP and host software data used on the trainers, the presence of other subsystems such as the Radar System Simulator, and visual system databases would be candidates for a new change control and distribution process.

G. **Subject:** **Navy F-14 Trainer Software Support Activity Overview** - Dual sought to determine the role and responsibility of the TSSA in the support of the trainer change process.

Results: Dual received a briefing at the Pt. Mugu TSSA. Refer to Appendix G for an overview of the TSSA mission. The TSSA primary functions are In-Service Support that includes software configuration management and documentation control, and technical coordination. Trainer Software Development Support consists of evaluating proposed contractor changes, monitoring contractor compliance, reviewing software documentation, and performing in-plant/acceptance testing. Prime responsibilities are to "establish and maintain the Navy's capability to implement approved software changes." TSSA incorporates new tactical software loads into the on-board processors, interfaces the processors and host computer software, and ensures new tactical software functionality. Responsibilities include providing new trainer capabilities, correcting software deficiencies/simulation problems, and performing Software Quality Assurance. Trainer Updates supported by the TSSA include tactical software load changes, Engineering Change Proposals (ECPs), Airframe Changes (AFCs), Avionics Changes (AVCs), Rapid Action Minor Engineering Changes (RAMECs), Trainer Engineering Change Requests (TECRs), Discrepancy Report corrections (contractor and TSSA), Minor Fleet Requests (not covered by TECRs), and minor software changes with no visible trainer impact.

Conclusion: The TSSA serves a very valuable function and derives synergy from its collocation with the aircraft SSA. A "critical mass" of trainer and aircraft experts play a key role in accomplishing engineering changes. This capability would not be easily duplicated. Additional hardware and support software is required to enhance their present capability. TSSA software processes have not been subjected to an independent assessment.

H. **Subject:** **Navy F-14 Simulator Change Process (General)** - We sought to outline the current process used by the TSSA to perform aircraft related trainer modifications.

Results: The software change process starts when the F14 Software Change Review Board identifies a Weapons System change that may

impact the trainers. These changes are forwarded to the Trainer Systems Change Control Board and the Trainer Advisory Group which confirm that the trainer change is required or desirable. Changes are assigned priorities, and delegated as block changes or assigned to the TSSA for more immediate response. Once changes are approved, NAVAIR establishes schedules and funding for project. TSSA then develops and integrates the changes assigned to them within the Trainer Software Development Facility (TSDF), and tests them at the respective trainer sites. The trainer site activities are usually performed on 2nd shift to minimize training impact. TSSA verifies and validates changes at the trainer site and then assists with Government Final Inspection.

The TSSA handles the Configuration Management and Data Management functions for the trainers. The CM/DM group within the TSDF ensures that each Trainer Software Baseline has a unique, standard ID number, and that all media and supporting documentation are appropriately marked. Changes are categorized, reviewed, and implemented under CM oversight. Current and past software baselines of each trainer are maintained, and a trainer change history is documented.

Software documentation is controlled by the TSSA. Updates to documentation are based on TSSA software/hardware changes. Documentation support includes Acceptance Test Procedure (ATP) generation, Operation & Maintenance (O&M) manuals changes, contractor support, and information/data support to other Navy activities as required.

The TSSA monitors contractor block updates to the F-14 trainers. These activities include conducting acceptance test procedures to validate trainer changes, providing tactical information to engineers, providing configuration management and data management of trainer software baselines, monitoring contract compliance, participation in Preliminary (PDR) and Critical Design Review (CDR) activities, reviewing software and system documentation, performing software system audits, and evaluation of software development tools.

Conclusion: The engineering change process and system for implementation encompasses all necessary activities and functions. They deal with all types of proposed changes ranging from aircraft ECPs to field-generated 4720 modification requests. The role of the TSSA is pivotal from management and execution perspectives. The expertise of the TSSA is vital in describing the work to be done by a contractor, monitoring progress and conducting acceptance tests. Having this trainer experience and knowledge of the aircraft software results in a "smart

buyer" capability.

I. **Subject:** **Navy F-14 Simulator Change Process (Tactical Tapes)** - Dual sought to determine the current process used by the TSSA to accommodate OFP tactical tape change to simulators and the impact on schedule and budget.

Results: Dual was briefed on how TSSA schedules are determined given the size and complexity levels of additional trainer capability due to tactical tape updates. One point brought up was the misleading nature of the term "drop in" when referring to the tactical tape software updates. In fiscal year 95, the D02 Tactical Tape update resulted in the addition of over 4700 executable software lines of code to the F-14D trainer host software (see Appendix H for a summary of D01 and D02 code changes). Although these trainers use many of the actual GFE black boxes from the aircraft; a sizable amount of code modules exist in the trainer as software simulations (the hybrid approach). These simulated modules were designed and written to interface with the trainer host computer, and do not perform the identical function as the stimulated boxes they emulate.

Once a OFP tape is released from the WSSA and the TSSA has modified the appropriate simulated host modules, the trainer black boxes are loaded with the new tactical data with a WRA (Weapon Replaceable Assembly) Load Station. See Appendix K for an overview of this device. This device consists of a personal computer with a menu driven user interface attached to a Bernoulli external disk drive. The accompanying interfaces allow attachment of the F-14 mission computer, display processor, converter interface unit, and airborne radar data processor WRAs.

Conclusion: In the actual aircraft these boxes operate together because the WSSA engineers have designed and thoroughly tested each box's software load, and assured compatibility between each unit prior to use in the aircraft. Once this tactical tape information is released to the TSSA, the unique software modules used in the trainer's "simulated boxes" must be evaluated, modified, and tested to ensure they will correctly communicate with the trainer's GFE boxes. Without these modifications, the GFE boxes would simply ignore the simulated black box software module's attempt at communication. If these trainers were fully "stimulated" devices, then the tactical tape would operate without modification of host software. The TSSA personnel have a working relationship with the WSSA engineers (whose office is in close proximity to the TSSA), and this facilitates a more timely update of the host simulated black box software.

J. **Subject:** **Simulator Change Process (Block Upgrades)** - We sought to determine the current process used to accommodate Block Upgrades to simulators and the ramifications of those changes to schedule and budget.

Results: For the Air Force, F-16 block upgrades are performed annually, while the Navy's F-14 block upgrades are typically on an 18-24 month cycle. Once a contractor takes a baseline out of government configuration control, two baselines for the same device exist, with separate teams of engineers working on them. The contractor is changing and upgrading a baseline, and the TSSA team is performing ongoing changes to the second baseline. Once the block changes are done, the new baseline is returned to the TSSA where a large amount of effort is applied to retrofit the preceding 24 months worth of TSSA changes back into a baseline that may have been extensively changed since last used by government personnel.

Conclusion: Block upgrades present a special challenge to the coordination and configuration management of mass trainer updates. The key problem here is that block changes are generally accomplished external to the TSSA via contract. The major disconnect occurs when a baseline is turned over to a contractor and is out of the jurisdiction of the TSSA Configuration Manager for a relatively long period of time. The existing block upgrade process requires the TSSA engineers to provide a baseline of software and documentation to the contractor, and provide technical assistance and related activities throughout the contract. Additionally, as with the ongoing TSSA efforts, the contractor block update process requires the ability to access baseline software quickly, modify/compile host software, test the modifications, and document the baseline changes. A method is required to coordinate and oversee both the TSSA and contractor development activities.

K. **Subject:** **Navy F-14 Trainer Software Development Facility (TSDF) Capabilities and Requirements** - To determine the current capabilities and future requirements of the TSDF in order to continue optimal support of TSSA objectives.

Results: Dual inspected Trainer Support Development Facility (TSDF) located at the TSSA. This lab has the capability to support code modification and compilation of source code, documentation, database updates, building test overlays, partial F-14D cold starts, generation of site disks and tapes, and software configuration management. Appendix J outlines equipment upgrades that could enhance production. Areas of concern by TSDF personnel included the storage capacity of the F14D system, the development environment, automated documentation

capabilities, and the use of automated software configuration management tools. Appendix J went on to explain the need for a computer platform to support off line development in a UNIX environment, the ability to use the Microsoft Access database program, and implementation of a software configuration management tool. Also discussed was the need to store and move data from the TSSA to the trainer sites, as well as provide support for documentation production and review efforts, log file generation, and classified data handling.

Conclusion: Any interface unit solution proposed should operate in concert with the existing equipment and procedures currently in place within the TSDF. Additionally, it must be flexible in order to accommodate new devices and capabilities envisioned to meet future needs of the F-14 trainer community.

V. OBSERVATIONS AND RECOMMENDATIONS

Once the literature review, data collection, discussions with designers, users and key management personnel was accomplished; the data was assessed to determine a process or procedure to streamline the aircraft to trainer upgrade process. The following observations constitute the areas that could most readily be addressed to accomplish the goal.

A. Observation: Existing Configuration Management Practices can be improved.

Discussion: During the life cycle of a trainer, all information concerning the software, hardware, documentation, courseware, and databases is placed into a configured baseline, which is then administered by a Configuration Management support element. As changes are identified and implemented to the baseline data, the Configuration Management (CM) group (which usually reports to program management) makes sure that items to be changed are released to the authorized engineers, all changes are properly documented, and that all the updated and properly tested items are returned to CM control for distribution to the simulators.

The process of managing changes is complicated by the need to support a team of TSSA engineers requiring access to the same data elements within the same time frame. Change regression can easily occur if data is not carefully managed throughout the update, testing and acceptance phases of the upgrade and maintenance process. Throughout this change process, the CM group is providing test loads which must be kept separate from the configured trainer baseline. This is to ensure that no corrupted, or incorrect software is allowed onto the simulator which could

impact training, and also to ensure that the testing efforts are addressing the proper problems. Once the testing process has confirmed that a set of authorized changes works correctly on the trainer, the modules are moved into the configured baseline, and are then forwarded for use on the individual simulators.

The Configuration Management process is an extremely important function of the TSSA. The management of change, ability to monitor and control change activity, ability to archive baseline data, the collection of metrics, and coordination of modules across multiple baselines and trainer configurations are all elements of cost control and timeliness of the update process.

Recommendation: The present system of Configuration Management is manual in nature. By implementing a computer based Configuration Management Tool, and by placing baseline data for all devices into a central computer system at the TSSA many benefits could be derived. Refer to Appendix K for representative configuration management tools now on the market. These tools provide control, oversight and management reporting capabilities that cannot be achieved in a manual environment. Information such as which engineer is currently working on a module, what changes were made to a module (and by whom), what versions currently exist, what differences exist between versions, what changes were made across configurations, are available through facility of these tools. By placing the CM tool, along with the baseline information into a central computer, data is obtained by engineers in a controlled manner, with multiple reporting capabilities available to assist their efforts.

B. **Observation: <u>Existing Block Upgrade Practices are inefficient and cause undesired software rework, but can be improved.</u>**

Discussion: Earlier it was noted that a separate system for block upgrades performed by contractors is currently in use. While it has been shown that changes to a trainer baseline by engineers working within a particular facility can be effectively managed through strict protocols and oversight by configuration management, the complication of maintaining and changing separate baselines in parallel adds substantial costs. Costs are incurred by the government when a contractor modified baseline is returned to the TSSA. The new contractor baseline must first go through an entire acceptance testing process on the target system. All of the TSSA changes applied to the original baseline must now be retrofit to the new baseline. Essentially, each individual module from either baseline that was changed during this period must be re-integrated into a single baseline to be maintained by the TSSA.

Recommendation: A separate baseline for contractor block upgrades should be terminated. All trainer baseline data should reside within the TSSA Configuration Manager's control/oversight at all times. Earlier in this section, the general configuration management procedures used at the TSSA were discussed. Aside from the fact that TSSA and contractor activities are often located in different locations, the procedures used are similar, and the goals identical. A central on-line repository of all trainer data, accessible to engineers located within the TSSA or in remote locations such as contractor facilities, WSSA sites, and simulator installations could support this approach. Using an automated configuration management tool, the TSSA Configuration Management department could extend their services to all entities working with the trainer baselines.

Another way to consider this recommendation is to make note of how commercial software houses maintain control over their assets. Company engineers are often located in different cities, or different buildings within a particular area, but they maintain one baseline at one location in order to maintain consistency, and foster reuse of existing data elements, rather than allowing divergent baselines or new elements to be created for one-time use. Also consider that TSSA control of all baselines should lower contractor charges for configuration management services, and allow government to more closely monitor project change progress.

C. **Observation: <u>The transmission of secure data and voice communications between Trainer Development Facilities, Simulator and Contractor Sites is inadequate and will be even more important when the F-14 trainers are relocated</u>**

Discussion: The change process requires a flow of information between each element of the simulator support organization to occur in a timely and secure manner. The WSSA is the origin point for Operational Flight Program data; the TSSA Configuration Manager is the responsible for trainer baseline data; and the individual engineer creates trainer change information. This information consists of computer text, such as documents and software code structures, voice data for coordination and consultation use, and can include subjects of a classified nature. Data movement may be accomplished locally, or sent out to remote locations such as a simulator site or contractor facility.

Recommendation: A method be provided to accommodate the connectivity between each operational element to provide data and voice communication at the appropriate level of security. An interface unit allowing connection of various site computers both internally and externally to each element should be provided. A secure voice

requirement be considered for communications between TSSA, simulator site, and contractor facilities where appropriate.

D. **Observation: <u>The present method of testing software changes at the simulator sites is marginal, at best, but will be inefficient when the F-14 trainers are relocated.</u>**

Discussion: Currently, no trainer is collocated with the TSSA, therefore testing must be accomplished at the trainer site. Changes are initially made using the TSDF lab computers. These are then hand carried to the trainer site for testing and checkout. Since the simulators are in use for training during the day, checkout of new loads is relegated to the 2nd shift. The time available must be shared between the testing of fixes on the student station or instructor operator station, and the actual programming, compiling and linking with the host computer. This situation definitely limits the time for both testing and programming activities, which in turn prolongs travel expenditures and impacts the routine simulator maintenance access availability, as well as any additional unscheduled training that could be accommodated.

Recommendation: A computer workstation, separate from the simulator host computer be provided at a lead remote trainer site to accommodate off-line software development of trainer software. This workstation should have the capability of hosting a UNIX operating system, and accommodate the transfer of program code between the TSSA baseline repository database, the workstation, and the host computer complex in a secure manner.

A separate workstation could accommodate several testing methods. First, it would allow a programmer on TAD from the TSSA to perform software development off-line while the simulator was being used for training thereby allowing the 2nd shift to concentrate on purely on testing activities while the trainer was available. Also, the TSSA engineer can remain at his home base and download new or modified modules to the remote simulator site workstation. Local support personnel can move these modules to the host computer for final compilation, execution, linking, and testing, and report back findings to the TSSA. Local personnel will achieve a high level of familiarity with trainer software through training and hands-on experience.

E. **Observation: <u>Trainer "Hybrid" Design Approach limits ability for "Drop - In" Tactical Tape Capability.</u>**

Discussion: The complicating factor behind the software effort involved

with updating and maintaining these trainers is that they utilize the hybrid design approach (see Appendix D). Although the F-14 trainers may have been envisioned to have "tape drop in capability", in actual usage, ongoing analysis and modification to trainer host software is required in order to keep the trainer in pace with the actual aircraft functionality.

Recommendation: In order to have a true "drop-in" capability a new design approach would be required for each trainer. A totally stimulated approach would probably be required, or as a minimum, all simulated portions of the trainer would require extensive rework to conform to an as yet unavailable standard interface protocol, addressing both aircraft hardware and simulator needs. This protocol would have to be developed with co-use of OFP code by aircraft and trainer black boxes kept in the forefront. No open ended changes on either the aircraft or simulator side could be accommodated. Because of the maturity of the F-14 weapon system and trainers, this approach is not recommended due to anticipated costs and associated risks vs. the benefits.

F. **Observation: <u>Having TSSA engineers at WSSA facility is a necessary coupling in the update process.</u>**

Discussion: To provide optimum transfer of knowledge concerning changes to aircraft functionality, the hybrid design approach requires coordination between the OFP programmers at the WSSA and the simulator support programmers at the TSSA. The OFP data is developed at the WSSA and is coordinated with the TSSA engineers who conduct the analysis for impact to the simulated portions of the trainer. New or modified host modules are produced, compiled and tested for proper operation on the target devices (in so far as possible without the availability of a trainer test bed). The process outlined above requires a group of engineers, intimately familiar with the target trainers technical operation, to be in close contact with the aircraft software development activity.

Recommendation: The technical coordination that currently exists between the F-14 WSSA and the TSSA be preserved. In the event that a full TSSA staff is no longer collocated with the WSSA, then a smaller group of simulation engineers should remain to represent the TSSA interest in the aircraft upgrade activities. An interface unit augments the flow of information between the WSSA and TSSA engineering staff. The TSSA should set a goal for achieving a level III software capability within two years.

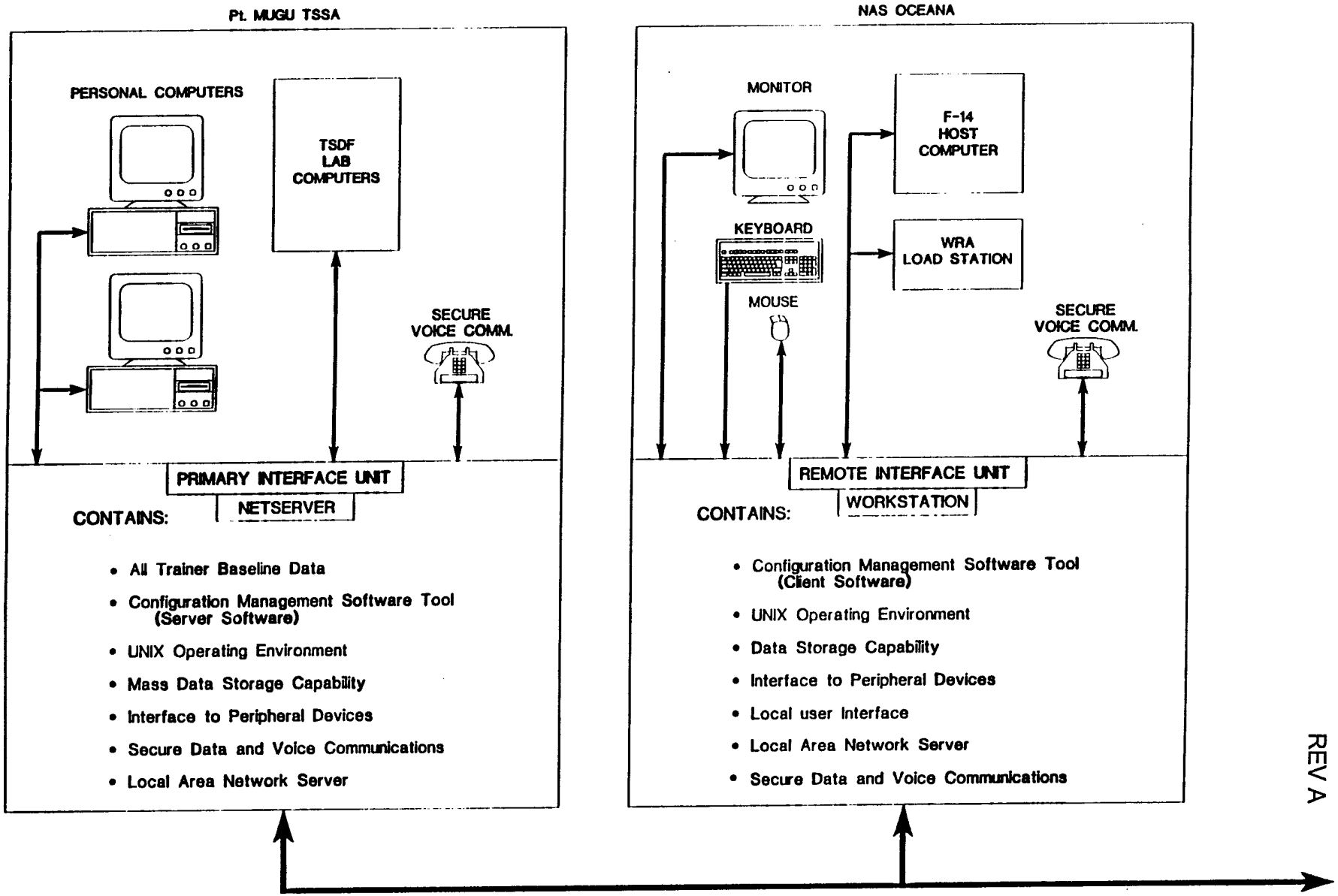
VI. RECOMMENDED SYSTEM DESIGN

The primary goal of the engineering change support system is to support the efforts of the TSSA team and the contractors that perform the block upgrades. The system supports the creation, control, and distribution of trainer baseline information to include software modules, OFP data, databases, hardware documentation, and manuals. The system facilitates the capture, control, storage and configuration management of all data associated with the training devices. It allows movement of data between existing host computer complexes, and allows for attachment of other devices such as personal computers, external storage, and support equipment such as the WRA Load Station, (see Appendix I) which is used to load OFP tape into the trainer black boxes. The individual units of the system attach to local area networks (LAN) and wide area networks (WAN) such that data flow within and between each TSSA, WSSA, contractor facility, or trainer site can be readily accomplished. Due to the security classification of these trainers, the ability to transmit STU III protocol for both voice and data is provided.

Figure VI-1 depicts the system designed to be responsive to fleet needs and that takes advantage of the capabilities of the various organizations involved in the trainer update process.

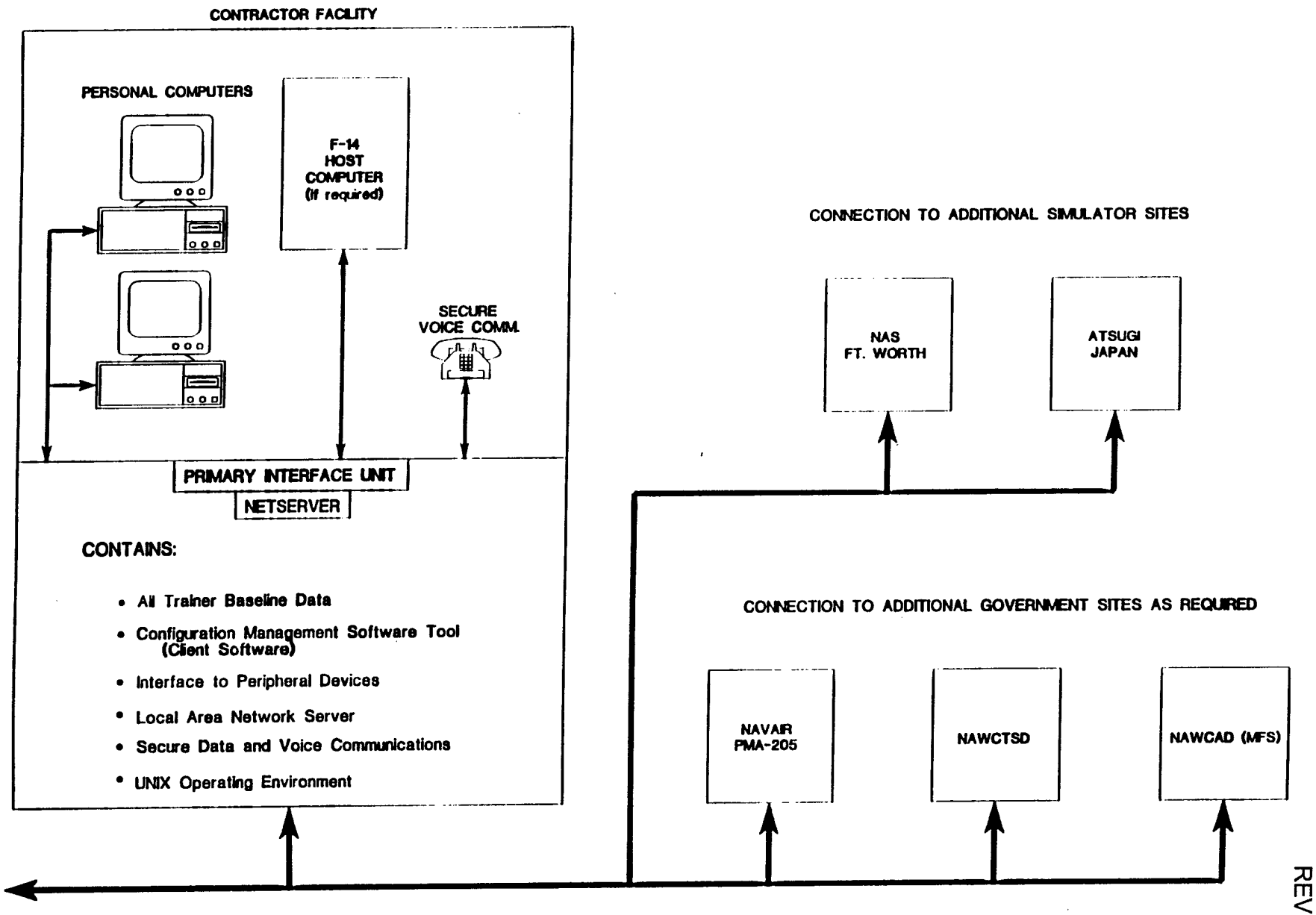
The Interface Unit design approach features computers and peripheral devices that can be customized according to facility need. In the case of a TSSA where the central baseline and development efforts are accomplished by groups of engineers, a network server computer is appropriate for a multi-user role. The Primary Interface Unit (Figure VI-2) is designed to meet this requirement. In a setting where a computer would be used less frequently such as at a simulator site, a Remote Interface Unit (Figure VI-3) featuring a single workstation, smaller storage capacity, and fewer peripherals are provided. Peripheral devices such as internal and external disk drives, floppy drives, digital audio tape drives, CD ROM drives, various printers, and the like are customized within each unit according to each site's individual requirements. The TSSA Primary Interface Unit features all of these devices to accommodate any data transfer demands of the simulators.

A typical installation of a complete Interface Unit System consists of placing a Primary Interface Unit at the TSSA, with a Remote Interface Unit at each simulator site. As additional facilities require access to the TSSA data by contractors and other government agencies involved with trainer design and management activities, additional Interface Units are added to the system.



SYSTEM CONCEPT FOR NETWORKING INTERFACE UNITS

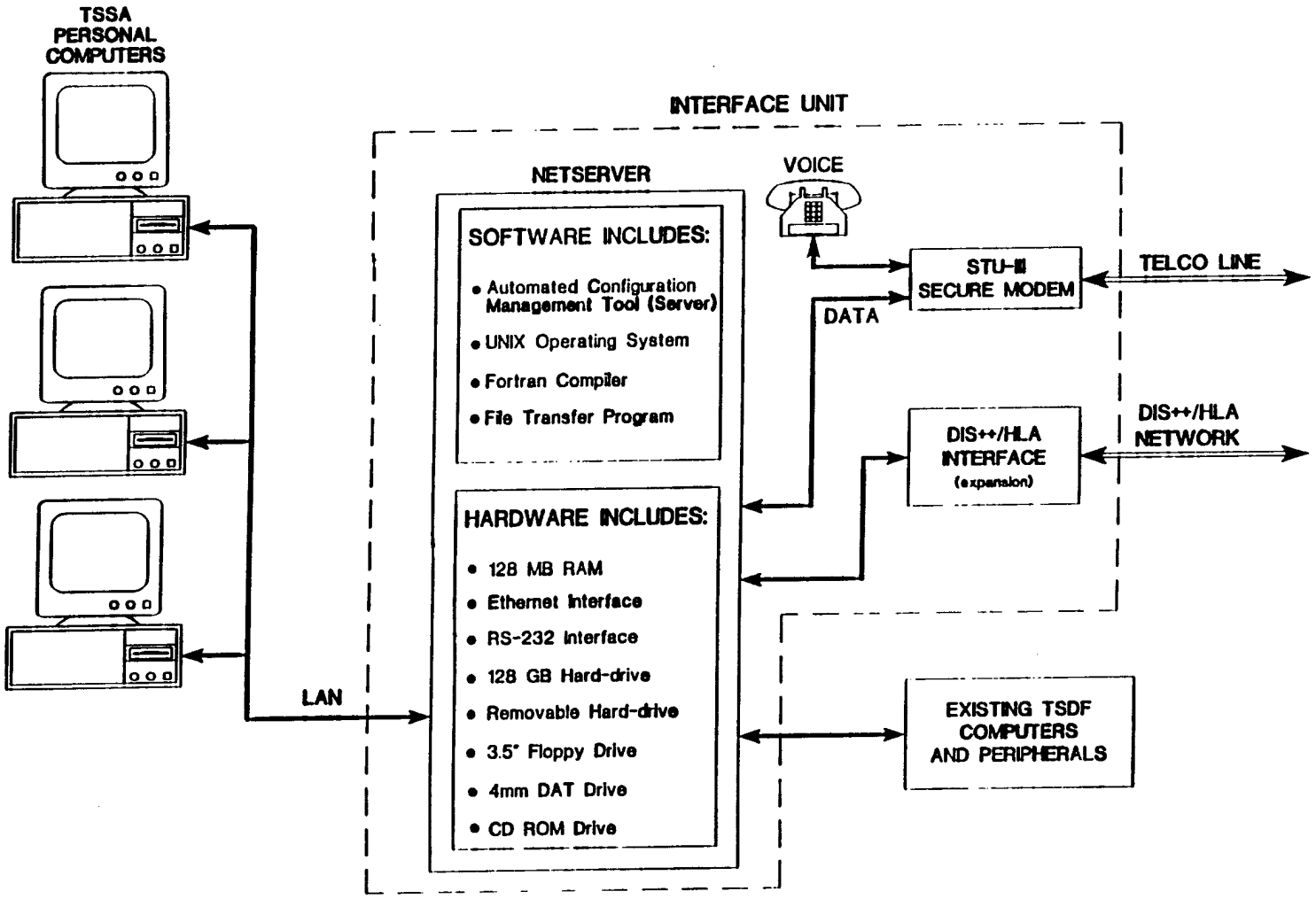
FIGURE VI-1 (1 of 2)



SYSTEM CONCEPT FOR NETWORKING INTERFACE UNITS

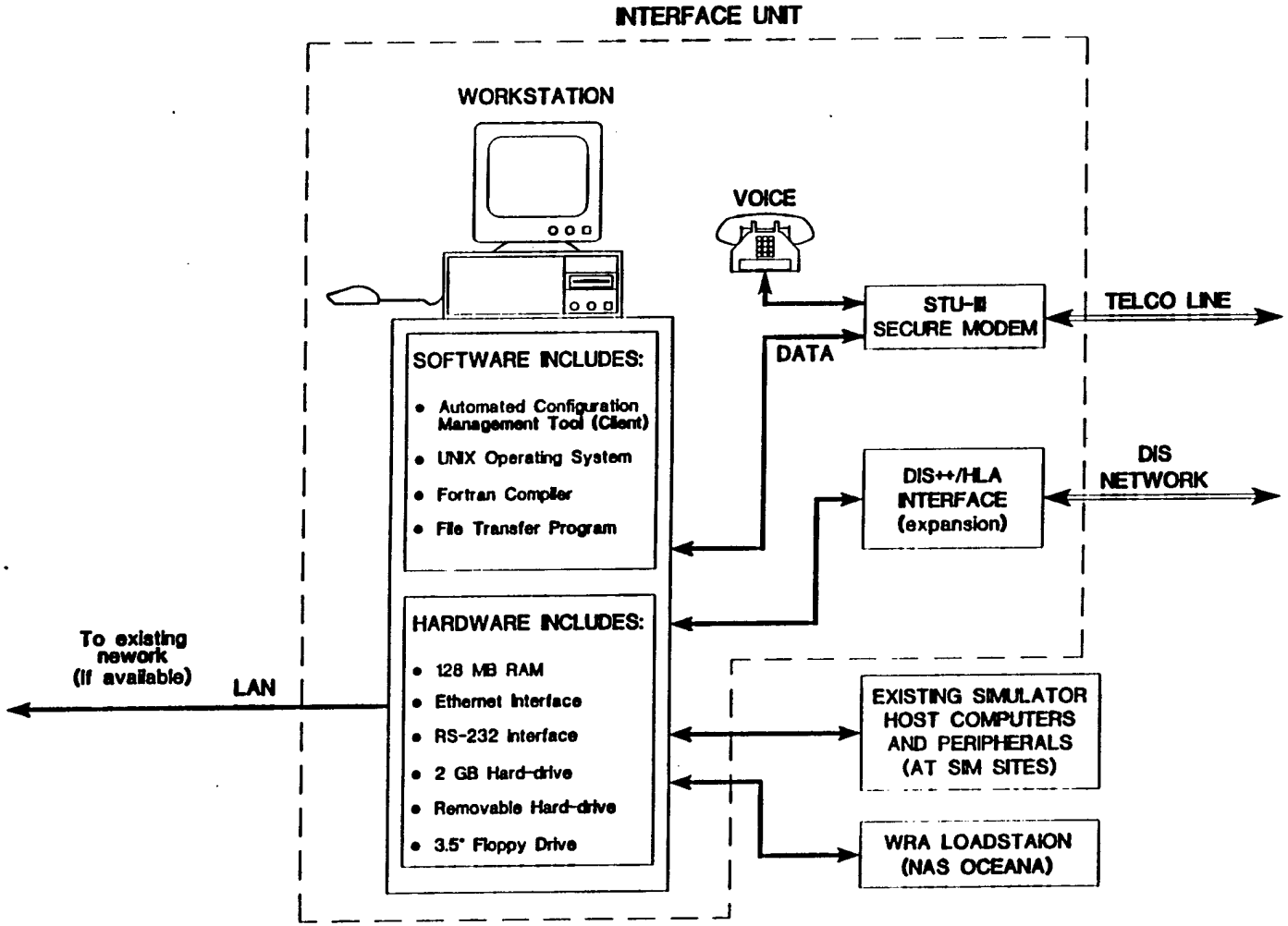
FIGURE VI-1 (2 of 2)

REV A



TSSA PRIMARY INTERFACE UNIT BLOCK DIAGRAM

FIGURE VI-2



TRAINER SITE REMOTE INTERFACE UNIT BLOCK DIAGRAM

FIGURE VI-3

A Primary Interface Unit is intended to service the Training System Design Facility, and the TSSA Configuration Management department. For the TSDF it can function as a UNIX development platform to allow software development and script file generation independent of the current lab equipment. If desired, the unit can function as network server to accommodate multiple users of the unit throughout the local facility. This feature allows the linking of the TSSA engineers to the WSSA on a common net (if collocated). Data is transferred between the existing development computers in the TSDF lab through the RS-232 links provided. The CM department implements the configuration management software tool on the unit, as well as using it to store and backup all trainer data on its expanded disk drive. For the rapid and secure movement of data between the TSSA, contractor or simulator sites, a STU III modem is provided on each unit which can transmit encrypted data or open data via plain old telephone system (POTS). As a future feature, a DIS ++/HLA Interface Unit is also available on the interface unit as desired.

The Remote Interface Unit is intended to be placed at simulator sites, a TSSA/WSSA outpost, or at contractor or government facilities. The unit allows the secure movement of data between the TSSA and the various user sites. Within the simulator facility the unit permits the download of modules and load packages into the simulator host computers, or the WRA Load Station for movement of OFP data to the trainer black boxes. A UNIX operating environment is provided on the Interface Unit computer so that software development can be supported during periods when the host computer is being used for simulation purposes. This allows trainer off hours to be devoted to testing and evaluation of new software, rather than having to share limited computer resources.

VII. ESTIMATES OF TECHNICAL FEASIBILITY

The System Concept for Networking Interface Units is low technical risk. All components are commercial off the shelf units, readily available from a variety of manufacturers. Refer to sample data sheets on the computers (Appendix L), and configuration management software packages (Appendix K) that have been examined in this investigation. This equipment is very straightforward with the flexibility to accommodate modifications, additions and upgrades in the future.

The NDI hardware required to implement this project is available from several companies including Sun Microsystems, Hewlett Packard, IBM, and Compaq Computers. Interface and networking connectivity for the net-servers and workstations include industry standards such as token ring, high-speed serial interface, ISDN, FDDI, and SCSI. This will allow ready interface to site equipment and connectivity to existing networks. Operating systems include UNIX based systems, with languages such as C, C++, and FORTRAN. All units

will support optional peripheral devices such as Digital Audio Tape backup drives, external hard-drives CD-ROM drives, printers, floppy drives etc. Several Configuration Management software tools have also been identified that would meet requirements of the TSSA.

VIII. VALUE OF THE PROJECT TO THE NAVY AND DEPARTMENT OF DEFENSE

There are essentially two dimensions of value with this project.

First, the ability to maintain training devices current with the parent weapon system results in more effective training. Because operational readiness is a function of how well aircrews are trained, it is imperative that training assets, such as flight simulators, provide the most effective training possible. With an initial investment in simulators totaling millions of dollars, any degradation of capability is unacceptable. Differences in the functional performance of the simulator must be minimized to ensure that training transfer takes place.

Secondly, the system for updating simulators can be improved to increase efficiency and reduce overall costs. Through the application of good systems engineering principles and the use of current technology, efficiencies in the fundamental process can be realized. Computer software support is human resource intensive, which is costly to the government. An improved system that avoids parallel, uncontrolled development, applies human labor and management most effectively and facilitates data and information transfer will result in a considerable savings to the government.

The Navy, specifically the Naval Air Systems Command is the immediate beneficiary of the improved system, however, the concept has widespread application throughout the Department of Defense in support of all warfare and platform software-intensive simulators. Given that the annual expenditure of DOD training devices is well in excess of $1.5 Billion dollars, the potential savings due to improved software support for the growing inventory becomes very significant.

IX. COMMERCIALIZATION

Dual's management is committed to transitioning this R&D effort to a product line and related services during the commercialization phase, i.e. Phase II and Phase III of the SBIR Program. The commercialization plan begins with the installation of the first system to support the F-14 training system program. Dual is recognized within and outside of the simulation and training community as a provider of quality products and services. Our experience and technical "know-how" lend credibility to marketing an improved process for support of large scale software systems.

Following the installation of the system to support the F-14 community, other aviation platforms will benefit from similar installations. Beyond aviation platforms within the Navy are training simulators for surface, submarine and land warfare. Our plan is to make the demonstrated system available to the Navy, Air Force, Marines, Army and Coast Guard.

The spin-off possibilities to the private and public sectors are numerous. Dual will market this approach to the commercial airlines, NASA and the FAA. In addition, companies engaged in large-scale software development, especially where development occurs at multiple and distributed locations, will be interested in improving productivity and reducing costs.

Dual has experience in commercializing products. We are currently marketing a family of security access systems throughout North America. Dual is a charter member of the Training and Simulation Technology Consortium (TSTC) which is funded through the Technology Reinvestment Project (TRP). It's mission is to assist defense contractors in finding new markets for military products, services and technologies. We intend to use TSTC to assist us in the marketing, sales and distribution of commercial applications of the software support system.

X. JUSTIFICATION AND PLANS FOR PHASE II CONTINUATION

The immediate impetus for installing the software support system for the F-14 program is the relocation of the aircraft and training devices to NAS Oceana, VA. An improved means for upgrading the trainers is a result of OFP and other engineering changes is vital to maintaining operational readiness. An initial investment will result in a considerable savings in fleet support dollars and improved training of our aircrews.

Dual's experience in building complex simulators, re-hosting fielded devices and modifying trainers lends us exceptionally qualified to install and operate the F-14 software support system. By working closely with the WSSA, TSSA, MFS, and the NAWCTSD ISEO, Dual will develop a system that meets user and developer needs. It is imperative that all parties have some ownership in the process and the "division of labor" in implementing this improved system.

Dual's plan for Phase II is to develop functional requirements and specifications for the hardware, software and other components of the interface system and install the system. Detailed cost estimates will be developed as rough orders of magnitude in the Phase II proposal and refined within 30 days after the Phase II contract award. A project team will be assembled to include the players identified earlier, managed by NAVAIR. As an integrated team initiative, milestones will be finalized, the initial system designed, developed and installed

by Dual. It is envisioned that Phase II will take approximately 18 months to execute. A budgetary estimate will be provided in the Phase II proposal.

APPENDIX A

F-14 AIRCREW SIMULATOR DEPLOYMENT

SIMULATOR	TYPE	RFT	REMARKS
NAS OCEANA			
2F95A (#4)	F-14A OFT	DEC 97	Upgrade visual , block upgrade, computer suite upgrade at Patuxent River.
2F95A (#3)	F-14A OFT	MAR 98	Upgrade visual , block upgrade, computer suite upgrade at Patuxent River.
15C9A (#2)	F-14A MT	JUN 97	Simtec upgrade/rehost.
15C9A (#3)	F-14A MT	AUG 97	Simtec upgrade/rehost.
2F169 (2 of them)	F-14B OFT	FY 97	Consists of two separate dome simulators with ability to be linked together.
2F153	F-14D MFT	ON LINE	
2F154	F-14D WST	AUG 97	Dual dome WST.
NAS FT. WORTH			
2F95 (#1)	F-14A OFT	ON LINE	Original unmodified.
15C9A (#1)	F-14A MT	OCT 97	
ATSUGI, JAPAN			
2F95 (#2)	F-14A OFT	JUL 97	No motion base.

APPENDIX B

AH-1W TRAINER QUESTIONS

MEMORANDUM

TO: Clark L. Morris, Dual Incorporated, Navy SBIR Project

FROM: Mike Sakach, MFS

SUBJECT: Reply to questions about AH-1 Training Device software update methods

DATE: 30 SEP 96

1.) Before answering the questions outlined in your fax, I would like to make a few clarifications to statements that I read in the August SBIR monthly progress report.

a.) The Manned Flight Simulator (MFS) facility at NAWC AD, Patuxent River has been tasked by NAVAIR PMA 2052L to build three AH-1W Aircrew Procedure Trainers (APT). The first device was delivered to Camp Pendleton in September 1995. The second device will be delivered in November 1996 to the Marine Reserves in Atlanta. The third device will be delivered to the Marine Reserves in New Orleans during the second quarter of 1997.

b.) The AH-1W Weapon System Software Activity (WSSA) is located at NAWC WD, China Lake. The Trainer Software Support Activity (TSSA) for the APTs is located at Camp Pendleton.

c). MFS has not transferred software updates via modem to the APT at Camp Pendleton. MFS has connected to the APT simulation computers at Camp Pendleton via modem and then edited, compiled, and linked files to create a new version of the simulation executable code.

2.) The answers to your questions:

a.) How often do you receive mission computer updates (or aircraft block changes) for incorporation into your AH-1 trainer?

APT 1 has five aircraft black boxes that contain code. The black boxes were procured by MFS with the (at that time) current versions of software and delivered with the device without modification. APT 2 has eight black boxes that contain code, five of which have been loaded with newer versions of software. Once the devices are delivered, they are maintained by the TSSA.

b.) Can you give typical examples of what these changes consist of? Are they mainly software updates, or are other changes involved, such as hardware installations or modifications?

So far the changes have consisted of software only.

c.) Physically, what do you get from the Aircraft Software Support activity? A tape, disk, or document describing the changes? What are the size of typical software changes?

We send the black boxes to the WSSA at China Lake who loads the new software and returns them to us. We do not have any information regarding the scope or size of change.

d.) When you get this data, what language is it in; and do you get a source code listing for it?

We do not get a code listing and or even know what language it is in. We have the interface design documents (ICD) for each black box.

e.) How do you get the data from the Aircraft Software Support Activity? Does it come by mail or over a modem or other data medium?

The only data we have received are the ICD's which came by mail.

f.) What are the security considerations for this Data as it travels to your facility, and once you receive it?

The black boxes and their ICD's are unclassified.

g.) Once you get this data to your AH-1 TSSA, who is it's custodian, and how is it stored?

N/A

h.) What process do you use to make Aircraft Operational Flight Program data useable by your training devices? Is this data suitable for direct load to the trainer's Mission Computer (or equivalent), or do your engineers have to modify it?

We use the code "as is".

i.) If your engineers have to modify the OFP data prior to loading on your trainers, do they follow pre-arranged standardized steps, or do they have to perform an analysis and customize the code each time?

N/A

j) How do you transfer the OFP data (unmodified or modified) from your AH-1 TSSA to each individual trainer computer (or mission computer). Can you describe the process, equipment, and personnel involved? Can you supply a block diagram or other info on your current setup?

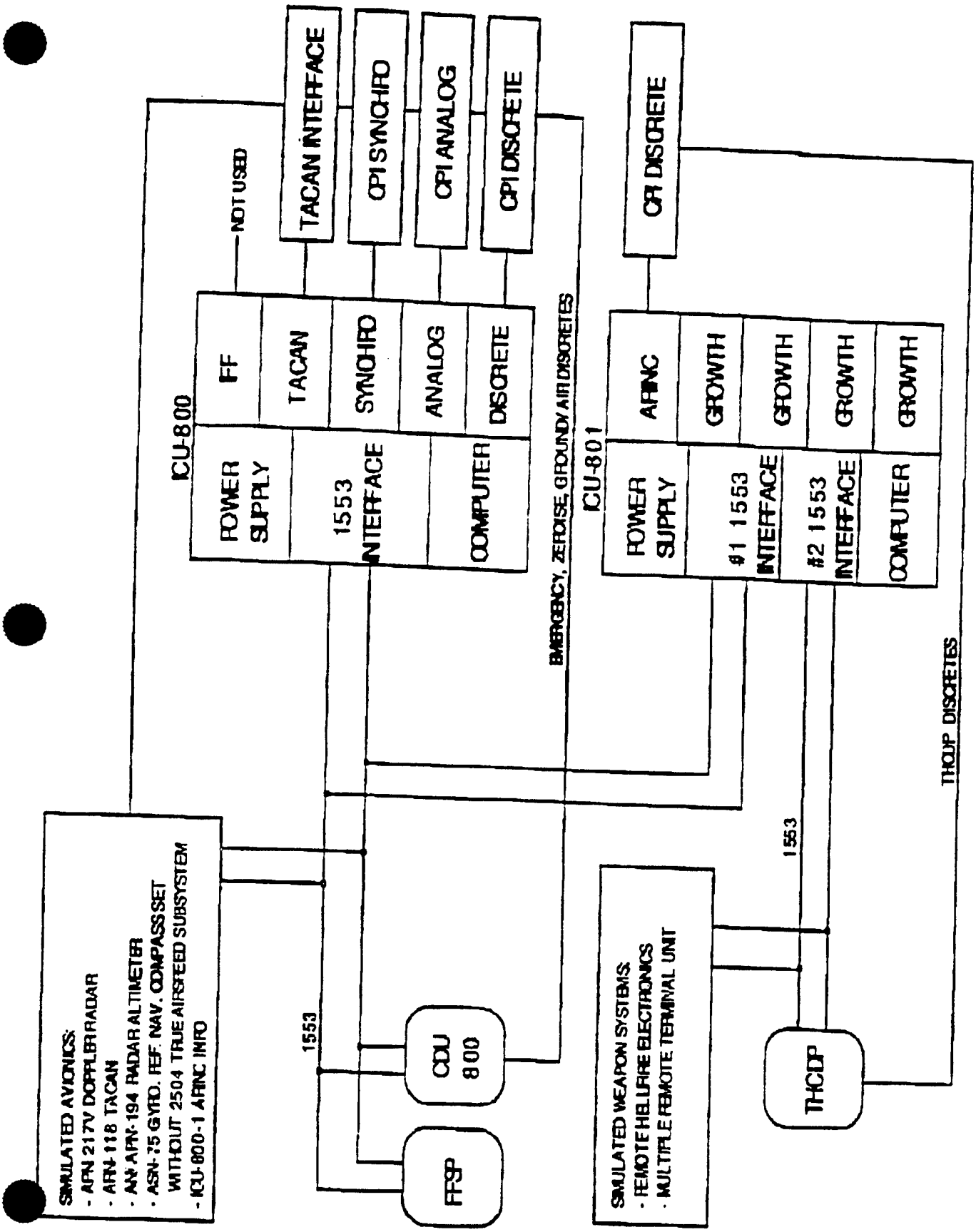
N/A

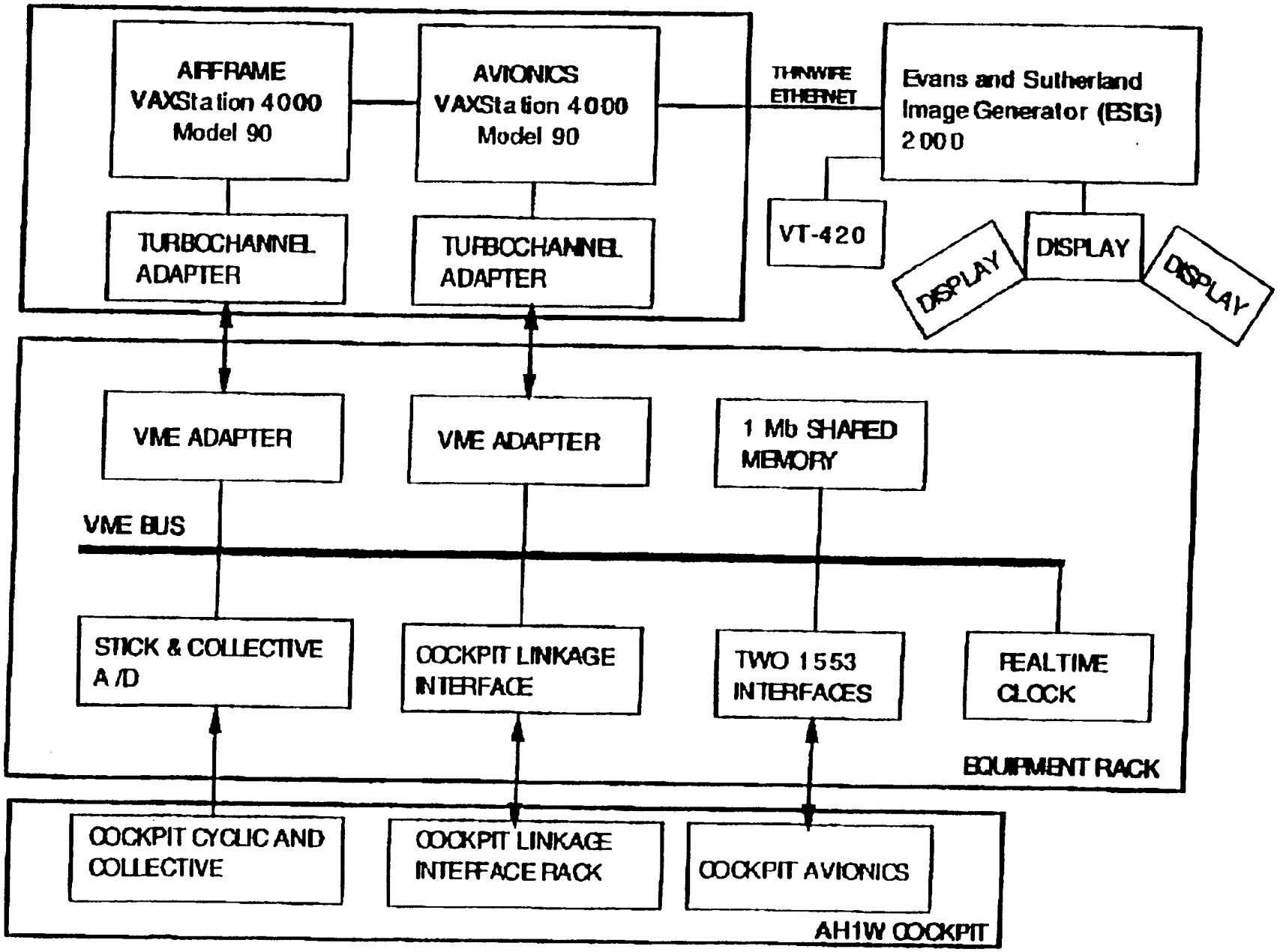
k.) Do you find your current system for performing OFP uploads adequate? If you were to improve this system, would you place an emphasis on speed of data transfer, or security, or cost of equipment to move the data? how much human interaction would you expect to see during the operation of a system such as yours?

N/A

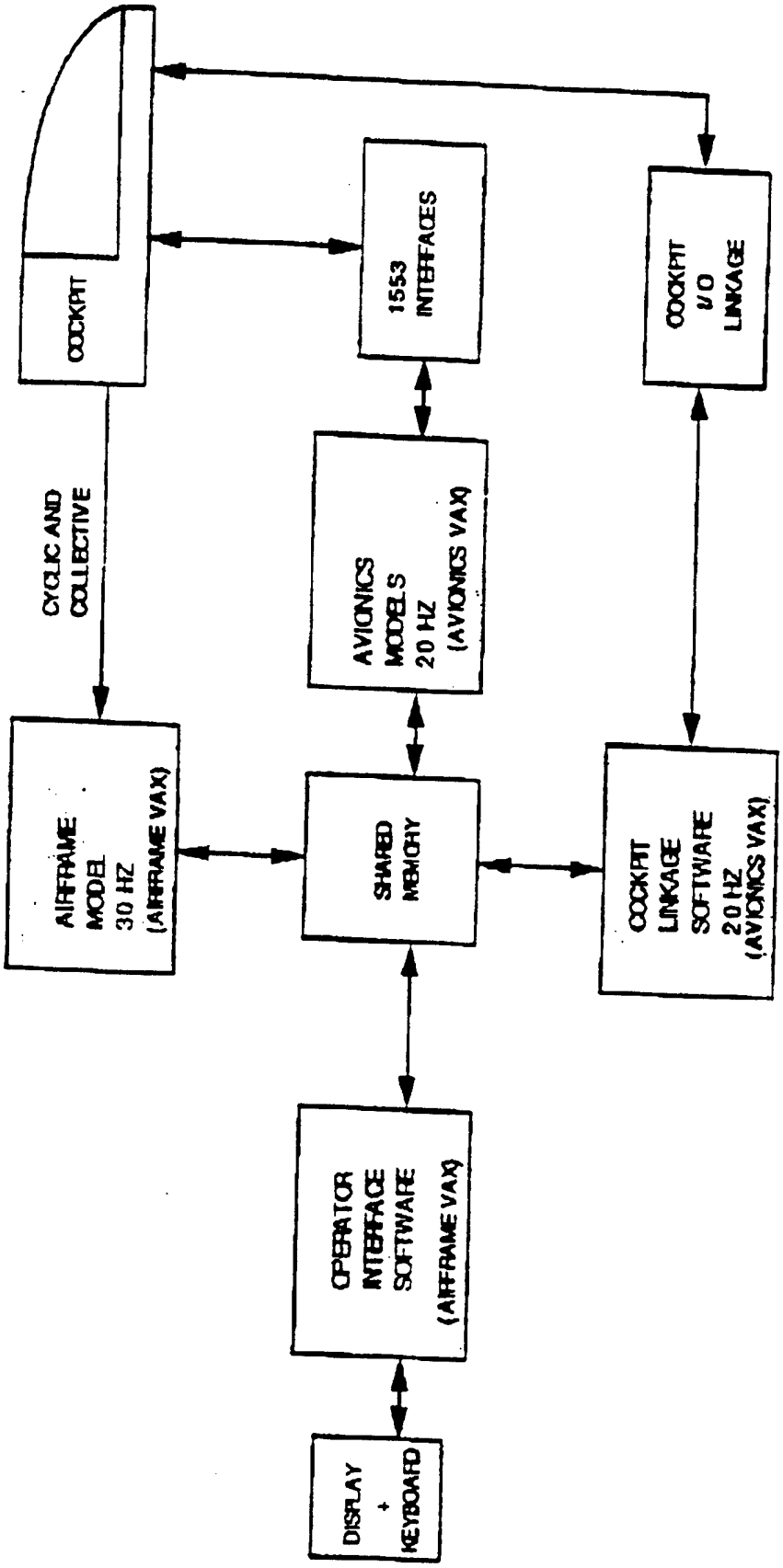
APPENDIX C

MARINE CORPS AH-1W TRAINER BLOCK DIAGRAMS


AH1W AVIONICS STIMULATION
SIMULATED AVIONICS:
- AFN 217V DOPPLER RADAR
- ARN-118 TACAN
- ANAPN-194 RADAR ALTIMETER
- ASN-75 GYRO. REF. NAV. COMPASS SET WITHOUT 2504 TRUE AIRSPEED SUBSYSTEM
- ICU-800-1 ARINC INRO
ICU-800
POWER SUPPLY
1553 INTERFACE
COMPUTER
FF
TACAN
SYNCHRO
ANALOG
DISCRETE
NOT USED
TACAN INTERFACE
CPI SYNCHRO
CPI ANALOG
CPI DISCRETE
ICU-801
POWER SUPPLY
#1 1553 INTERFACE
#2 1553 INTERFACE
COMPUTER
ARINC
GROWTH
GROWTH
GROWTH
GROWTH
CPI DISCRETE
EMERGENCY, ZEROISE, GROUND/AIR DISCRETES
THCDP DISCRETES
1553
1553
CDU 800
FFSP
THCDP
SIMULATED WEAPON SYSTEMS:
- REMOTE FIBRE ELECTRONICS
- MULTIPLE REMOTE TERMINAL UNIT



AH1W SIMULATION HARDWARE ARCHITECTURE



AH1W SIMULATION SOFTWARE ARCHITECTURE

APPENDIX D

TRAINER DESIGN APPROACHS

TRAINER DESIGN APPROACHES - Training devices utilize one of three basic methods to operate; these are the "simulation" , "stimulation", and "hybrid" design approaches.

The "Simulation" method utilizes software code modules within the host computer(s) to replicate the functions of the OFP driven "black boxes" that are found in modern aircraft. No actual black boxes exist on the training devices. The advantage to this approach is that the trainer is not dependent on actual aircraft hardware, which can be very expensive or not available during the trainer build cycle. The disadvantage of this design approach is that it requires close coordination in the initial design effort, between the aircraft system and training device software engineers, to include provisions for OFP updates. Unless this design goal was accomplished, when modifications are made to the OFP data, the trainer software will have to be modified for each individual operational change of the aircraft. These types of changes are usually expensive and time consuming, and often do not yield the desired results.

The "Stimulation" method uses the host computer to provide appropriate inputs to the actual OFP operated aircraft hardware. The host computers task is to provide "believable" data to the aircraft hardware to cause it to respond as if it where in the desired flight regime. The advantage to this approach is that as changes are made to the OFP, the latest data can be uploaded and run with limited modifications to the host software load. The cost of host software maintenance is lower on a fully stimulated trainer than either the simulated or hybrid approaches. A potential drawback to this design approach is that the OFP hardware was originally intended for in-flight use and older equipment is not set up to handle the demands of training devices such as freeze, reset, and playback. Newer on board computers program designs are including "hooks" for simulator use, and some are being retrofit for this purpose. The drawback to using actual aircraft hardware in trainers is generally cost, availability of replacement components, and the OFP change issue.

The "Hybrid" method utilizes elements from both the "Simulation" and "Stimulation" design approaches. Key pieces of the trainer design are stimulated aircraft equipment, while others aircraft functions are replicated strictly by software modules on the host or other non-aircraft equipment. From a designer's viewpoint, this approach gives the leeway to utilize hardware and software components according to availability, cost, maturity of design, and how each can meet the demand of the product specification. The advantage is that the level of support for OFP changes can be mitigated somewhat compared to the full simulation approach, but of course host software will require changes and OFP data may require tailoring for trainer use.

APPENDIX E

AIR FORCE F-16
TRAINER CHANGE PROCEDURES
(Excerpts)

Correction Master

F-16 A/B AIRCREW TRAINING DEVICES (ATD)

OPERATIONAL/SUPPORT CONFIGURATION

MANAGEMENT PROCEDURES (O/S CMP)

15 January 92 Interim ~~30 AUGUST 90~~

APPROVAL:

OO-ALC/MMA, 19 June 90 Date

for BAF VDT/B, 29 Aug 90 Date

RDAF AIRMATCOM/F-16 PO, 10 AUG 90 Date

~~RNLAF~~ DMKLu/AVL/VL2, 10 AUG 1990 Date

RNOAF AMC/TFAT, 16 June 90 Date

Attachment 1

OO-ALC ON-BASE COORDINATION

CHIEF, MMAM / date

CHIEF, MMAR 24 Jan 90 date

John Hadley/MMAMT (Prog Mgr)

Milt Smedley/MMARE-1 (Engr'ng)

E. Helfer/MMAMT (EPAF Coord'r) 30 May 90

Ronald Rex/MMQB (Quality Assurance) 1 Jun 90 date

Jack Horting/MMEOB (Hill Software Control Center - SCC) 28 Dec 89 date

Edie Staples/MMMA 31 May 90 date
[MM OPR, AFR800-14/OOALCR 800-21 and OO-ALC Mission Critical Computer Resources (MCCR) Focal Point]

BELGIUM SCR/ MMA-L-BE / 24 May 90 date

DEMMARK SCR/ MMA-L-DE 24 JAN 1990 date

NETHERLANDS SCR/MMA-L-NE 1 June 90 date

NORWAY SCR/ MMA-L-NO 15 Mar 1990 date

OO-ALC/RF (AF Res, Nat Gd) 27 Jan 89 date

Attachment 2

OFF-BASE COORDINATION

	19 Sep 90		15 Jun 90
HQ TAC/SCX	date	ASD/YWF	date
	18 MAY 90		23 MAY 90
AF/RER (AFRES)	date	NGB/XOPM	date
	30 MAY 90		5-30-90
AFLC ILC/XMXA	date	AFLC LOC/ATO	date

	1/19/90
CHIEF, HQ DMA/PRR	date

F-16 A/B AIRCREW TRAINING DEVICES (ATD)

OPERATIONAL/SUPPORT CONFIGURATION

MANAGEMENT PROCEDURES (O/S CMP)

16 January 92

~~30 AUGUST 1990~~

Rev I

DRAFT.!!

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ADDENDUM B.	Distribution
ADDENDUM C.	EPAF Cost Sharing Methodology
ADDENDUM D.	On-Site Configuration Control Guidelines

F-16 A/B AIRCREW TRAINING DEVICES (ATD)

OPERATIONAL/SUPPORT CONFIGURATION

MANAGEMENT PROCEDURE (O/S CMP)

1.0 INTRODUCTION

1.1 Purpose. This Operational/Support Configuration Management Procedure (O/S CMP) details the concepts and procedures used for OO-ALC/MMA management and configuration control of F-16 A/B Aircrew Training Devices (ATD) in support of the United States Tactical Air Forces (TAF), and European Participating Air Forces (EPAF).

1.2 Scope. The United States Tactical Air Forces (TAF), and the European Air Forces of Belgium, Denmark, The Netherlands and Norway are the Using Commands being supported through this O/S CMP.

1.2.1 F-16 Aircrew Training Devices (ATD): This document provides basic management and configuration control procedures/policies pertaining to computer resources support for the F-16 A/B ATD which consists basically of the Weapon System Trainer (WST) and Visual System. The F-16 WST includes the Operational Flight Trainer (OFT), Electronics Warfare Training Device (EWTD), Norwegian EWTD (NEWTD), and Digital Radar Landmass System (DRLMS).

— Include ADF visual TSSC Support incl.

1.2.2 Trainer Support Policy:

1.2.2.1 All USAF F-16 A/B WST devices will be supported under Contract Logistics Support (CLS) policy managed by OO-ALC/LIRBE. This policy includes software support through the F-16 Training System Support Center (TSSC).

1.2.2.2 EPAF F-16 A/B WST devices are not under CLS support policy, but will be supported through Service Contracts managed by OO-ALC/LIRBE. EPAF WST devices will also receive software support through the TSSC.

1.2.2.3 Non-WST type training systems (Simulated Aircraft Maintenance Trainers - SAMTS, Hardware Aircraft Maintenance Trainers - HAMTS, etc.) will be addressed under a separate O/S CMP.

1.2.2.4 Funding for CLS/TSSC contracts and applicable updates or modifications produced by the TSSC contractor will be cost-shared "up front" by all Users on a trainer population ratio basis per Addendum C.

Add Sec

1.2.3 Maintenance Concepts: Basic procedures outlined herein shall be used to manage and control all changes to F-16 WST software and/or hardware baselines resulting directly or indirectly from weapon system concurrency requirements, deficiency correction, operational enhancements or redirection of trainer utilization requirements.

1.2.4 User Compliance: All Air Force activities involved in the change process shall ensure that these procedures are followed, and that the associated intra-command controls and procedures allow for their compliance.

1.2.5 **O/S CMP Maintenance:** As a living document, this O/S CMP will be updated periodically to reflect requirements of the latest configurations as determined by the Training devices Multinational Computer Resources Working Group (TDMCRWG). It will be upgraded to the Computer Rewources Life Cycle Management Plan (CRLCMP) following the next major system upgrade IAW AFR 800-14 and AFLCR 800-21.

1.3 Applicability.

1.3.1 **General:** The procedures described herein apply to all Tactical Air Force (TAF) users, the European Participating Air Forces (EPAFs), and to the F-16 ATD support organizations within TAF, AFLC and AFSC. This document is based on requirements and guidance outlined in Section 8.1 of this O/S CMP plus the following:

a. The F-16 A/B WST Multinational Computer Resources Integrated Support Plans (CRISP).

b. F-16 A/B Memorandum of Understanding (MOU) Between the Government of the United States and the Governments of Belgium, Denmark, the Netherlands and Norway (6 June, 1976).

c. F-16 A/B WST User's Group Charter, 25 June 1986.

1.3.2 **F-16 WST System Description:**

1.3.2.1 OFT (Operational Flight Trainer):

a. Computation System: The F-16 A/B OFT is controlled and driven by a ND-100/500 computer complex. The computer system controls all required interfacing to the Signal Conversion Equipment (SCE)/cockpit controls and indicators, Avionics Multiplex Bus (AMUX), Visual Instructional System, DRLMS and EWTD/NEWTD to control the simulation. The Computer Program System (CPS) is programmed in FORTRAN with the exception of a few modules coded in "C" and Assembly.

> NOTE: At the next major software upgrade, the redesign or addition of more than one-third of the software for the system or subsystem, requires the use of ADA software language. This includes major block updates to systems both before and after program management responsibility transfer occurs. Analysis and risk management approaches as described in current risk analysis, must be used to quantify the scope and effect of the change to determine if the software should be rewritten entirely in ADA, the language should be mixed or the modification should be done in the original language. See AF/CVA policy letter, 9 Nov 88, and subsequent policy letters and regulations for additional guidance and waiver approval.

b. Cockpit: The simulator cockpit is a replica of the F-16 aircraft cockpit depending on configuration. All instruments, Fly-By-Wire controls, avionics displays, and indicators are identical in appearance, color, feel and function to those of the F-16 aircraft design being simulated. A mechanoreceptor cueing system comprised of

a G-seat, Anti-G suit and Seat Shaker is integrated into the cockpit to help simulate the sensations of motion. An aural cue system reproduces realistic aircraft sounds.

c. Avionics System: The Fire Control Computer (XFCC), Stores Control Panel (SCP), Central Interface Unit (XCIU), Data Transfer Unit (DTU), Heads-Up Display (HUD), Fire Control Navigation Panel (FCNP), and Radar Electro-Optics (REO) are unmodified aircraft hardware. Other devices connected to the Avionics MUX Bus such as the Combined Altitude Radar Altimeter (CARA), Fire Control Radar (FCR), Inertial Navigation System (INS), and Central Air Data Computer (CADC), are simulated in software and connected to the MUX bus via a Programmable Terminal Controller (PTC).

d. Instructional System: The Instructor Operator Station (IOS) is comprised of three Silicon Graphics Workstations with an Ethernet interface to the NORD 100. The IOS provides interactive color displays, using touch screen technology, and a cockpit instrument repeater panel.

1.3.2.2 Electronic Warfare Training Device (EWTD) and Norwegian EWTD (NEWTD): The EWTD consists of a ND-10 computer system, 10 Megabyte disk drive, a Terminal and EW electronics cabinet. The NEWTD consists of a Nord 10/~~50~~ computer system, 75 Megabyte disk drive and EW electronics cabinet. Additionally, Norway (NEWTD) also uses an unmodified ~~CM 4777~~ALR-69 Digital Processor stimulated by video signals generated by the EW cabinet. CCM. 479

1.3.2.2.1 Panels/displays are installed in the OFT cockpit and repeated on the IOS. Interface to the OFT is via a universal DMA channel.

1.3.2.2.2 An extensive CPS is provided for real-time simulation and computer-aided update capability consisting of eleven major functions. These functions include EWTD Control, Radar Warning Receiver (RWR) Equipment, Electronic Counter Measures (ECM) Equipment; JARM (Jammers, Artillery, Radar,Missiles) environment, Interface Control, ECM Equipment Support, RWR Equipment Support, JARM Environment Support, Support Utilities, Diagnostics, and Encounter Support.

1.3.2.2.3 The CPS is programmed in FORTRAN with the exception of certain modules which require the efficiency and flexibility of assembly level code.

1.3.2.3 DRLMS (Digital Radar Landmass System): The DRLMS provides a simulation of the air-to-ground modes and displays of the F-16 AN/APG-66 Fire Control Radar. The system consists of a Norsk Data ND-10/50 computer system, one 75 megabyte disk drive, two 288 megabyte disk drives, an Update Console Subsystem, a Radar Simulation Subsystem, and a Database Transformation Subsystem.

1.3.2.3.1 Display information is provided through a Data Base Transformation Subsystem. The Update Console Subsystem consists of vendor supplied equipment including a radar display, a monochrome graphics terminal, and radar controls emulated by a digitizing tablet. Hard copy devices for the radar display and monochrome graphics terminal are also included.

1.3.2.3.2 The Radar Simulation Subsystem generates the simulated radar image from transformed data on the 288 megabyte discs. The Data Base Transformation Subsystem is a computer program that operates on a Defense Mapping Agency (DMA) computer system in St. Louis, Missouri. This program validates and certifies DMA terrain and culture data and transforms it for use within the DRLMS.

1.3.2.3.3 Interface to the OFT is via Shared Memory. The CPS is organized into five functional areas which include System Executive Programs, Real-Time Operational Programs, Data Base Modification Programs, Maintenance and Test Programs, and Support Programs.

1.3.2.3.4 The CPS is coded in FORTRAN with the exception of a few modules which are coded in assembly.

1.3.2.4 Visual System: The training capability of the OFT is enhanced by a Visual System which provides realistic training in take-off and landing operations, with a specialized capability for air-to-surface and air-to-air tactical operations. A repeater of the visual scene including all Heads-Up Display (HUD) symbology is located at the instructor station.

1.3.2.4.1 A Vital IV System is used by EPAF (produced by McDonnell Douglas Electronics Systems Corporation - MDESC). A Singer-Link Night Visual System (NVS) is utilized by the USAF pending update to the Evans and Sutherland SPX system currently being implemented on the F-16 OFT.

1.3.2.4.2 The CPS for both systems (Vital IV and E&S SPX) is proprietary since both were procured as Commercial Off-The-Shelf (COTS) systems. Only the visual scene databases, therefore, will be addressed in this document.

1.3.2.4.3 The Vital IV interface module V001 is an integral part of the CPS for the F-16 A/B OFT. As such, it comes under TSSC configuration management.

Adde

TSSC add support for ~~AA~~ ADE Visual

1.4 Definitions/Abbreviations

1.4.1 Definitions:

a. Block Update: A revision level update to the software product baseline. This update will normally include a block of previously approved TSSC generated software changes which are held until it becomes practical and cost effective to distribute. Some of these changes may have been previously distributed as temporary changes. A Block Update cycle of one year is a scheduled goal.

b. Command Certification. A statement of requirement from the office of change authority of any command, country or other User consisting of an official request for a specific type hardware and/or software modification to the current master product baseline configuration.

c. Computer Software Configuration Item (CSCI). A CSCI is an aggregation of software or any of its discrete portions, which satisfies an end use function.

d. Computer Program System (CPS). The total simulator computational software program product including all operational,

support, diagnostic and real-time software programming and media as defined by the Computer Program Product Specification (CPPS).

e. Computer Program Identification Number (CPIN): A variable length, alphanumeric identification for control and management of Mission Critical Computer Resources (MCCR) software in the Air Force.

f. Configuration Control. The systemic evaluation; coordination; approval or disapproval; and implementation of all approved changes in the configuration of a Configured Item.

g. Configuration Status Accounting. Recording and reporting of the information that is needed to manage configuration effectively, including a listing of the approved configuration identification, the status of proposed changes and the implementation status of approved changes.

h. Development Technician Team (DTT). Using command technical support personnel skilled in Simulator Technology.

i. Emitter Identification Data (EID). The EID represent the known radar threats that may be encountered in a hostile environment. These are stored in memory (PROMS, EPROMS, RAM, etc.) and can undergo reprogramming action.

j. Hardware Product System (HPS). The physical training device hardware design product as defined in the Prime Item Fabrication Specification, configured Engineering Drawing set, other associated technical documentation and as defined in the TSSC contract Statement of Work (SOW).

k. Mission Critical Computer Resources (MCCR). All computer equipment, programs, data, documentation, personnel and supplies integral to a defense system from the design, acquisition, operations and support point of view. This excludes general purpose, commercially available automatic data processing equipment used for administrative data processing.

l. Operational Flight Program (OFP). The software, used for control of aircraft avionics computers, which perform computations and makes logical decisions related to mission performance and aircraft control.

m. Product Baseline (PB). The composite trainer system configuration database consisting of the Computer Program System (CPS - software, firmware and associated technical data) and the Hardware Product System (HPS - Engineering Drawings, Support Equipment, associated technical data and spares etc) as defined in the TSSC contract SOW and Air Force Documentation.

n. Product Team (PT). The complement of logistics and technical personnel having OO-ALC responsibility for, and dedicated to, the logistical support and management of F-16 training devices. This group was originally organized as an F-16 Product Team 'Cell' under OO-ALC/MMI Trainer Division, but was relocated under the F-16 Weapon Systems Division (OO-ALC/MMA) in June 1989. This cell or team is now known as the F-16 Training Devices Logistics Product Team (referred

to hereafter simply as the F-16 Product Team or just 'Product Team') and includes OO-ALC/MMAMT (Logistics) and MMARE-1 and -2 (Engineering). (Para 2.2.2)

o. ATD Project Officer (PO). The individual designated as liaison between the Government and the Contractor Logistics Support (CLS) Contractor with the responsibility for assuring base participation in providing logistics and administrative support of the Aircrew Training Devices. (See Para t. TSSC Liaison Engineer)

p. ATD Quality Assurance Representative (QAR). The Government individual who exercises surveillance over the quality of the CLS Contractor's work to make sure that the contractor has properly accomplished all work tasks in accordance with contract specifications. (See Para t. TSSC Liaison Engineer)

q. Separately Procured Modification (SPM). A change to the Product Baseline that is beyond the capability/scope of the TSSC or would extend beyond the contractual period.

r. Software validation. Evaluation, integration and test activities conducted at the system level to ensure that the developed software satisfies requirements set down as performance and design criteria in the system specification and operational/support requirements.

s. Training System Support Center (TSSC). An ATD support function normally staffed by the Contractor Logistic Support (CLS) contractor. Under the direction of OO-ALC/MMA, the TSSC performs configuration management, configuration status accounting, and general update of the Product Baseline (PB). This function is currently located in Bldg 1264 at Hill AFB.

t. TSSC Liaison Engineer (TLE): OO-ALC/MMA engineer who will interface with the TSSC contractor personnel. This function also includes the duties of the Project Officer (PO) and Quality Assurance Representative (QAR) for TSSC functions. The ATD PO/ATD QAR will handle TSSC equipment maintenance issues.

u. Temporary Change: A temporary software change to the User Site (working) copy of the ATD CPS . These changes may be distributed between Block Updates to enhance training capability of the ATD in a timely manner. Such changes will be permanently incorporated into the CPS as part of the next Block Update.

v. Time Compliance Technical Manual (TCTM). The time limited technical manual directing installation of a permanent change to the product baseline at the User Sites as generated and distributed by the TSSC contractor under MMAMT direction. Since Air Force Technical Orders are not applicable under the CLS concept, the TCTM is the TSSC contractor's document filling the same requirement.

2.0.7 HQ AFRES (Air Force Reserves): AF/RER, Air Force Reserve Requirements and Development Office is the Point of Contact for AFRES Aircrew Training Devices.

2.0.8 NGB (National Guard Bureau): NGB/XOPM is the Point of Contact for Air National Guard Aircrew Training Devices.

2.0.9 European Participating Air Forces (EPAFs).

2.0.9.1 Belgium Air Force (BAF): The management focal point for F-16 software is the avionics section of the BAF Air staff (VDT/B) located in Brussels, Belgium. The Belgian Liaison office at OO-ALC (MMA-L-BE) will act as an interface between the BAF Air staff and USAF organizations.

2.0.9.2 Royal Danish Air Force (RDAF): The management focal point for F-16 software in RDAF is the Air Materiel Command (AMC), Aircraft Division, F-16 Branch (FMK/TYF). The AMC, located at Air Base Vaerloese, Denmark, is responsible for logistics, engineering and maintenance support as well as finance and planning, and as such will provide F-16 software liaison to USAF and F-16 MNFP Air Forces. The RDAF SCR at OO-ALC/MMA-L-DE will coordinate RDAF participation on the MCCB and SCCSB.

2.0.9.3 Royal Netherlands Air Force (RNLAF): The RNLAF/Directorate of Materiel (DMKLu) is located in the Hague. The F-16 Project office is the office of primary responsibility for the RNLAF F-16 program. Focal and coordination point for F-16 is the Avionics Section (VL2) of the Aircraft Engineering and Logistics Branch (AVL), office symbol DMKLu/AVL/VL2. The RNLAF will participate as a minimum in the MCCB and SCCSB as delineated in the F-16 WST CRISP through OO-ALC/MMA-L-NE.

2.0.9.4 Royal Norwegian Air Force (RNOAF): The RNOAF Material Command located at Kjeller, Norway is responsible for logistics, technical and maintenance support, as well as finance, organization and Planning. Aeronautical Division, Avionics Branch (TFA), will be the F-16 WST coordination and focal point. The RNOAF SCR at OO-ALC/MMA-L-NO will coordinate RNOAF participation in the MCCB and SCCSB.

2.0.10 **Air Training Command (ATC).** ATC is responsible for providing Air Force training including training curriculum, manuals and schedules, both for pilots in the simulators, and training of maintenance and support personnel.

2.0.11 **Air Force Operational Test and Evaluation Center (AFOTEC).** AFOTEC is responsible for the operational test and evaluation of all new acquisitions to verify acquired equipment is functional within the scope of Air Force specifications, and that it meets reliability and maintainability requirements.

2.1 Control Boards, Panels and Groups

2.1.1 **Multinational Computer Resources Working Group (MCRWG).** The MCRWG is responsible for management and update of the F-16 Weapon System (aircraft) Computer Resources Integrated Support Plan (CRISP)

and O/S CMP. This group is also responsible for review and implementation of aircraft software Operational Flight Programs (OFPs) as approved by the SCCSB.

2.1.1.1 **Training Devices Multinational Computer Resources Working Group (TDMCRWG).** The F-16 TDMCRWG is responsible for management and update of the F-16 ATD O/S CMP and training devices Mission Critical Computer Resources (MCCR) configuration concurrency with the aircraft software OFP configurations.

2.1.2 **F-16 WST Users Group (WSTUG):** The F-16 WSTUG was established by the F-16 Multinational Fighter Program Operations Sub Committee (OSC) June 1986. The purpose of the WSTUG is to review the overall program direction, Screen proposed changes, assign priorities, and otherwise provide guidance for F-16 WST/aircraft configuration concurrency.

2.1.2.3 **EPAF F-16 WST Pre-Users Group:** The four EPAF countries will hold a Pre-Users Group meeting in country as required, prior to the scheduled WSTUG meeting. Purpose of this meeting is to organize information of common interest (i.e. Service Deficiency Reports, problems etc) to be presented at the WESTUG meeting. Prioritization of Enhancement type change requests is of prime importance and consensus among participants is desireable. Pre-User Group meeting minutes will be taken and copy provided OO-ALC/LIRBE prior to the scheduled WSTUG meeting.

2.1.3 **Computer Software Screening Panel (CSSP):** The change classification screening function referred to in AFR 800-14 and designated as the Computer Software Screening Panel (CSSP) in AFLCR 800-21. For the F-16 Training Devices program, this function will be accomplished by the F-16 Product Team. (Para 2.2.2)

2.1.4 **OO-ALC/MM/MMA Configuration Control Board/Multinational Configuration Control Board (OO-ALC CCB/MCCB):** Upon program Management Responsibility Transfer (PMRT) of any F-16 system/subsystem to Ogden, the OO-ALC CCB/MCCB (hereafter referred to as the "MCCB") is the configuration change control authority for all such F-16 U.S./Multinational Participating Air Force changes as currently designated in OO-ALCR 57-2, and has the responsibility for all changes to the assigned system and its Configuration Items (CI).

2.1.4.1 **F-16 Software Configuration Control Sub-Board (SCCSB):**

a. The F-16 SCCSB (formerly known as the Computer Program Configuration Control Board - CPCSB) operates under the authority of the MCCB for training devices as prescribed in AFR 800-14 and AFLCR 800-21.

b. The SCCSB will have primary responsibility to exercise configuration management and control of each PMRTd ATD CSCI and is the approval authority for Class I and II CSCI changes not exceeding two million dollars in cost or requiring less than 15 man years (organic) or five million dollars and 25 man years (contractual). Changes exceeding these limits will be approved at the MCCB or higher authority level.

c. The SCCSB will convene as directed by the chairperson.

2.1.5 Control Group Interface Structure: The interface structure of these groups as pertains to change implementation at the User Sites is provided in Figure 2-1.

2.2 Organization Responsibilities

2.2.1 WSTUG Organizational Structure: The WSTUG is chaired by OO-ALC/MMAMT and consists of primary members from TAC and the EPAF

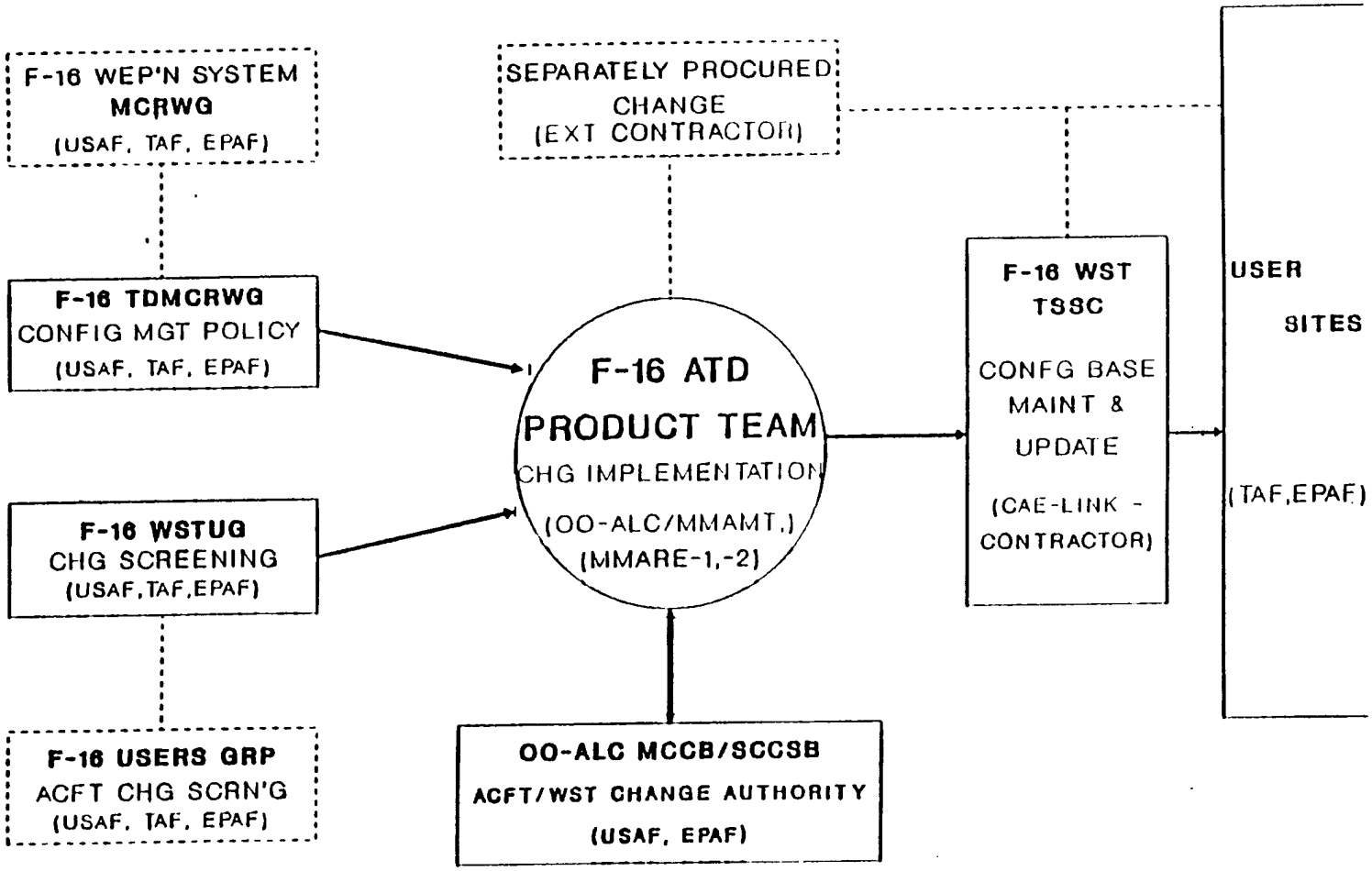

Fig 2-1, F-16 ATD Change Organization Structure

* MCCR Representative

2.2.5.3 Meetings: At a minimum, this group will meet semiannually in conjunction with the MCRWG, but any participating organization may request the chairman to convene the working group.

3.0 CONFIGURATION MANAGEMENT CONCEPTS

3.1 Change/Discrepancy Classifications and Priorities: Change requests/discrepancy reports to Computer Software Configuration Items (CSCIs), and hardware must be controlled in an efficient and responsive manner; yet, provide the flexibility required to meet mission requirements.

3.1.1 **CSCI Change Classification:** CSCI changes are classified as Class I (design) and Class II (discrepancy) changes, as defined in Appendix XIV of MIL-STD-483A.

3.1.2 **Hardware or Combined Hardware/Software Change Classification:** Any change involving hardware only or combined hardware/software will be classified in accordance with AFR 57-4.

3.1.3 **Change Discrepancy Priorities:** Priority will be assigned by the F-16 Product team in coordination with the Users according to the following guidelines.

3.1.3.1 Priority E (Emergency).

3.1.3.1.1 An emergency priority will be assigned if immediate resolution of the request is essential to prevent a serious compromise of national security, fatal or serious injury or illness to personnel, extensive loss of damage of equipment, or severe restriction of degradation of combat readiness.

3.1.3.1.2 Such change must be completed within 72 hours and will generally, in the interest of time, be implemented as a temporary change by the TSSC pursuant to approval by the SCCSB.

3.1.3.1.3 Coordination with the change originator on E priority requests will be accomplished via electrical message direct from the F-16 Product Team with information copies to the Command's/Country's primary member of the WSTUG.

3.1.3.2 Priority U (Urgent).

3.1.3.2.1 An urgent priority will be assigned if prompt resolution of the request is essential to prevent either/or serious degradation to the mission effectiveness of deployed equipment, potential injury to personnel or damage to equipment, program schedule slippage or increased cost, or a lost opportunity for significant lifecycle cost savings.

3.1.3.2.2 Upon review and approval by the Product Team, Urgent type changes must be corrected within 10 working days as a temporary change.

3.1.3.2.3 Coordination of urgent change requests will be accomplished by the Product Team through normal command channels. Direct communication may be required with the change originator concerning technical details.

3.1.3.3 Priority R (Routine).

3.1.3.3.1 A Routine priority will be assigned to all requests which do not meet the criteria for Emergency or Urgent

3.1.3.3.2 Coordination will be accomplished as outlined in these procedures.

3.1.4 **Electronic Warfare Integrated Reprogramming (EWIR) Changes (USAF Only):** The following subsections describe the types of Aircraft EWIR changes as specified in AFR 55-90. EWIR changes may occur periodically as a aircraft block update change or may be directed as an emergency change. Technical/intelligence data for real world emergency changes and exercises are transmitted according to distribution identified in this document.

3.1.4.1 Type U (User). Change is accomplished by the user and is restricted to a change in tactics equipment setting, etc., that does not affect software or hardware configuration. OO-ALC serves in an advisory capacity to users on requests to assist in evaluation.

3.1.4.2 Type L (Logistics). OO-ALC is responsible for determining feasibility, designing, coding, testing, and releasing type L changes in Electronic Warfare Systems and Ground Support Equipment (GSE).

3.1.4.3 Type S (System). Type S changes are normally hardware system changes using the ECP process and will be processed in accordance with AFR 57-4.

3.1.5 **Trainer Priorities for EWIR Changes:** The priority stated in the change request will establish the work schedule and level of effort required to support the change. Usually, the priority will be assigned as E, U or R as noted above.

3.1.6 **Mission Data Changes:** Changes in site-peculiar mission data will be accomplished by the CLS Contractor/EPAF site personnel. Each CLS site will be under the direction of the ATD PO. The TSSC may be tasked by the F-16 Product Team to maintain common Sensor Databases such as DRLMS Site/Real-Time databases, and Visual databases. Approach/Departure plates, etc may also be included.

3.1.7 User Site Configuration Control: Configuration control of User Site software configuration shall be in accordance with procedures outlined in Addendum D of this O/S CMP.

4.0 MODIFICATION/CHANGE PROCEDURES

4.0.1 **General:** The F-16 ATD Modification/Change procedure paragraphs outlined below correspond to like numbers on Figure 4-1. Change Requests not affecting system configuration such as database updates/mission changes will be handled by the on-site CLS contractor or on-site EPAF personnel.

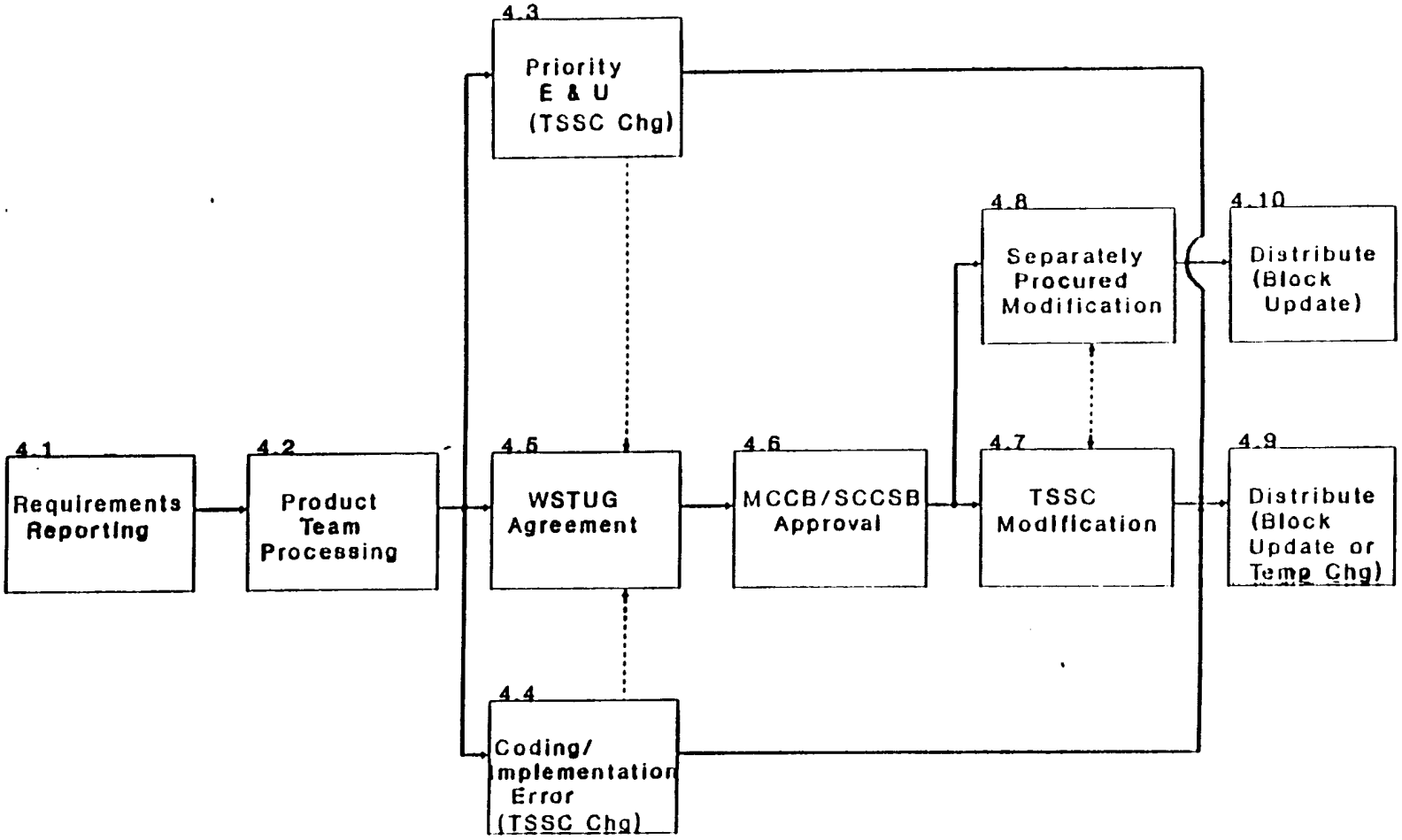

FIGURE 4-1 MODIFICATION/CHANGE FLOW

4.1 Reporting Requirements.

4.1.1 **Modification/Discrepancy Report Sources:** Proposed changes and discrepancy reports on the F-16 ATD may be identified by any of the sources listed below. They may originate as Operational Change Requirements (OCR's), as a result of modifications to an aircraft system, from system deficiencies, or from proposed system enhancements.

a. Weapon System, Electronic Warfare or Trainer System Program Manager (SPM)

b. Using Command Field Units via the ATD Quality Assurance Representative (QAR)

c. DTT

d. TSSC

4.1.2 **Submittal Procedure:** All Change Requirements/Requests will be submitted to the F-16 Product Team (OO-ALC/MMAMT) as outlined below. This change requirement will usually be submitted following the receipt and review of a rough draft 'Impact and Cost Sharing/Funding Package' (reference para 4.2.1.3).

a. F-16 Aircraft Concurrency Changes. A Change Requirement may be submitted as a Program Management Directive (PMD), Command Certification (AF Form 1067), etc. The Change Requirement will be reviewed and processed in accordance with AFLCR 800-21 Chapter 4, OO-ALCR 800-22, and procedures outlined herein.

b. Software Deficiency Reports (SDRs), Material Deficiency Reports (MDRs) and Enhancements (trainer unique). All SDRs, MDRs and Enhancements will be reported and processed in accordance with standard T.O. 00-35D-54 procedures.

c. TSSC and DTT Change Requests. Change Requests originating with the TSSC or DTT will be submitted/reported to the Liaison engineer.

4.2 F-16 Product Team Processing:

4.2.1 **Aircraft Concurrency Changes:** The F-16 Product Team is responsible for identifying and implementing change requirements to ATDs resulting from changes to the aircraft.

4.2.1.1 The F-16 Product Team receives a copy of all aircraft Engineering Change Proposals (ECPs)/Organic Change Proposals (OCPs) from the aircraft ECP Monitor (MMARS).

4.2.1.2 The F-16 Product Team, with the assistance of the TSSC, reviews each ECP/OCP for potential ATD applicability and logs into a Logging and Tracking Database. Tracking under the Material Improvement Project (MIP) system will be accomplished using the assigned Aircraft MIP number.

4.2.1.3 For any ECP/OCP with potential impact to an ATD, a rough draft 'Impact and Cost Sharing/Funding Package (AFLC Forms 18 and 75)' is prepared and presented to TAF for Command Certification. Coordination and certification for the EPAF users will be accomplished at the Aircraft Modification Review Panel (MRP). Further screening type activity pertaining to need, priority and implementation method/schedule will be accomplished through the quarterly newsletter (Para 4.2.2.5) and inclusion as agenda items at the WSTUG meetings.

4.2.1.4 For those ECPs/OCPs approved for implementation by TAF and EPAF users, a Final 'Impact and Cost Sharing/Funding Package (AFLC Forms 18 and 75)' is prepared and presented to the MCCB for approval.

4.2.2 **SDR, MDR and Enhancements:** F-16 Product Team processing and responsibilities for these potential change requirements are as follows:

4.2.2.1 The F-16 Product Team will establish a Material Improvement Project (MIP) for SDRs, MDRs and Enhancements requiring a Design Change to the ATD. A Design Change is defined as any change to the ATD which causes it to operate/function differently than specified by the design and product specification. Coding Errors and Implementation Errors are excluded.

4.2.2.2 A Block Update 'Candidate Number' will be assigned to each potential Design Change to the ATD. Further discussion of these Block Update Candidates at the WSTUG and MCCB will reference this number.

4.2.2.3 The F-16 Product Team, with the assistance of the TSSC, will prepare a briefing package for each candidate for presentation to the WSTUG.

4.2.2.4 MIPs and Candidate Numbers will not be assigned to ATD change requirements related to Coding Errors/Implementation Errors unless the scope of the change will require an effort beyond the core work level of the TSSC.

4.2.2.5 The F-16 Product Team and TSSC will prepare and distribute a quarterly newsletter to keep the ATD community informed of upcoming candidates, results of MRP actions pertaining to specific candidates, and any other pertinent information between WSTUG Meetings.

4.2.3 **TSSC/DTT Change Requests:** Potential change candidates originating with the TSSC or DTT will be screened and processed in accordance with procedures of Para 4.2.2, the same as for SDRs and MDRs.

4.2.4 **Priorities:** A priority will be assigned to each change request/requirement according to the definitions in section 3.1.3. The priority will determine the relative speed at which a request/requirement is reviewed, evaluated, developed and implemented. The proposed priority is assigned by the originator and will not change unless a different priority is negotiated with the originator.

4.3 **Priority E and U Processing:** Priority E and U Change Requirements/Requests will be immediately tasked to the TSSC for work. The originator and each Command's/Country's primary member of WSTUG

will be coordinated with by phone or message. The change will be implemented as a Temporary Change pending the next Block Update.

4.4 Design Versus Implementation Error Changes: In order to expedite the change process, different procedures will be used for design versus coding and implementation error change requests.

4.4.1 Coding Error/Implementation Change: If a change request is determined to be a result of a coding or implementation error, the change request will normally be tasked to the TSSC for work and implementation. Implementation will be by a Temporary Change or held for the next Block Update. If the scope of the change will require an effort beyond the core work level of the TSSC, the change request will be presented to the WSTUG for approval prior to expending resources to correct the problem.

4.4.2 Design Changes: If the change request is determined to require a design change to the ATD such as an aircraft concurrency change or an enhancement, the change request will be presented to the WSTUG prior to tasking the TSSC. Aircraft concurrency changes may have previously been command certified and approved by the MCCB/SCCSB, but will still be presented at the next WSTUG.

4.5 WSTUG Action:

4.5.1 OO-ALC Responsibilities. The F-16 Product Team and TSSC will assume the following responsibilities at the WSTUG:

4.5.1.1 Brief the progress of previously approved ECPs/OCPs and Block Update Candidates.

4.5.1.2 Prepare and present briefings for each aircraft ECP/OCP having a potential impact on the ATD.

4.5.1.3 Prepare and present briefings for each Block Update Candidate, providing specific response to queries arising from User review of the quarterly TSSC Newsletter (Para 4.2.2.5).

4.5.1.4 Assist the User in screening, prioritizing, and establishing a Candidate List for the next Block Update. A Block Update may also contain one or more Aircraft Concurrency Changes.

4.5.1.5 Chair the Meeting, take minutes, and assign action items.

4.5.2 User's Responsibilities. The User's will assume the following responsibilities as members of the WSTUG:

4.5.2.1 Screen all potential Block Update Candidates (Including Aircraft ECPs/OCPs) for need, priority, implementation method, etc. as addressed at the MRPs, WSTUG meetings and in the quarterly TSSC Newsletter.

4.5.2.2 Assist OO-ALC in establishing a Candidate List for the Next Block Update. This may require a vote of the WSTUG voting members. Voting members consist of one representative from TAC, ANG/AFRES, Belgium, Denmark, Netherlands, and Norway.

4.5.2.3 Respond as necessary to action items and the quarterly TSSC Newsletter.

4.6 MCCB/SCSSB Action:

4.6.1 **Change Approval:** All changes to the ATD Product Baseline must be approved by the MCCB/SCCSB.

4.6.2 **Change Package:** The F-16 Product Team will develop the required AFLC Forms 18 and 75 Package for review, approval, or disapproval in accordance with AFLCR 800-21 for each Block Update.

4.6.3 **Temporary Changes:** Changes previously distributed as Temporary Changes will be included in the next scheduled Block Update.

4.7 Implementation - TSSC:

4.7.1 **Prototype Effort:** For those approved change requests which are within the scope of the CLS TSSC Contract, the TSSC will be tasked to design, develop, prototype, and document the change.

4.7.2 **Validation:** The F-16 Product Team Liaison Engineer and DTT (as requested) will validate the change and also ensure that the documentation, configuration control, and status accounting functions have been properly completed.

4.7.2.1 Generally, the Hill AFB F-16 A/B ATD in building 118 will be the validation site. However, any other USAF/EPAF site or contractor facility may be used if necessary. Discrepancies identified during validation will be recorded and tracked by the F-16 Product Team until resolved.

4.7.2.2 Quality Assurance (QA) provisions for changes to existing software will be in accordance with those used during the procurement of the ATD. Any new software will be evaluated against DOD-STD-2168 Quality Assurance requirements. The F-16 Liaison Engineer will accomplish the QA tasks.

4.7.2.3 Independent Verification and Validation (IV&V) will be accomplished by the F-16 Liaison Engineer.

4.7.3 **Integration Responsibilities.** The TSSC is responsible for maintaining the Product Baseline. In support of Separately Procured Modifications (SPMs), the TSSC will participate in providing the SPM contractor reference data and implementing the final product.

4.7.3.1 Upon direction from the F-16 Product Team, the TSSC will provide a copy of the Product Baseline software media and documentation to the SPM Contractor.

4.7.3.2 The TSSC will participate in Design, In-Process Documentation Reviews, Program Management Reviews, and validation of SPCs when requested by the F-16 Product Team. If the SPM contractor is the same company as the TSSC contractor, the F-16 Product Team will perform the above reviews and validation.

4.7.3.3 The TSSC will integrate the changes from the SPM contractor into the Product Baseline. In most cases, this will involve taking the new validated Product Baseline from the SPM contractor and adding any TSSC changes.

4.8 Implementation - Contractual:

4.8.1 **Activation:**

4.8.1.1 For Those modifications that are out of scope of the TSSC, the Product Team will initiate action for competitive or sole source contract or procurement in accordance with AFR 57-4 procedures.

4.8.1.2 F-16 Product Team engineering will generate the required data/information (Description of Services, Statement of Work (SOW), etc.) for competitive or sole source procurement.

4.8.1.3 F-16 Product Team Production Management personnel will generate required Justification/Authorization (J&A) and Purchase Requests, and submit the package to the office of Contractual Procurement (OO-ALC/PMZET). For competitive-type contractual efforts, F-16 Product Team technical personnel will participate in development of the bid package and sit on the source selection panel for selection of the contractor.

4.8.1.4 Upon receipt of the procurement package, PMZET will complete and process either a competitive bid or sole source package, as applicable, and award a contract to a contractor.

4.8.1.5 Both the software and engineering data Product Baselines (Master Disk Packs and engineering drawings) to be used as the baseline by the contractor will be obtained from the TSSC (Para 4.7.3.1).

4.8.2 **Implementation:** The contractor will develop the modification, update the Product Baseline, produce the required TCTM, install kits at user sites per requirements of the contract CDRL, and provide the new Product Baseline (includes documentation) to the TSSC.

4.9 TSSC Distribution:

4.9.1 **Temporary Changes.**

4.9.1.1 Temporary Changes may be distributed to USAF/EPAF sites on floppy disk or magnetic tape with installation procedures. This distribution will be accomplished with the approval of the using commands and these changes will only be installed on the Site (working) disk packs. For EPAF, Foreign Disclosure Policy Office (FDPO) coordination will be obtained as appropriate.

4.9.1.2 Temporary Changes will not require an update to the documentation and will not require CPIN updates. However, a Temporary Change will be included in the next Block Update and will then be fully documented and CPINs updated.

4.9.2 Block Updates.

4.9.2.1 Block Updates will be scheduled annually. However, the scope of a given change and other factors may cause this schedule to change slightly. Block Updates will be the official change to the Product Baseline and will include all Temporary Changes that have not been previously incorporated into the Product Baseline. The TSSC will archive copies of the Product Baseline two revisions back.

4.9.2.2 The TSSC will prepare AF Forms 1243 (CPIN Data) necessary for the Software Control Center (SCC) to update the USAF CPIN compendium.

4.9.2.3 The TSSC will deliver a copy of the software media and related software documentation to the SCC.

4.9.2.4 The TSSC will deliver a copy of all other technical documentation and engineering drawings to the Stock, Store, and Issue Center (SSIC).

4.9.3 **USAF Users:** Distribution of software media and all documentation (software & hardware) to USAF Users will be made by the TSSC and SSIC. The F-16 Product Team will coordinate this action with the SCC.

4.9.4 **EPAF Users:** Distribution of software media and related software documentation to EPAF Users will be made by the SCC via the CPIN system. All EPAF users must submit an initial AFTO form 157 (Ref T.O. 00-5-17) through their Technical Order Distribution Office (TODO) to the SCC to establish the initial software update requirement and/or receive software and associated documentation for the initial change requirement. This is normally in response to receipt of a TCTM from the TSSC. Once the AFTO form 157 has been submitted, it will not be required on future distribution requirements from this User.

4.9.4.1 Upon receipt of these requests, the SCC obtains appropriate F-16 Product Team and any required Foreign Disclosure Policy Office (FDPO) coordination. EPAF requests with coordinations are forwarded to OC-ALC/MMDUC for processing (authorization of signature and sufficient funds in Country Case).

4.9.4.2 Upon receipt of mailing labels (AFTO forms 221 and 273) from OC-ALC/MMDUC, the SCC makes distribution to TODOs.

4.9.4.3 All EPAF users are billed for software/documentation distribution costs through the CPIN system. The SCC establishes software distribution costs (blank media plus reproduction time) for each CSCI received in the CPIN system. EPAF billing for modification development is outlined in Addendum C, "EPAF Cost-Sharing Methodology".

4.9.5 **Hardware Documentation:** Distribution of hardware documentation will be through the SSIC.

4.10 <u>Separately Procured Modification (SPM) Contractor Distribution:</u>

4.10.1 **Temporary Changes.** Temporary Changes will not be used by the contractor.

4.10.2 Block Updates.

4.10.2.1 The contractor will prepare AF Forms 1243 (CPIN Data) necessary for the SCC to update the USAF CPIN compendium.

4.10.2.2 The contractor will deliver a copy of the new Product Baseline media and related software documentation to the TSSC and the SSC.

4.10.2.3 The contractor will deliver the modified hardware documentation to the TSSC and the SSIC.

4.10.2.1 Distribution to the User sites will be in accordance with the contract.

4.11 Installation Verification: Upon completion of installation of a Block Update, the CLS/TSSC contractor will submit AFTO Form 349 to OO-ALC/MMAMT, and USAF Users will report installation in the next Field Service Report. EPAF Users will report installation status by message to OO-ALC/MMAMT. No formal response will be required for installation of a Temporary Change. However, the user sites will maintain a local record of all Temporary Changes installed.

5.0 STATUS ACCOUNTING

5.1 Reporting Requirements. The F-16 Product Team is responsible for identifying and analyzing all aircraft changes which may impact the ATD. Additionally, the Team has responsibility for receiving and tracking all change requests such as MDRs, aircraft ECP's, etc. These change requests will be tracked throughout the approval/disapproval and modification process. The TSSC has responsibility for tracking and reporting any modifications made to the product baseline. Additionally, the TSSC may track and report changes to non-configured data such as DRLMS data bases, Visual data bases, etc. as specifically tasked by a User through the Product Team (MMAMT).

5.2 Status Accounting System.

5.2.1 Status of Change Requests: Change Requests will be entered into and tracked by the GO21 (MIP) reporting/tracking system if applicable. Additionally, The F-16 Product Team will receive all Change Requests and log into an internal identification, logging and tracking system. Data such as Change Type, Change Number, Source, Users Group approval, Command Certification, MCCB/SCCSB action, and completion date will be tracked.

5.2.2 Status of Change Requests Approved for Implementation: The TSSC will log and track the status of all CPS modifications using the Configurations Management System(s) delivered with the CPS. These systems will track/report modules changed, corresponding Change Request Numbers, time to implement, documentation completion status, etc. Reports from these systems will be available to the WSTUG and Product Team upon request. The TSSC will also be responsible for updating any affected CPIN Numbers by submitting AF forms 1243 to the SCC requesting revisions/corrections.

6.2.3 Status of Sensor and Visual Databases: The TSSC will perform status accounting on all sensor databases such as DRLMS data, Visual data, etc. This status accounting will include databases available at each user site, databases available at the TSSC, and tracking of media by location, type, and serial number.

6.0 COMMUNICATION REQUIREMENTS

6.1 Electrical Communications.

6.1.1 DEFENSE SWITCHED NETWORK (DSN): Secure telecommunications will be provided via the DSN using STU-III instruments for TSSC personnel to communicate securely with the using commands and WR-ALC.

6.1.2 AUTODIN: English language text messages will be used to transmit operational instructions and related data for changes via AUTODIN.

7.0 SECURITY

7.1 Security Management. Portions of the WST CPS are classified SECRET based upon the F-16 Aircraft Security Classification Guide. F-16 WST and TSSC operation, including IOS displays and hardcopy printouts, are considered classified until reviewed for unclassified determination. Security provisions will be in accordance with AFR 100-45. The TSSC facility will be adequate for use and storage of classified information up to and including SECRET. A computer program is provided with the CPS for declassifying hard disk packs and floppy disks by overwritting the entire media surface three times and then spot checking the media.

7.2 Item Classification. Items will be classified in accordance with the F-16 Aircraft Security Classification Guide and releasability will be determined in accordance with applicable Deletion Disclosure Letters (DDLs).

8.0 APPLICABLE DOCUMENTS

8.1 References.

AFR 50-11	Management and Utilization of Training Devices
AFR 65-3	Configuration Management
AFR 57-1	Statement of Operational Needs (SON)
AFR 57-4	Modification Program Approval and Management
AFR 800-4	Transfer of Program Management Responsibility
AFR 800-14	Life Cycle Management of Computer Resources in Systems
AFR 800-19	System or Equipment Turnover

AFLCR 800-21	Management and Support Procedures for Computer Resources used in Defense Systems
OO-ALCR 57-2	Configuration Management Procedures (Class IV and V, 27 Oct 83)
OO-ALCR 800-3	Management of Computer Resources in Systems
OO-ALCR 800-22	Acquisition, Management and Support of Computer Resources in Systems
TACR 800-3	ATD Acquisition, Testing and Modification Management
AFR 65-32	DOD Configuration Management
AFR 55-90	Electronics Warfare Policy
MOA (6 Jun 1976)	Government of the United States and the government of Belgium, Denmark, Netherlands and Norway
EWIR	Headquarters USAF Electronic Warfare Integrated Reprogramming

8.2 **Military Standards**

MIL-STD-480	Configuration Control - Engineering Changes, Deviations, and Waivers
MIL-STD-481A	Configuration Control - Engineering Changes, Deviations, and Waivers (Short Form)
MIL-STD-483 (USAF)	Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs
DOD-STD-2167	Defense System Software Development
DOD-STD-2168	Defense System Software Quality Program

8.3 **Forms**

AF Form 1067	Modification Proposal
AF Form 1775	Engineering Change Notice/Software Problem Report
AFLC Form 48	Class IV Modification
AFLC Form 75	SCCSB Item Record

AF Form 1243	CPIN/AFCRI Data and Control Record -
DD Form 173	Joint Message Form
AFTO Form 157	Request for Software Distribution
AFTO Form 349	Maintenance Data Collection Form

ADDENDUM A.

ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS AND ACRONYMS

AFLC	Air Force Logistics Command
AFLCR	AFLC Regulation
AFOTEC	Air Force Operational Test and Evaluation Center
AFM	Air Force Manual
AFRES	Air Force Reserves
AFR	Air Force Regulations
AGR	Air to Ground Ranging
AFSC	Air Force Systems Command
ALC	Air Logistics Center
AMC	Air Material Command
AMUX	Avionics Multiplex Bus
ASD	Aeronautical System Division
ATC	Air Training Command
ATD	Aircrew Training Device
BAF	Belgian Air Force
BU	Block Update
CADC	Central Air Data Computer
CARA	Combined Altitude Radar Altimiter
CCB	Configuration Control Board
CDRL	Contract Data Requirements List
CI	Configuration Item
CIU	Central Interface Unit
CLS	Contractor Logistics Support
CONUS	Continental United States
CPCSB	Computer Program Configuration Sub-Board (No longer used - see SSCSB)
CSCI	Computer Software Configuration Item
CSSP	Computer Software Screening Panel

CPIN	Computer Program Identification Number
CPS	Computer Product System
CR	Computer Resources
CRISP	Computer Resources Integrated Support Plan
CRWG	Computer Resources Working Group
DDLS	Delegation Disclosure Letter
DMA	Defense Mapping Agency
DOD	Department of Defense
DRLMS	Digital Radar Landmass System
DTT	Development Technician Team
DTU	Data Transfer Unit
ECP	Engineering Change Proposal
EID	Emitter Identification Data
EPAF	European Participating Air Force
EW	Electronic Warfare
EWIR	Electronic Warfare Integrated Reprogramming
EWTD	Electronic Warfare Training Device
FCC	Fire Control Computer
FCNP	Fire Control Navigation Panel
FCR	Fire Control Radar
FMS	Foreign Military Sales
HPS	Hardware Product System
HUD	Head Up Display
ILC	International Logistics Center
INS	Inertial Navigation System
IOS	Instructor Operator Station
J & A	Justification and Authorization

LOC	Logistics Operational Center
MCCB	Multinational Configuration Control Board
MCCR	Mission Critical Computer Resources
MCRWG	Multinational Computer Resources Working Group
MDESC	McDonnel Douglas Electronics Systems Corporation
MDR	Materiel Deficiency Report
MIP	Material Improvement Project
MIS	Management Information System
MOA	Memorandum of Agreement
NEWTD	Norwegian Electronics Warfare Training Device
NVS	Night Visual System
OCR	Operational Change Request
OFP	Operational Flight Program
OFT	Operational Flight Trainer
OO-ALC	Ogden Air Logistics Center
OPR	Office of Primary Responsibility
O/S CMP	Operational/Support Configuration Management Procedures
PACAF	Pacific Air Forces
PMRT	Program Management Responsibility Transfer
PO	Project Officer
PTC	Progammable Terminal Controller
QA	Quality Assurance
QAR	Quality Assurance Representative
RDAF	Royal Danish Air Force
REO	Radar Electro-Optical
RNOAF	Royal Norwegian Air Force

RNLAF	Royal Netherlands Air Force
SAMT	Simulated Aircraft Maintenance Trainer
SCC	Software Control Center
SCCSB	Software Configuration Control Sub-Board
SCE	Signal Conversion Equipment
SCP	Stores Control Panel
SOW	Statement of Work
SPM	System Program Manager, or
SPM	Separately Procurred Modification
TAC	Tactical Air Command
TAF	Tactical Air Forces (TAC, PACAF and USAFE)
TAWC	Tactical Air Warfare Center
TCTM	Time Compliance Technical Manual (CLS)
TDMCRWG	Training Devices Multinational Computer Resources Working Group
TSSC	Training System Support Center
USAF	United States Air Force
USAFE	United States Air Force in Europe
WR-ALC	Warner Robins Air Logistics Center
WST	Weapon System Trainer
WSTUG	Weapon System User's Group

per Norway. 17 actgo

Additional abbreviations and acronyms to Addendum A of F-16A/B ATD O/S CMP dated 30 Aug 90.

COTS	Commercial Off The Shelf
CRLMP	Computer Resourses Lifecycle Management Plan
DMA	Direct Memory Access
ECM	Electronic Counter Measure
ECO	Engineering Change Order
FDPO	Foreign Disclosure Policy Office
GSE	Ground Support Equipment
IV&V	Independant Verification & Validation
JARM	Jammer,Artillery,Radar, Missile
MRP	Modification Review Panel
MOU	Memorandum Of Understanding
NGB	National Guard Bureau
OSC	Operations Sub Committee
PMD	Program Management Directive
PB	Product Baseline
PROM	Programable Read Only Memory
PT	Product Team
RAM	Random Access Memory
RWR	Radar Warning Receiver
SCMS	Standard Configuration Management System
SDR	Software Deficiency Report
SSIC	Stock,Store and Issue Center
TCG	Technical Coordination Group
TODO	Technical Order Distribution Office
WSTUG	Weapon System Trainer User's Group

ADDENDUM D

August 1991

F-16 TRAINER FLIGHT SIMULATOR - OCU
A/F 37A-T63
CONTRACT F42600-91-C-0608
TASK ASSIGNMENTS 91-009 and 91-011

F-16 OFT BLOCK 10/15 OCU

SOFTWARE ON-SITE

CONFIGURATION CONTROL GUIDELINES

PREPARED FOR
TRAINING SYSTEMS MANAGEMENT DIVISION
F-16 PRODUCT TEAM (OO-ALC/LIRBE)
OGDEN AIR LOGISTICS CENTER
HILL AIR FORCE BASE, UTAH

CAE-LINK CORPORATION
F-16 Training System Support Center
Hill Air Force Base, Utah

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2.2 Site Software Configuration Controller 1

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1.0 INTRODUCTION

1.1 Scope and Purpose

Software for the OCU Trainer is managed by OO-ALC/LIRBE and changed by the Training System Support Center (TSSC). This includes operational software for the Operational Flight Trainer (OFT) and Digital Radar Landmass System (DRLMS). Radar landmass databases for the DRLMS are also included. The purpose of these guidelines is to establish a common set of definitions and procedures for managing any future changes to the operational software and DRLMS databases at the using sites.

2.0 GENERAL

2.1 Operational Software and Database Changes

Aircraft changes, recommended enhancements, and discrepancies will result in TSSC developed software changes to the above training devices. Additionally, radar landmass databases are still being updated for recently added/modified terrain and cultural features. In order to field changes quickly, changes to the operational software will be sent to sites on a floppy disk with installation instructions (temporary changes) when practical. These changes may be applied to your site baseline (see later definition) and may be used for training. The extent of the changes may sometimes dictate a revision level update to the Product Baseline (Block Update) with new 300MB packs. Updates to the DRLMS database will include a new S-RDDB (Site) 300MB disk pack. The site will then have to build a R-RDDB (RT) pack from this S-RDDB disk using the Mission Generation capability of the DRLMS.

2.2 Site Software Configuration Controller

It is recommended that a Site Software Configuration Controller (SSCC) be established at each training site. This individual should be familiar with both the NORSK DATA SINTRAN III Operating System and the Link Configuration Control Software. The SSCC will ensure that the Site Baseline is not corrupted by unauthorized modifications and will also be responsible for installing any changes received from the TSSC. The SSCC should also be responsible for making mission related changes. It is recommended that the individual selected as the SSCC identify himself to the TSSC. A good working relationship between the TSSC and the SSCC will help ensure successful updates to the software.

3.0 OFT REQUIREMENTS and DEFINITIONS

3.1 Site Disk Pack Requirements

There should be a minimum of eight configured and one scratch 300 MB disk packs dedicated to each OFT. The configured packs should be labeled as outlined below, since the TSSC will refer to them by these names:

a. Product Baseline Disk Set (PBDS). The PBDS is a copy of the Air Force Product Baseline maintained at the TSSC. This disk set should be secured in a safe location and only be used for copying purposes. Changes should never be made to this disk set. At Contractor Logistics Support (CLS) sites this disk set should be under the direct control of the project officer. The PBDS consists of the following disk packs:

1) OPERATIONS

2) SYMD

b. Site Master Disk Set (SMDS). The SMDS is a copy of the PBDS which has been modified at the site to include mission data and any temporary changes provided by the TSSC. This disk set is the Site Baseline referred to in paragraphs 2.1 and 2.2. The SMDS consists of two copies each; one copy designated "MASTER SMDS" and one copy designated "BACKUP". The SMDS consists of the following disk packs:

1) OPERATIONS (Master and Backup)

2) SYMD (Master and Backup)

c. Site Operational Disk Set (SODS). The SODS is a copy of the SMDS OPERATIONS Master pack. This pack is the real-time training pack. The SODS consists of the following disk pack:

1) OPERATIONS (2 copies recommended)

3.2 OFT SOFTWARE UPDATE PROCEDURES

3.2.1 Block Updates and Temporary Changes

Sites will receive software updates as revision level updates to the Product Baseline (Block Updates)as new 300 MB disk packs or as updates on floppy disk (Temporary Changes). The intent of Temporary Changes is to provide quick solutions to software deficiencies/enhancements without requiring documentation updates and regeneration of site mission data (required for Block Updates).

3.2.1.1 Block Update Procedures

A Block Update is a new revision level update to the Air Force Product Baseline. This update will be received as 300MB disk packs labeled as the Product Baseline Disk Set (PBDS). The following procedures should be followed by the SSCC for each Block Update:

a. Examine the new disk packs for physical damage, including shock watch activation. If the packs appear to be undamaged, copy the new PBDS

OPERATIONS disk to a scratch disk and bring up the real-time load using the scratch disk. If any obvious problems are observed, contact the TSSC and do not proceed any further.

b. Copy the new PBDS disks (OPERATIONS, SYMD) to the MASTER SMDS disks.

c. Install your site mission changes on the MASTER SMDS disks.

d. Copy the MASTER SMDS OPERATIONS disk to the scratch disk.

e. Using the scratch disk, bring up the real-time load and verify that the mission changes were made correctly. Repeat steps b. through e. if necessary to get a correct load.

f. Copy the MASTER SMDS disks to the BACKUP SMDS disks.

g. Copy the MASTER SMDS OPERATIONS disk to the SODS OPERATIONS disk.

h. Declassify the replaced PBDS disks and the scratch disk using the Declassify Program as follows:

1. Spin up OPERATIONS pack on drive 0. Load SINTRAN.

2. Spin up pack to be declassified on drive 1.

3. In User System:

```
@RT DSCLR <cr>
disk type = 3
unit = 1
continue = y
```

i. Verify that all software changes reported in the Version Description Document work accordingly. Report any discrepancies to the TSSC.

FAX: (801) 825-2627
Phone: (801)825-2650

3.2.1.2 Temporary Changes

Temporary Changes are intended to provide quick solutions to software discrepancies/enhancements. The changes will usually be provided as source code on a floppy disk and will include a Mode file which will automatically perform the update process for the user, if practical. Included with the floppy will be both a paper and an electronic copy of the Temporary Change Document which details the procedures for installation of the Temporary Change on the SMDS. The following procedures should be followed for each Temporary Change:

a. Install the Temporary Change on the MASTER SMDS disks as instructed. Note that changes should never be made to the BACKUP SMDS. The BACKUP SMDS should only be used for copying.

b. Copy the MASTER SMDS OPERATIONS disk to a scratch disk.

c. Using the scratch disk, bring up the real-time load and test the installed changes. If the update failed, copy the BACKUP SMDS disks to the MASTER SMDS disks and repeat steps a. through c. until the update is installed correctly.

d. Copy the MASTER SMDS disks to the BACKUP SMDS disks.

e. Copy the MASTER SMDS OPERATIONS disk to the SODS OPERATIONS disk and declassify the scratch disk.

3.3 Reporting Problems

Software problems should be reported to OO-ALC via the MDR system. Prior to submitting a MDR, the problem should be verified as being a software problem with the PBDS. If the problem appeared after installation of a temporary change, make a note of this in the MDR.

4.0 DIGITAL RADAR LANDMASS SYSTEM (DRLMS)

4.1 Site Disk Pack Requirements

There should be a minimum of three 75 MB disk packs and four 300 MB disk packs dedicated to DRLMS. The disk packs should be labeled as follows:

1) DRLMS Product Baseline OPERATIONS (75 MB) (1 each)

2) DRLMS Site OPERATIONS (75 MB) (MASTER and BACKUP)

3) DRLMS S-RDDB (Site) Database (300 MB) (MASTER and BACKUP)

4) DRLMS R-RDDB (RT) Database (300 MB) (MASTER and BACKUP)

4.2 DRLMS Product Baseline OPERATIONS Disk

Changes to DRLMS Operational software contained on the OPERATIONS disk pack are not anticipated. However, if changes are made, a new DRLMS Product Baseline OPERATIONS disk will be sent to applicable sites. This disk should be stored in a safe location and should never be used for training purposes. At CLS sites, the Project Officer should control this baseline. This disk should only be used to build Site OPERATIONS packs by copying.

4.3 DRLMS Site OPERATIONS Disks

These packs are copies of the DRLMS Configuration Master OPERATIONS disk with changes to directory files which match the DRLMS R-RDDB (RT) database and are used for training. These directory files are updated whenever a new DRLMS R-RDDB (RT) Database disk is generated using the Mission Generation task of DRLMS.

4.4 DRLMS Site Database Disk (S-RDDB)

This disk contains Radar Digital Data of requested areas of Defense Mapping Agency (DMA) data. The S-RDDB may then be enhanced as necessary by the Small Area Update task and used to build a real time gaming area disk pack (R-RDDB) using the Mission Generation task. There is only a 128 cell maximum capacity for each S-RDDB disk pack, therefore, depending on individual site requested coverage, the possibility exists that a site may have several S-RDDB disk packs. Each disk is built and delivered by the TSSC, and the Backup is generated on site by copying.

4.5 DRLMS R-RDDB (RT) Database Disks

These disks contain the Real-Time Radar Digital Data used for generating the ground map radar return during a mission. The MASTER disk is generated from data contained on the S-RDDB disk by defining a gaming area during the Mission Generation task. The BACKUP is a copy of this disk.

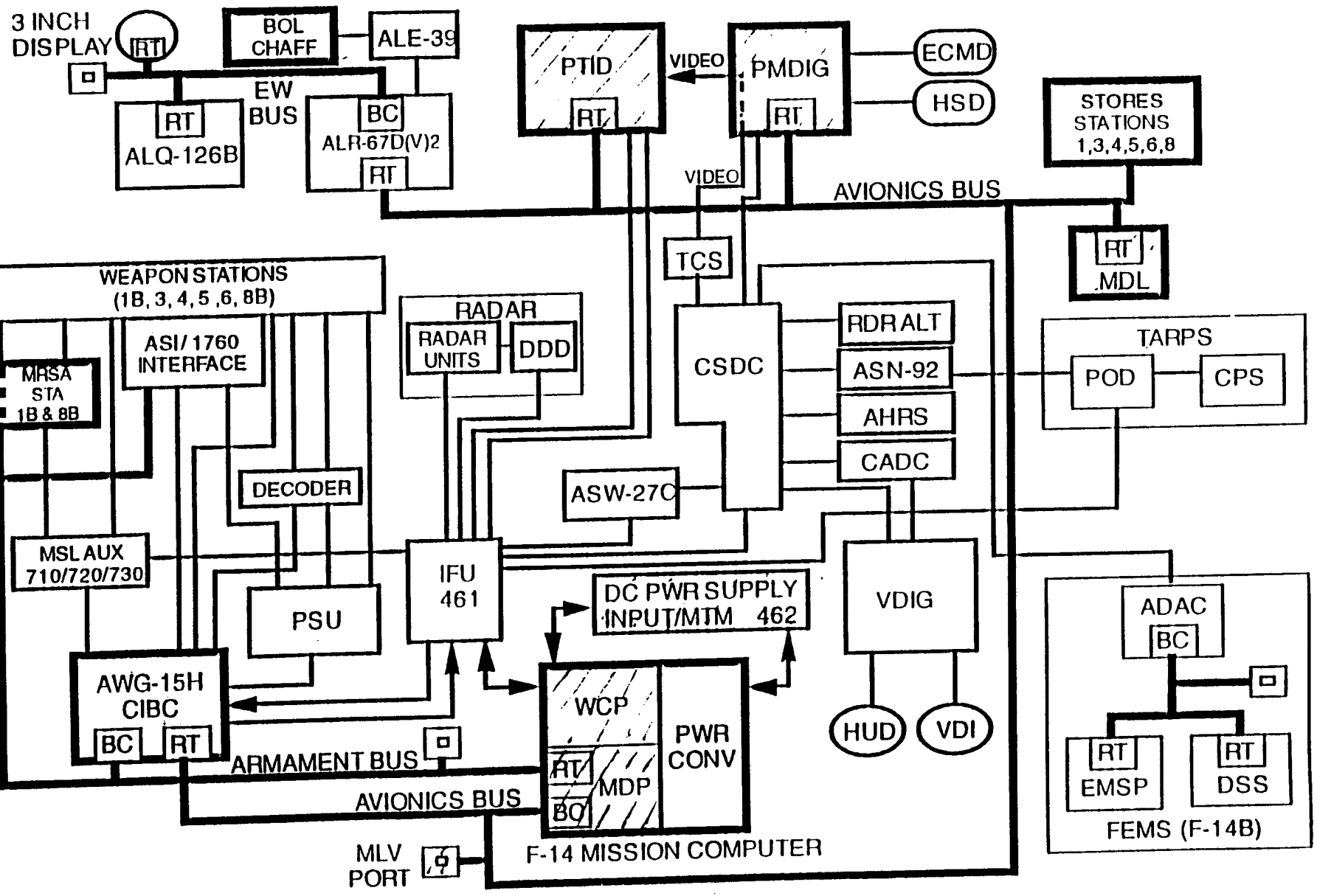
4.6 Requests For New Databases

Any requests for additional database areas should be directed to the TSSC. If data is available for the requested mission area, a new DRLMS S-RDDB MASTER disk will be built and forwarded to the requesting site. A blank replacement 300 MB disk pack should be returned to the TSSC. If data is not available for the requested mission area, the Using Command will have to make arrangements with the Defense Mapping Agency (DMA) for the requested data areas to be transformed and forwarded to the TSSC.

APPENDIX F

F-14 AIRCREW TRAINER BLOCK DIAGRAMS

F-14A/B UPGRADE ARCHITECTURE



System Overview - 4

▨ = GFE IN TRAINER

F-14D PRIME SYSTEMS

GRUMMAN

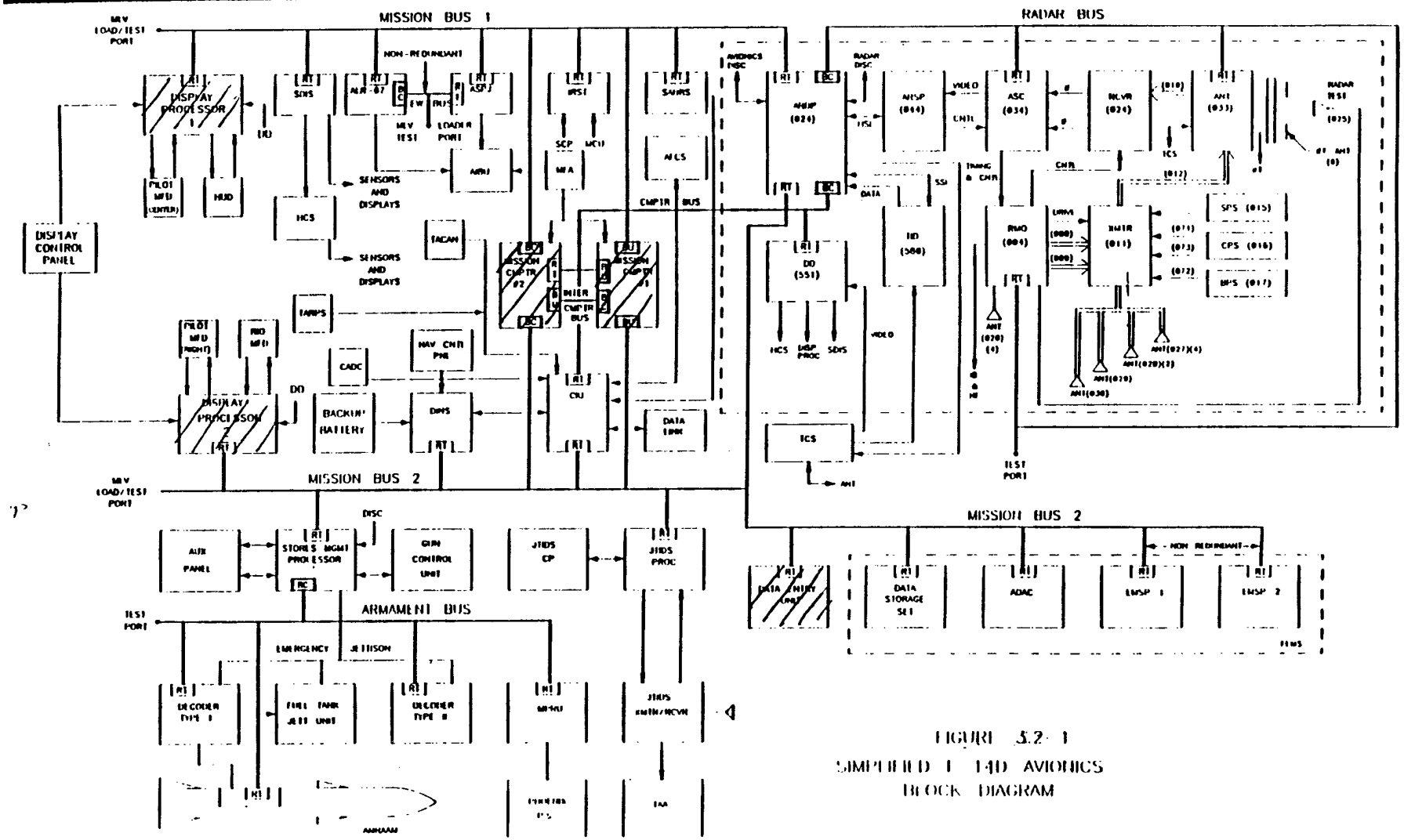
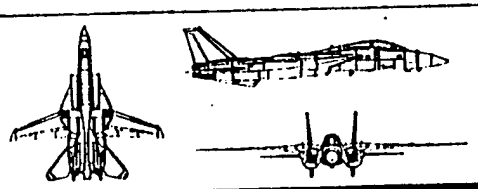
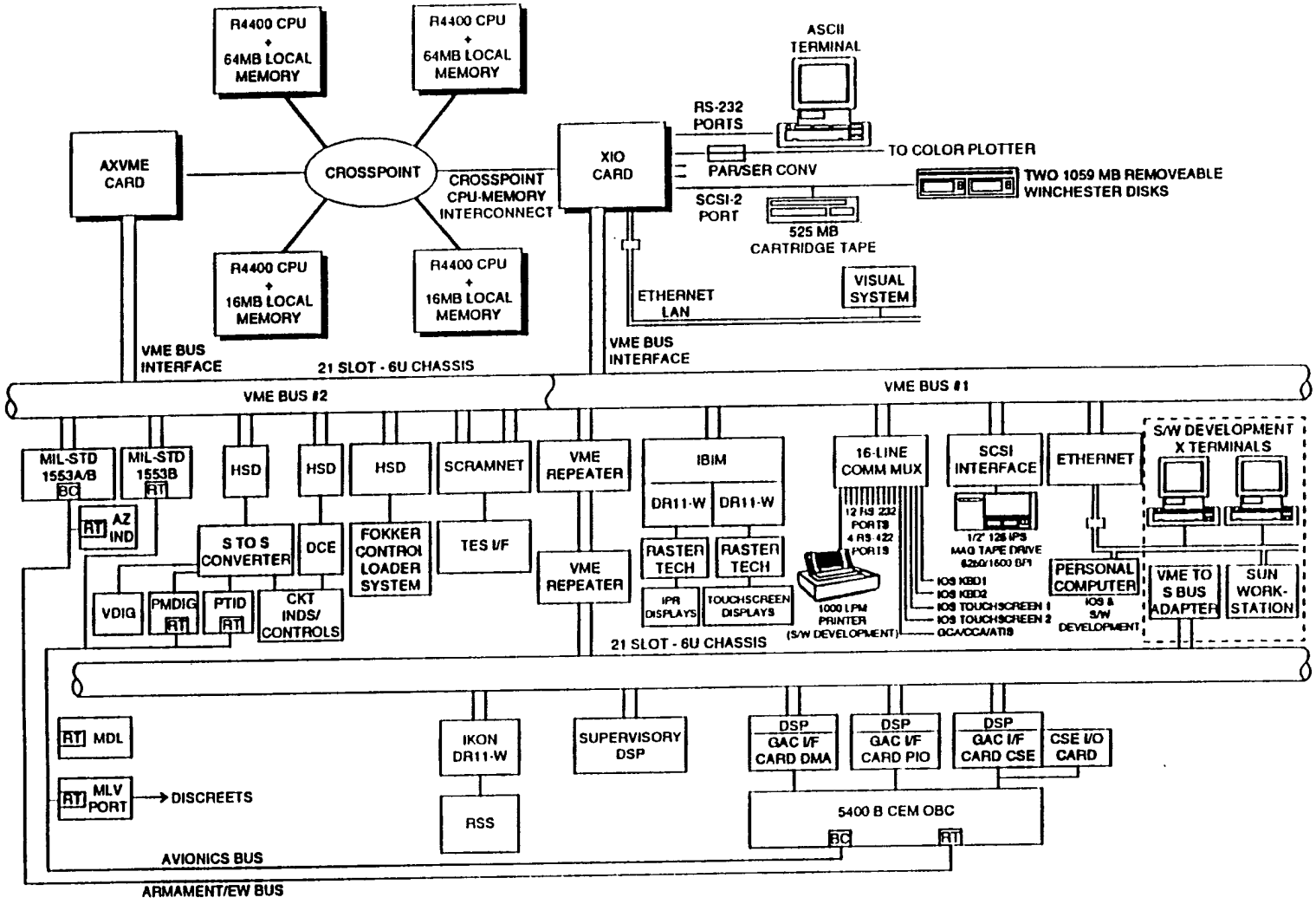


FIGURE 3.2-1
SIMPLIFIED F-14D AVIONICS
BLOCK DIAGRAM





TSDCS Test Configuration
Concurrent Model 9502 Computer System
(Planned Upgrade)

KA STP6-DISK80

F-14D MFT

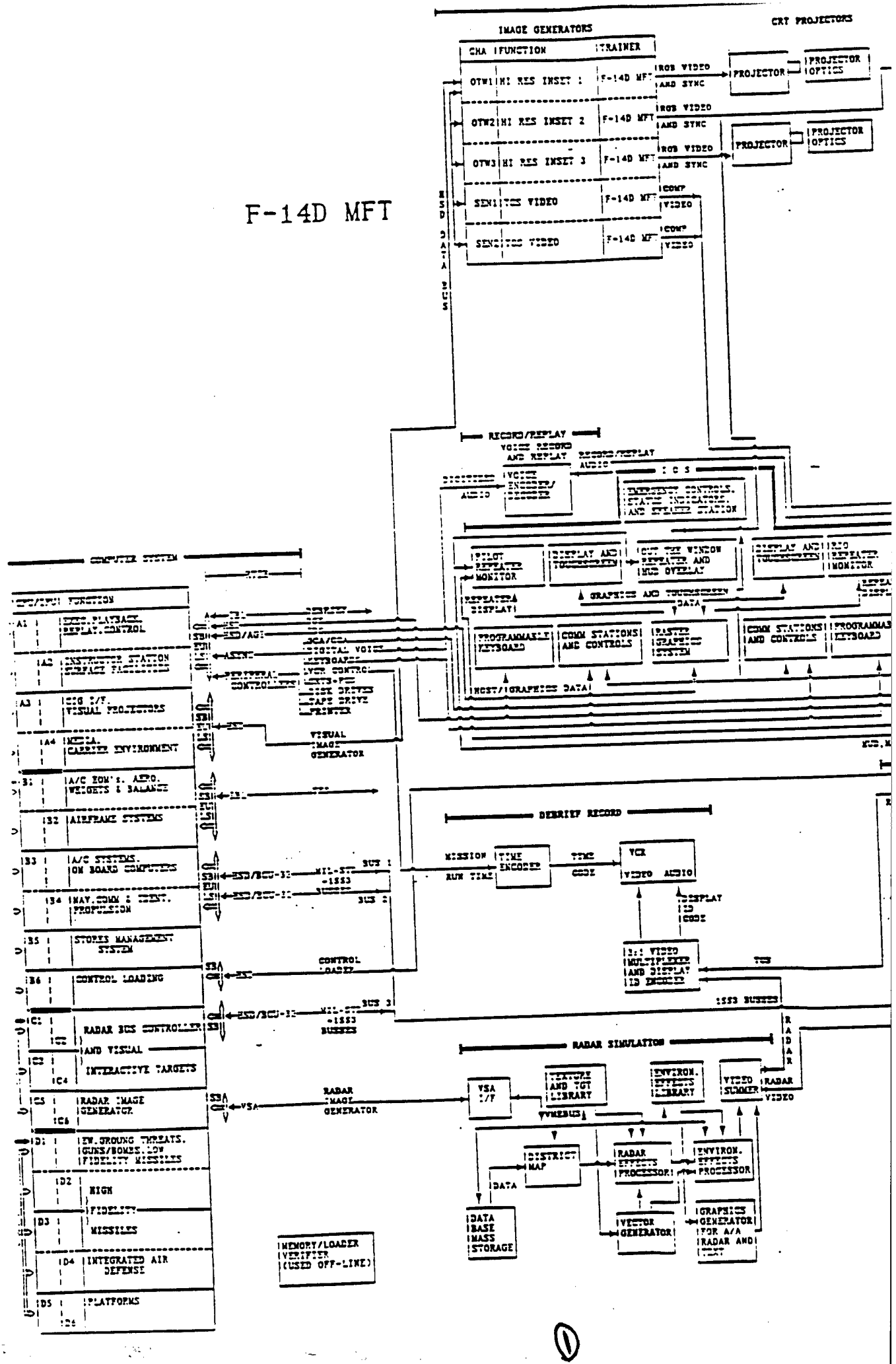
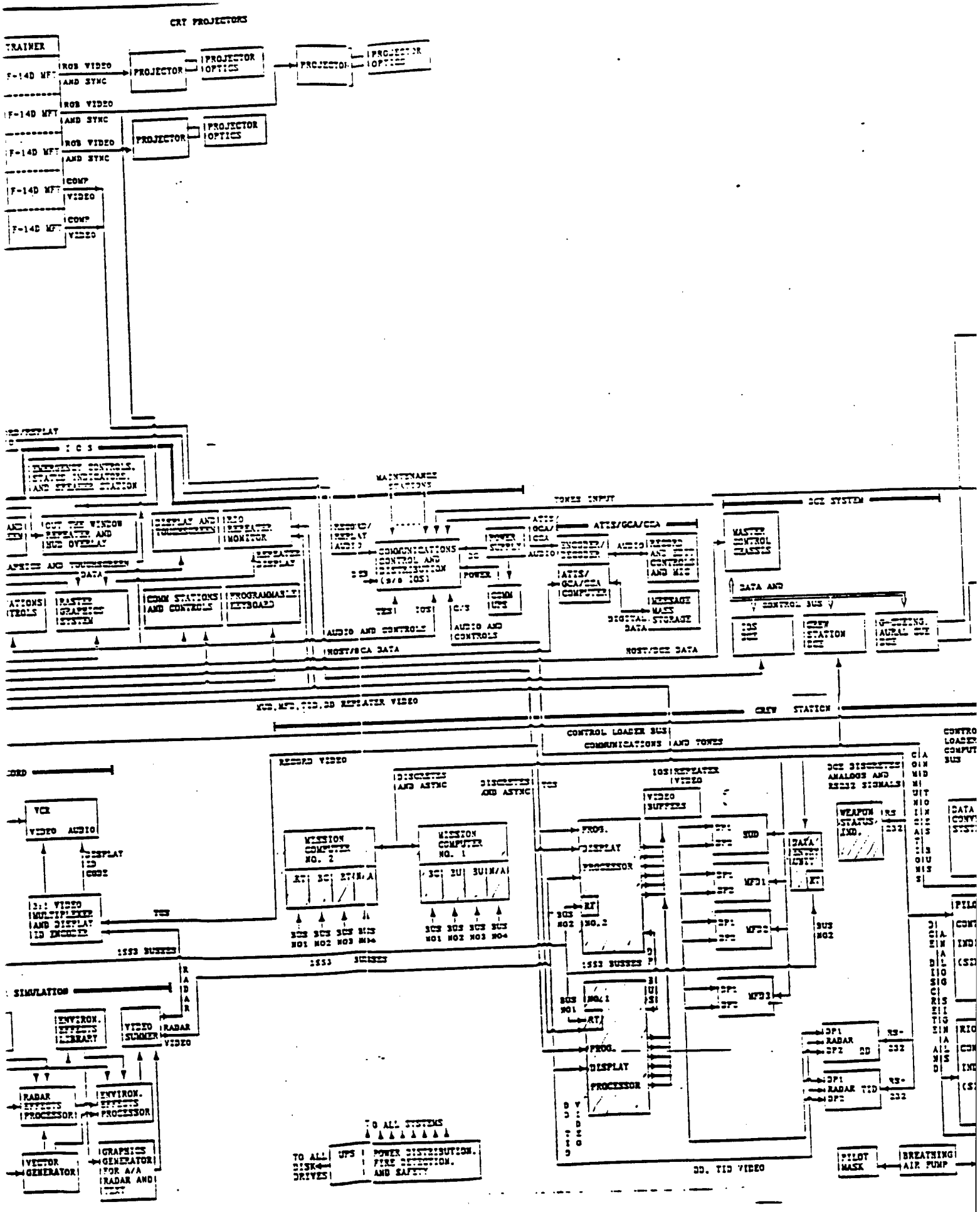
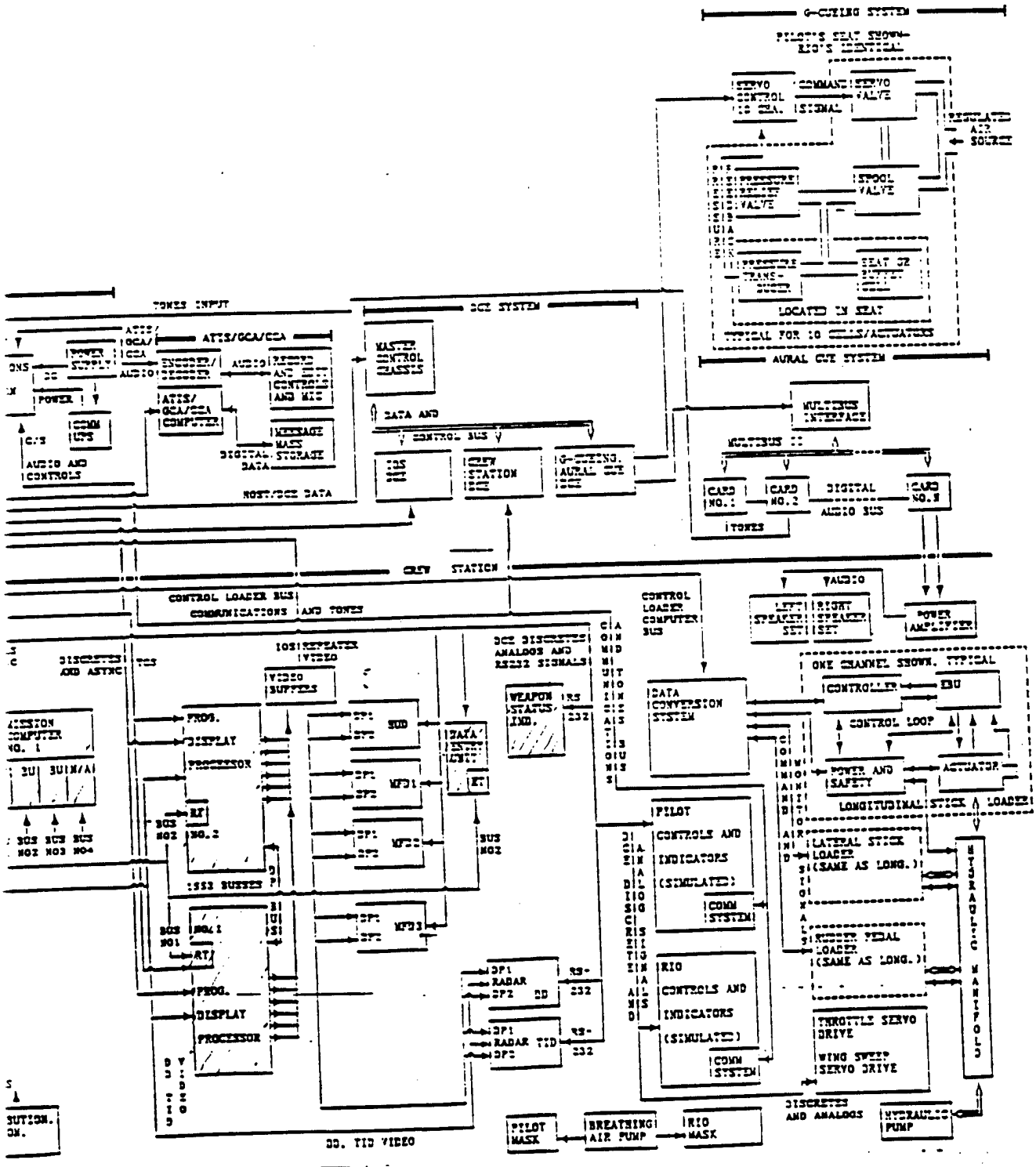


IMAGE GENERATORS
CRT PROJECTORS
CHA FUNCTION TRAINER
OTW1 HI RES INSET 1 F-14D MFT
OTW2 HI RES INSET 2 F-14D MFT
OTW3 HI RES INSET 3 F-14D MFT
SEN1 TGT VIDEO F-14D MFT
SEN2 TGT VIDEO F-14D MFT
RGB VIDEO AND SYNC
PROJECTOR
PROJECTOR OPTICS
COMP VIDEO
ESD DATA BUS
RECORD/REPLAY
VOICE RECORD AND REPLAY
AUDIO
ICS
PILOT REPEATER MONITOR
DISPLAY AND TOUCHSCREEN
OUT THE WINDOW REPEATER AND HUD OVERLAY
REPEATER DISPLAY
GRAPHICS AND TOUCHSCREEN DATA
PROGRAMMABLE KEYBOARD
COMM STATIONS AND CONTROLS
RASTER GRAPHICS SYSTEM
HOST/GRAPHICS DATA
COMPUTER SYSTEM
CMDS/EPU FUNCTION
A1 MSN PLAYBACK REPLAY CONTROL
A2 INSTRUCTOR STATION INTERFACE FACILITIES
A3 CIG I/F VISUAL PROJECTORS
A4 MEDIA CARRIER ENVIRONMENT
B1 A/C ECM'S, AERO, WEIGHTS & BALANCE
B2 AIRFRAME SYSTEMS
B3 A/C SYSTEMS, ON BOARD COMPUTERS
B4 NAV, COMM & ENGT, PROPULSION
B5 STORES MANAGEMENT SYSTEM
B6 CONTROL LOADING
C1 C2 RADAR BUS CONTROLLER AND VISUAL
C3 C4 INTERACTIVE TARGETS
C5 C6 RADAR IMAGE GENERATOR
D1 EW, GROUND THREATS, GUNS/BOMBS, LOW FIDELITY MISSILES
D2 HIGH FIDELITY
D3 MISSILES
D4 INTEGRATED AIR DEFENSE
D5 D6 PLATFORMS
ESD/AGI
ASCB
PERIPHERAL CONTROLLERS
DCA/CCA
DIGITAL VOICE
ASCB-PCI
VCR CONTROL
DISK DRIVES
TAPE DRIVE
PRINTER
VISUAL IMAGE GENERATOR
ESD/BCU-1
ESD/BCU-2
MIL-STD-1553 BUS 1
BUS 2
CONTROL LOADER
ESD/BCU-3
MIL-STD-1553 BUSSES
BUS 3
RADAR IMAGE GENERATOR
VSA
DEBRIEF RECORD
MISSION RUN TIME
TIME ENCODER
TIME CODE
VCR
VIDEO AUDIO
DISPLAY ID CODE
3:1 VIDEO MULTIPLEXER AND DISPLAY ID ENCODER
TGS
1553 BUSSES
RADAR SIMULATION
VSA I/F
FEATURE AND TGT LIBRARY
ENVIRON. EFFECTS LIBRARY
VIDEO SUMMER
RADAR VIDEO
VMEBUS
DISTRICT MAP
DATA
RADAR EFFECTS PROCESSOR
ENVIRON. EFFECTS PROCESSOR
DATA BASE MASS STORAGE
VECTOR GENERATOR
GRAPHICS GENERATOR FOR A/A RADAR AND
MEMORY/LOADER VERIFIER (USED OFF-LINE)


CRT PROJECTORS
TRAINER
F-14D MFT
RGB VIDEO AND SYNC
PROJECTOR
PROJECTOR OPTICS
COMP VIDEO
MAINTENANCE STATIONS
TONES INPUT
DCE SYSTEM
ATTS/GCA/CCA
COMMUNICATIONS CONTROL AND DISTRIBUTION
POWER SUPPLY
MASTER CONTROL CHASSIS
DATA AND CONTROL BUS
CREW STATION
AUDIO AND CONTROLS
HOST/GCA DATA
HOST/DCE DATA
MUD,MFD,TID,3D REPEATER VIDEO
CONTROL LOADER BUS
COMMUNICATIONS AND TONES
RECORD VIDEO
DISCRETES AND ASYNC
MISSION COMPUTER NO. 1
MISSION COMPUTER NO. 2
1553 BUSSES
VCR
VIDEO AUDIO
VIDEO MULTIPLEXER AND DISPLAY ID ENCODER
SIMULATION
ENVIRON. EFFECTS LIBRARY
VIDEO SUMMER
RADAR VIDEO
RADAR EFFECTS PROCESSOR
ENVIRON. EFFECTS PROCESSOR
VECTOR GENERATOR
GRAPHICS GENERATOR FOR A/A RADAR AND
VIDEO BUFFERS
PROG. DISPLAY PROCESSOR
WEAPON STATUS IND.
RS 232
MFD1
MFD2
MFD3
RADAR
3D
RADAR TID
TO ALL SYSTEMS
TO ALL DISK DRIVES
UPS
POWER DISTRIBUTION, FIRE DETECTION, AND SAFETY
3D, TID VIDEO
PILOT MASK
BREATHING AIR PUMP


G-CUEING SYSTEM
PILOT'S SEAT SHOWN
REO'S IDENTICAL
SERVO CONTROL I/O CKT.
COMMAND SERVO VALVE SIGNAL
REGULATED AIR SOURCE
SPOOL VALVE
SEAT DZ
LOCATED IN SEAT
TYPICAL FOR 10 CELLS/ACTUATORS
AURAL CUE SYSTEM
TONES INPUT
DCE SYSTEM
ATTS/GCA/CCA
MASTER CONTROL CHASSIS
DATA AND CONTROL BUS
MULTIBUS INTERFACE
MULTIBUS II
CARD NO.1
CARD NO.2
DIGITAL AUDIO BUS
CARD NO.N
TONES
CREW STATION
G-CUEING, AURAL CUE
ATTS/ GCA/CCA COMPUTER
MESSAGE MASS STORAGE
DIGITAL DATA
AUDIO AND CONTROLS
HOST/DCE DATA
CONTROL LOADER BUS
COMMUNICATIONS AND TONES
CONTROL LOADER COMPUTER BUS
AUDIO
LEFT SPEAKER SET
RIGHT SPEAKER SET
POWER AMPLIFIER
DISCRETES AND ASYNC
IOS REPEATER VIDEO
VIDEO BUFFER
DCE DISCRETES ANALOGS AND RS232 SIGNALS
WEAPON STATUS IND.
RS 232
DATA CONVERSION SYSTEM
ONE CHANNEL SHOWN, TYPICAL
CONTROLLER
EBU
CONTROL LOOP
POWER AND SAFETY
ACTUATOR
LONGITUDINAL STICK LOADER
PROG. DISPLAY PROCESSOR
SUB
MFD1
MFD2
MFD3
DP1
DP2
RT
BUS NO2
BUS NO1
1553 BUSSES
PILOT CONTROLS AND INDICATORS (SIMULATED)
COMM SYSTEM
RIO CONTROLS AND INDICATORS (SIMULATED)
LATERAL STICK LOADER (SAME AS LONG.)
RUDDER PEDAL LOADER (SAME AS LONG.)
THROTTLE SERVO DRIVE
WING SWEEP SERVO DRIVE
MONITORING
RADAR
RADAR TID
DD
DD, TID VIDEO
DISCRETES AND ANALOGS
HYDRAULIC PUMP
PILOT MASK
BREATHING AIR PUMP
RIO MASK

(3)

APPENDIX G

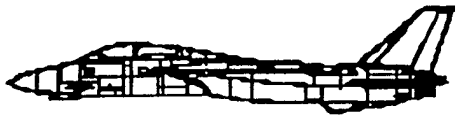
F-14 TSSA OVERVIEW BRIEFING

F-14 TRAINER SOFTWARE SUPPORT ACTIVITY

CODE 451140E

NAVAL AIR WARFARE CENTER WEAPONS DIVISION

POINT MUGU CALIFORNIA

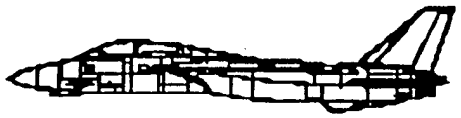


TSSA OVERVIEW

AGENDA

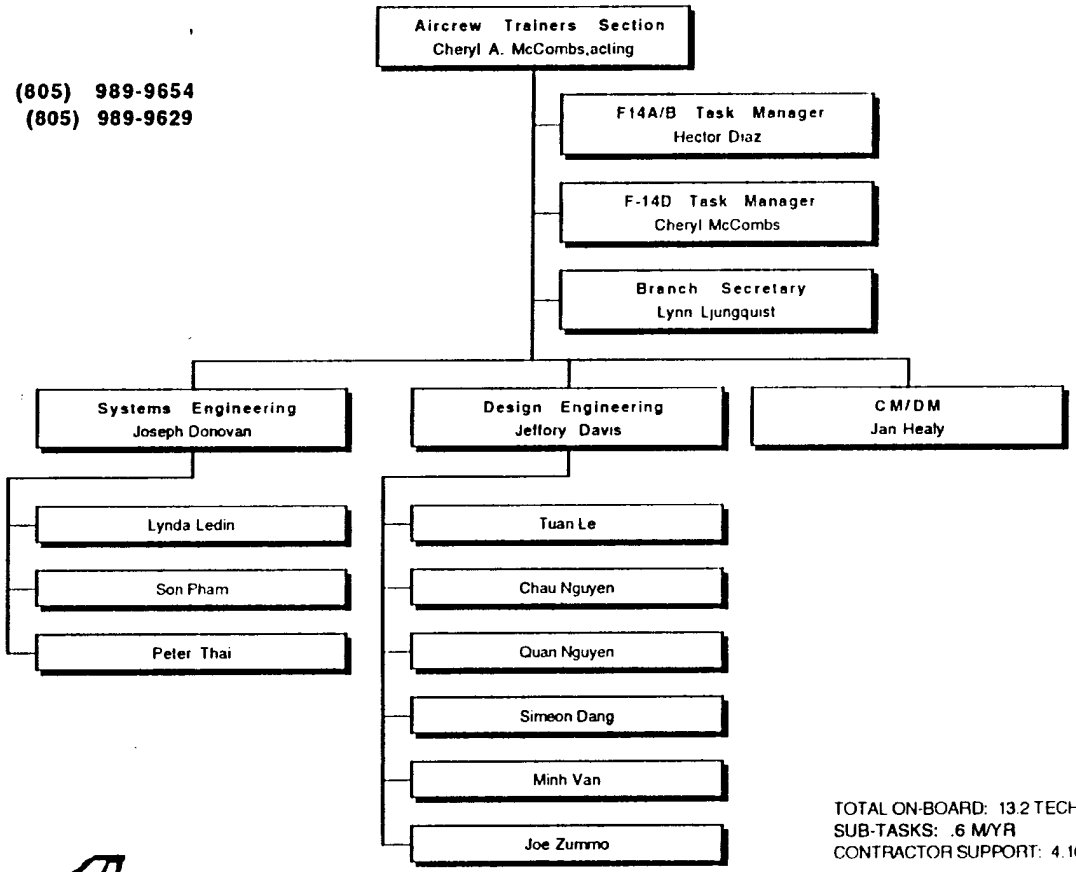
- TSSA DEFINITION
- TSSA S/W UPDATES
- TRAINER S/W DEVELOPMENT SUPPORT
- SCHEDULES
- TSSA LABS

TSSA DEFINITION



451140E ORGANIZATION CHART

TSSA (805) 989-9654
FAX (805) 989-9629



TOTAL ON-BOARD: 13.2 TECHNICAL
SUB-TASKS: .6 M/YR
CONTRACTOR SUPPORT: 4.16 M/YR

TSSA DEFINITION

NAWC-WD is designated as the F-14A/B/D System Software Support Activity. Within NAWC-WD the Aircrew Trainers Branch has the responsibility for acting as the SSA for the F-14 trainers.

F-14A trainers

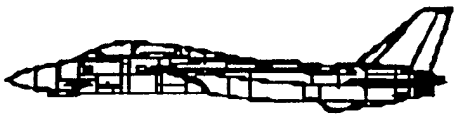
* **Device 15C9A - Mission Trainer (MT)**
* **Device 2F95 - Operational Flight Trainer (OFT)**

F-14D trainers

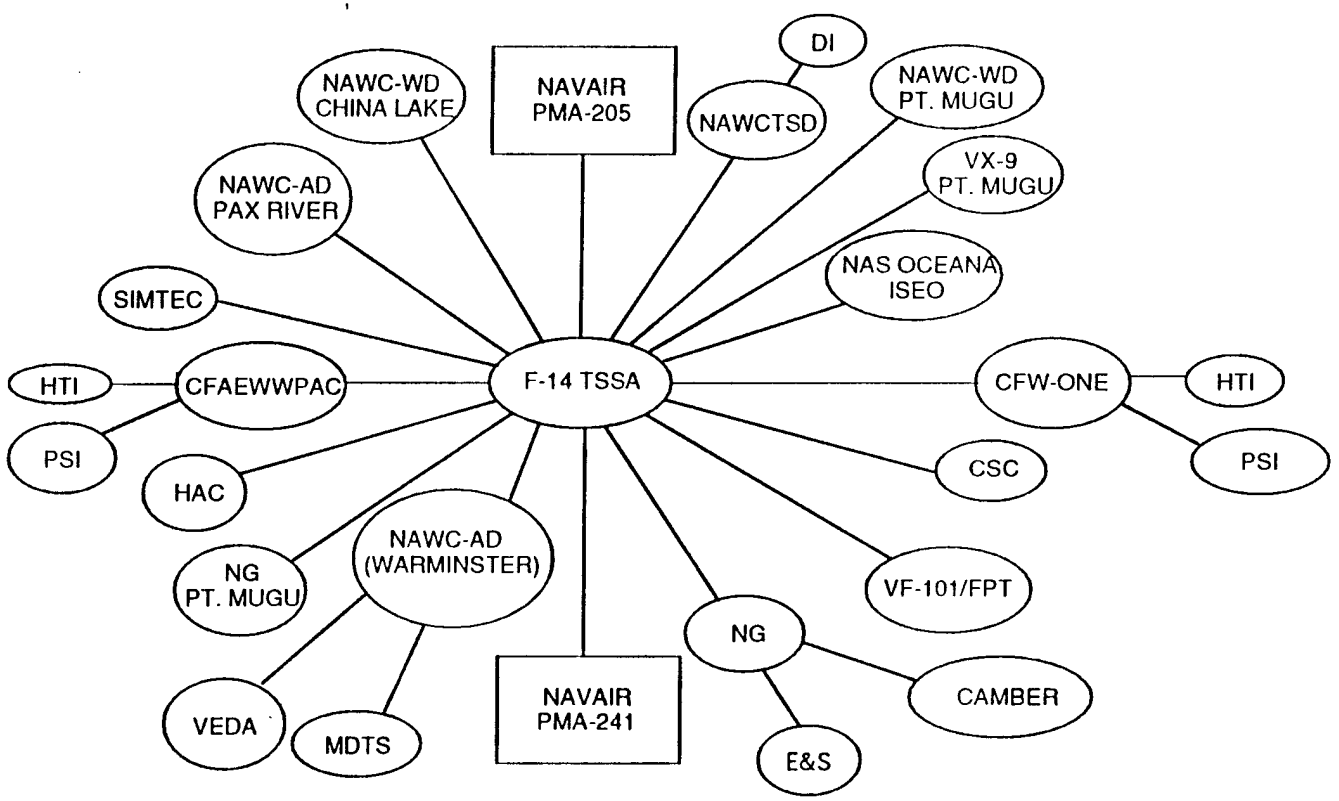
* **Device 2F153 - Mission Flight Trainer (MFT)**
* **Device 2F154 - Weapon Systems Trainer (WST)**
  Tactical Environment System (TES)

F-14B/A WST trainer

* **Device 2F169 - Weapon Systems Trainer (WST)**



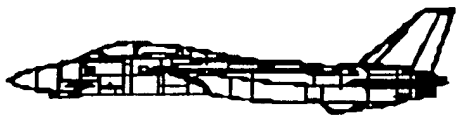
F-14 TRAINER S/W COMMUNITY INTERFACES



TSSA DEFINITION

HISTORY

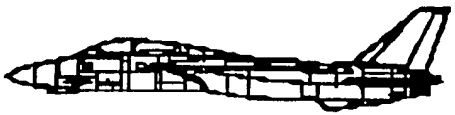
- First TSSA engineering team assembled 1974.
- In FY77 TSSA began to implement s/w changes on existing F-14 aircrew trainers with Block 105 update on OFT, which included tactical tape 111C Engineering Change Proposals (ECPs).
- Successfully incorporated s/w updates to all trainers, and have expanded to include minor h/w changes.



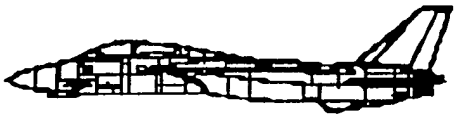
TSSA DEFINITION

TSSA Functions

- **In - Service Support**
  - Implement approved changes
  - Provide Configuration, Documentation Control
  - Evaluate proposed changes
  - Provide technical coordination
- **Trainer Software Development Support**
  - Evaluate proposed contractor changes
  - Monitor contractor compliance
  - Evaluate suitability of s/w tools
  - Review s/w documentation
  - Participate in in-plant/acceptance testing



TSSA SOFTWARE UPDATES



TSSA SOFTWARE SYSTEM UPDATES

The TSSA's main responsibilities are:

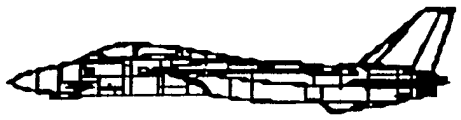
- **To establish and maintain the Navy's capability to implement approved software changes.**

- **To incorporate new tactical software loads into on-board processors, interface the processors with the host computer software, and to fully simulate/stimulate the new tactical software functionality;**

  to provide software simulation/stimulation of new Aircraft system hardware;

  to implement new F-14 capabilities into the trainer suites;

  and accurately simulate the real-world threat environment.



TSSA SOFTWARE SYSTEM UPDATES

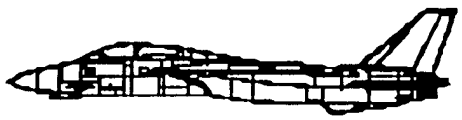
TSSA's main responsibilities include:

- **To enhance the trainers' performance to meet new Aircrew training requirements by providing new capabilities. (New missiles, A/G capability, etc)**
- **To correct identified software deficiencies and simulation problems.**
- **To perform Software System Quality Assurance on all TSSA developed products.**

REQUIREMENTS INCORPORATED IN TSSA UPDATES

TSSA Updates consist of:

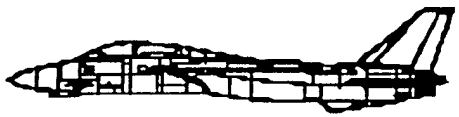
- Tactical software load changes (116A, F14D02)
- ECPs
- Airframe Changes (AFCs), Avionic Changes (AVCs)
- Rapid Action Minor Engineering Changes (RAMECs)
- Trainer Engineering Change Requests (TECRs)
- Discrepancy Report corrections, from both contractor and TSSA updates
- Minor Fleet Requests not covered by TECRs
- Minor Software changes with no visible trainer impact



SOFTWARE CHANGE PROCESS

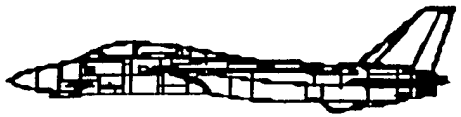
The change process for a tactical update:

- Weapons system change identified (F-14 Software Change Review Board)
- Trainer community identify and confirm Trainer requirement for weapon system change (Trainer Systems Change Control Board, Trainer Advisory Group)
- NAVAIR establish funding, scheduling via NAWCTSD and TSSA (Airtask)
- TSSA develop and integrate update (TSDF, trainer site)
- TSSA verify and validate update (trainer site)
- Fleet, NAWCTSD, TSSA perform Gov't Acceptance Testing (Gov't Final Inspection at site)



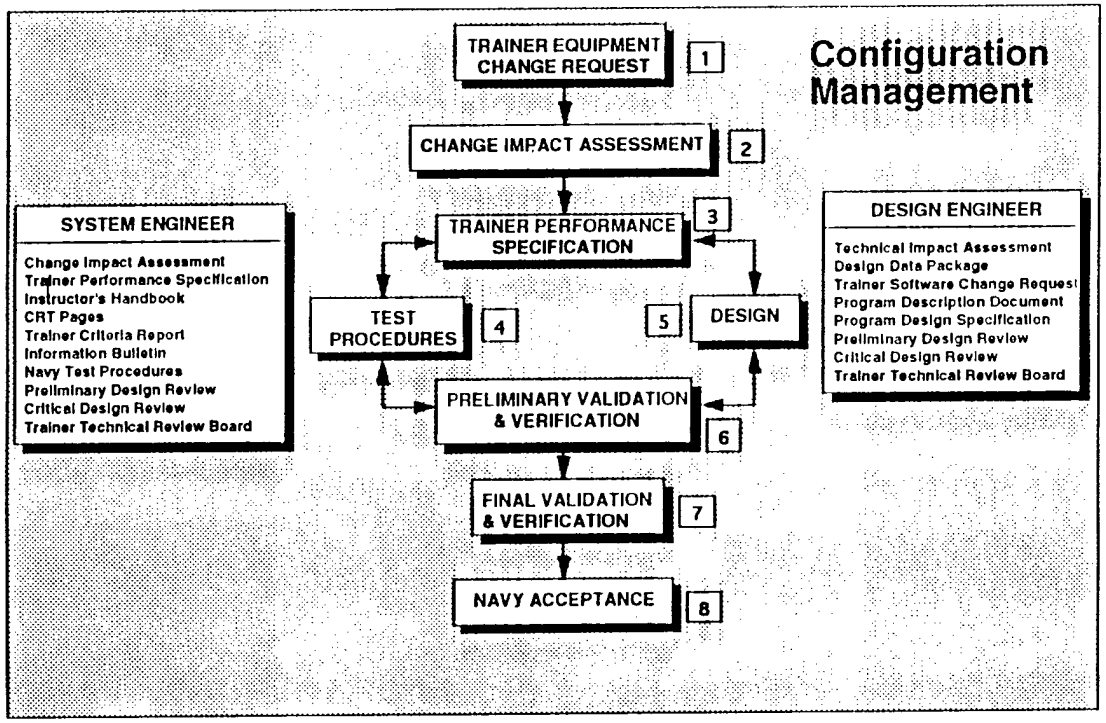
SOFTWARE CHANGE PROCESS

- Currently TECRs, DR corrections are funded on an indivitual basis, dependent upon Fleet request. Placed within updates depending upon the requirement, funding availability, and TSSA's schedule.
- Minor Fleet requests are incorporated on a not-to-interfere basis.



SOFTWARE CHANGE PROCESS

TSSA Software Update Process



AWG-9 TACTICAL TAPE 116A/P16A

TID MENU PHASE II

- ENHANCEMENT AND ENLARGEMENT OF TID MENU FUNCTIONS (VECTOR MODE TIME-TO-GO, WAYPOINT/PSEUDO FILES DATA PAGES, STORES MANAGEMENT STATUS, AND A/G CAP SELECTION).

MCAP SYSTEM INTERFACE

- THE MCAP UPDATE WILL INSTALL A PROGRAMMABLE TID AND A PARTIAL MIL STD 1760 WEAPON STATION MODIFICATION (INCLUDING MIL STD 1553 BUS) FOR FUTURE GROWTH.
- MCAP IS PROJECTED TO BE INSTALLED ON APROXIMATELY 150 F14A/B AND TO BE OPERATIONAL WITH TACTICAL TAPE 116A/P16A, CURRENTLY SCHEDULED FOR JUN 94.

AWG-15 & AWG-9 CONTROLS & DISPLAYS IMPROVEMENTS

- PROVIDES DISPLAY MODE COMMUNICATION FROM THE AWG-15 TO THE AWG-9.
- CHANGE THE AIM-7 SIMULATED MISSILE LOAD-OUTS TO BE CONSISTENT FOR TACTS/MSR, IFT/DL AND IFT.
- TCS SLAVE SYMBOL DISPLAYED DURING PLM.
- PROVIDE A DISPLAY ADVISORY ON THE TID TO ADVISE THE AIRCREW THAT A NAV POWER SUPPLY (NPS) POWER TRANSIENT HAS OCCURRED.

AWG-15 IMPROVEMENTS

- PROVIDES AN AWG-15 PROGRAM IDENTIFICATION BLOCK.
- DELETES CAGE/SEAM LOGIC IN A/G GUN MODE.
- PROVIDES A MAINTENANCE BIT ADVISORY.
- PROVIDES THE CAPABILITY TO BYPASS MAINTENANCE BIT IF PILOTS WEAPON SELECT SWITCH IS NOT "OFF".

COMPUTER EXPANDED MEMORY

- EXPANDS COMPUTER MEMORY TO 96K (CEM+)

PSTT HOT TRIGGER DISABLE FOR AIM-54 TARGET OUT OF RANGE

- INHIBIT HOT TRIGGER AGAINST A PSTT TARGET BEYOND AIM-54 ACTIVE RANGE (IF ACM GUARD DOWN).
- INHIBIT HOT TRIGGER AGAINST A TCSTT TRACK WHEN THE RADAR IS SLAVED AND THE MODE IS PULSE SEARCH.

AWG-9 TACTICAL TAPE 116A/P16A (CONT)

AIR TO GROUND SOFTWARE IMPROVEMENTS

- ALLOW DESIGNATION OF A TCS TARGET WITHOUT A VALID TCS LOCK.
- INCLUDE NEW EJECTION VELOCITIES FOR THE BRU-32 RACK.
- UPDATED BALLISTICS COEFFICIENTS.
- HUD DIAMOND NOT DISPLAYED IN MIRROR STATE FOR GUN.
- ALLOW SELECTION OF CAGE/SEAM WHILE IN GUNS.
- A/G OVERRIDES FF/DL ADVISORIES.

RADAR TRACK FILE PROCESSING DISPLAY IMPROVEMENTS

- DISPLAY COMPOSITE ADR SYMBOL WHEN ADR IS SELECTED FOR TRACKS WITH RDOT VALID.
- PREVENT NEGATIVE RANGES IN TRACK FILES.
- ENHANCE TRACK FILE RANGES.
- PROVIDE MR ENHANCEMENT.
- CORRECT AIM-54C PRELAUNCH STE AND JAM CODES FOR BORESITE LAUNCHES.

TACTS/MSR ENHANCEMENTS

- MODIFY TACTS/MSR DOWNLINKING LOGIC TO PROVIDE IMPROVED RSTV CAPABILITY AND CORRECT VARIOUS TACTS/MSR DOWNLINKING PROBLEMS.

AIM-7 ENHANCEMENTS

- ADD AIM-7R AND ENHANCE AIM-7H/M ID CONSTANTS USED IN TACTS/MSR, TACTS, IFT & IFT/DL.
- ENHANCE MISSILE PERFORMANCE IMPROVEMENT AGAINST D TYPE TARGETS.
- INCORPORATE AIM-7R MISSILE CAPABILITIES.

FEMS ENGINE DIAGNOSTIC S/W IMPROVEMENTS (F-14B/D ONLY)

- NEW ENGINE ALGORITHMS HAVE BEEN DEVELOPED TO ELIMINATE FALSE FAULT CODES AND ADD NEW FAULT CODES TO IMPROVE ENGINE DIAGNOSTIC CAPABILITY.

AWG-9 TACTICAL TAPE 116A/P16A (CONT)

RM TRAINING, RSTV AND FMM ENHANCEMENTS

- DISPLAYS A CONTOUR FOR THE RSTT FILE USING LINKED TCSTT FILE DURING RSTV CONDITIONS.
- PROVIDES EXPANDED RM TRAINING CAPABIITIES.
- PROVIDES NEW RM TERMINATION LOGIC.
- PROVIDES IMPROVED MIXED STT CAPABILITIES.
- PROVIDES AIM-54C SEEKER RANGE BASED ON PDSTT FILE COEFFICIENT FOR PDS/RWS WHEN RSTV.
- INHIBIT FMMs FROM GOING OUT TO A MISSILE ADDRESS WITH THE MISSILE COMMON ID BIT SET.
- PROVIDES CORRECT LAR WHEN AIM-54C SPECIAL ECCM CONDITIONS EXIST AND ONLY AIM-54A MISSILES AVAILABLE.

IMPLEMENTATION OF AIM-54C CONFIGURATION ID

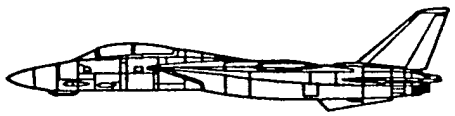
- DISPLAYS AIM-54C HARDWARE/SOFTWARE CONFIGURATION DURING MOAT.

PROVIDE AIR-TO-AIR TARPS HUD STEERING DISPLAYS

- PROVIDES SELECTION OF A/A TARPS STEERING CUES VIA THE CAP BYPASSING THE DISPLAY CUES ON THE TID.

AIR-TO-GROUND PULL UP CUE (PUC) AND BREAK-X DISPLAY ENHANCEMENT

- BLINKS THE PUC AND VV IF FRAGMENTATION CLEARANCE ALTITUDE IS REACHED.
- DISPLAYS THE BREAK-X ONLY IF GROUND CLEARANCE ALTITUDE IS REACHED.



TSSA FY95/F14D02 CHANGE LIST

CHANGE NUMBERS	TITLE	DOCUMENTS
NAWC-2F154-FY95/F14D02-01.01	MEDIUM PRF	FRD-FRD039-0204 A55FRVAD053C A55AD00911AF-11 F14D-FRD122-3015A(S) F14D-FRD033-0283
NAWC-2F154-FY95/F14D02-01.02	PRECISION VELOCITY UPDATE	F14D-FRD080-1343
NAWC-2F154-FY95/F14D02-01.03	AIR-TO-GROUND	F14D-FRD080-1214 202-TM-91-F14D-006R2 202-TM-91-F14D-009R1
NAWC-2F154-FY95/F14D02-01.04	FREEZE DATA	
NAWC-2F154-FY95/F14D02-01.05	VAIRIABLE RELEASE SEQ/INT SEL	DELETED
NAWC-2F154-FY95/F14D02-01.06	STORED WPNS RELEASE PROG.	
NAWC-2F154-FY95/F14D02-01.07	TSD REFORMAT	202-TM-91-F14D-009
NAWC-2F154-FY95/F14D02-01.08	TID DISPLAY CONVERAGE IND.	
NAWC-2F154-FY95/F14D02-01.09	UPDATED TSD FUNCTIONS	F14D-FRD143-4152 F14D-FRD111-3022A/B 202-TM-91-F14D-008 202-TM-91-F14D-009R1
NAWC-2F154-FY95/F14D02-01.10	REDUCTION OF CAW &DW BOX	
NAWC-2F154-FY95/F14D02-01.11	TACAN REVERTS TO DATA PAGE	
NAWC-2F154-FY95/F14D02-01.12	INADEQUATE INDICATION OF CSCAN	
NAWC-2F154-FY95/F14D02-01.13	HUD HOOKING	

TSSA FY95/F14D02 CHANGE LIST

CHANGE NUMBERS	TITLE	DOCUMENTS
NAWC-2F154-FY95/F14D02-01.14	AMRAAM MISSILE CAPTIVE CARRY	FRD-FRD086-2171A F14D-FRD089-2014 F14D-FRD123-3312
NAWC-2F154-FY95/F14D02-01.15	AIM-7M H BUILD MODE 11 (RDR)	F14D-FRD038-1042
NAWC-2F154-FY95/F14D02-01.16	ADDITIONAL NAV WAYPOINTS	F14D-FRD050-0332C F14D-FRD050-0254
NAWC-2F154-FY95/F14D02-01.17	JTIDS	A55FRVAD053C A55AC170001F-10
NAWC-2F154-FY95/F14D02-01.18	INCREASE SIZE OF TSD DISPLAY	
NAWC-2F154-FY95/F14D02-01.19	CHANGE TSD P&R TO PILOT/RIO	
NAWC-2F154-FY95/F14D02-01.20	IRSTS AUTO HOOKING	
NAWC-2F154-FY95/F14D02-01.21	NO DROP BOMB SCORING	F14D-FRD019-3277B
NAWC-2F154-FY95/F14D02-01.22	MIXED MODE SINGLE TGT TRACK	F14D-FRD135-3167
NAWC-2F154-FY95/F14D02-01.23	LCOS MPRF GUNSIGHT	F14D-FRD048-1056B
NAWC-2F154-FY95/F14D02-01.24	LGB AND CLUSTER MUNITIONS	DELAYED
NAWC-2F154-FY95/F14D02-01.25	GUNSIGHT CLEANUP	F14D-FRD048-1056
NAWC-2F154-FY95/F14D02-01.26	ANGLE FILTER SOL FOR GUNS	
NAWC-2F154-FY95/F14D02-01.27	MCS/ ARIGS F14D02 INTERFACE	
NAWC-2F154-FY95/F14D02-02	INC. OF ASPJ C/B	
NAWC-2F154-FY95/F14D02-03	INC. OF SDIS	ECP 1244
NAWC-2F154-FY95/F14D02-04	INC. OF HAVE QUICK	ECP 1046
NAWC-2F154-FY95/F14D02-05	INC. OF RADAR HCU RELOCTION	ECP 1258
NAWC-2F154-FY95/F14D02-06	MOD OF ENG MODE SELECT FUNC	ECP 221
NAWC-2F154-FY95/F14D02-07	LOW FUEL PRESSURE AURAL	ECP 222
NAWC-2F154-FY95/F14D02-08	REPLACE RIO MISSILE OPT SW	RAMEC NORVA 10-92

F-14A/B/D Trainers SLOC

Device	System	Baseline	# of Files	Executable LOC	Comment LOC	Total LOC
2F95	OFT	FY94/116A	199	59,958	33,657	93,615
2B34	VITAL	FY94/116A	55	7,425	825	8,250
15C9A	MT	FY94/116A	833	163,777	121,805	285,582
2F112	WST	FY94/116A	1968	386,930	287,770	674,700
-	WAVS	FY89/115A	294	45,854	65,863	111,717
-	RSS	Merit Rev. 16		TBD	TBD	85,000
2F169	WST	Estimate	4,710	734,593	1,055,154	1,789,747
	Firmware	TBD				
2F153	MFT	D01	4,710	734,593	1,055,154	1,789,747
	Firmware	TBD				
2F154	WST	D01	5,181	808,052	1,160,669	1,968,721
	Firmware	TBD				
-	TES	GAC Rev. 2	1,843	287,449	412,886	700,335
	Firmware	TBD				
-	Debrief	GAC Rev. 10	819	127,755	183,505	311,260
-	Threat DB	D01	829	324,139	380,511	704,650
Total			**21,441**	**3,680,525**	**4,757,799**	**8,438,324**

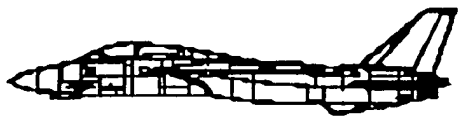
TSSA SOFTWARE UPDATES

DEVICE	UPDATE	TACTICAL RELEASE	TSSA DELIVERY
MT	Block 110/111D	Oct-80	Nov-80
MT	Block116/111E	Mar-83	Feb-83
MT	FY84/111E2	Sep-84	May-84
MT	Interim 113A & BIT	Sep-84	Oct-86
MT	Interim 114A	Dec-86	Feb-87
MT	FY86/114A+87/114B	Aug-87	Nov-88
MT	FY88/114C2	Dec-88	Apr-89
MT	FY89/115A	Jan-90	Feb-90
MT	FY91/115B	Jan-90	Oct-91
MT	Reinstall FY91/115B	Jan-90	Dec-91
MT	FY92 AIR-TO-GROUND/115B	Jan-90	Nov-92
MT	FY94/116A	Jan-96	Apr-95
MT	FY95/116A	N/A	Feb-96
OFT	Block 105/111C	Jul-78	Dec-79
OFT	Block 110/111D	Oct-80	Nov-80
OFT	Block 121/111E	Mar-83	Mar-84
OFT	FY87/114A	Dec-86	Oct-87
OFT	FY88/114C2	Dec-88	Apr-89
OFT	FY88/114C2(REINSTALL)	Dec-88	Sep-89
OFT	FY89/115A	Jan-90	Feb-90
OFT	FY91/115B	Jan-90	Sep-91
OFT	Block 116/111E	Mar-83	Feb-83
OFT	FY92 AIR-TO-GROUND	Jan-90	Nov-92
OFT	FY93/116A	Jan-96	May-95
OFT	FY95	N/A	Apr-96
WST	111E	Mar-83	Mar-83
WST	Block 125/111E	Mar-83	Sep-83
WST	FY84/111E2	Sep-84	May-84
WST	FY86/111E2	Sep-84	May-86
WST	FY86/114A	Dec-86	Mar-87
WST	FY86/114B	Aug-87	Aug-87
WST	FY87/114B+ AIM-9L/M	Aug-87	Nov-88
WST	FY87/114B+ 88/114C2	Dec-88	Jan-89
WST	FY89/115A	Jan-90	Feb-90
WST	FY91/115B	Jan-90	Sep-91
WST	REINSTALL FY91/115B	Jan-90	Jan-93
WST	FY94/116A	Jan-96	Dec-94
MFT/WST	FY93/D01	Aug-93	Mar-95
MFT #2	FY95/D02	Aug-95 (prelim)	Feb-96
WST/TES	FY95/D02	Aug-95 (prelim)	Mar-96

CONFIGURATION CONTROL

TSSA's CM/DM group, via the Trainer Software Development Facility (TSDF), ensures:

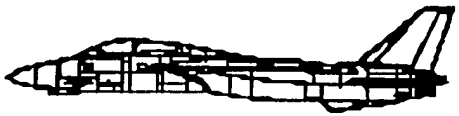
- Each Trainer Software Baseline has an unique, standard configuration ID number, and that all software tapes, disks, and supporting documentation are accordingly marked.
- Proposed changes are categorized, reviewed and implemented under complete CM control.
- Current and past software baselines for the Trainer Suite are maintained.
- The Trainer Correction Action Program (TCAP) document is maintained, to provide a software change history file.



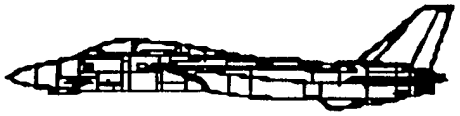
SOFTWARE DOCUMENTATION

TSSA controls the F-14 software documentation, to:

- **Provide updates to Trainer Documentation based on TSSA software/hardware changes.**
- **Provide documentation in support of Navy Acceptance Testing of TSSA software/hardware updates.**
- **Provide documentation to assist the Trainers' Operators/ Instructors in use of the new software/hardware.**
- **Provide trainer software documentation to contractors as required by contract updates.**
- **Provide trainer software documentation to other Navy activities as required.**



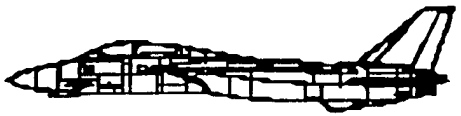
TRAINER S/W
DEVELOPMENT SUPPORT



MONITOR CONTRACTOR UPDATES

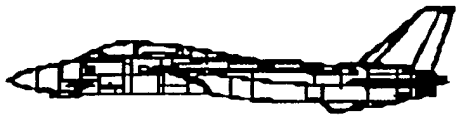
The TSSA monitors contractor updates to the F-14 Aircrew Trainer Suite to ensure work is done correctly and in a cost-effective manner.

- Assist NAWCTSD in formal and informal Navy Acceptance testing of contractor updates
- Provide tactical information in accordance with the Update Contract
- Provide CM/DM of Trainer Software Baselines
- Monitor Contractor compliance to the Update Contract
- Participate in Design and Program Reviews
- Review Software and System Documentation
- Perform software system audits
- Evaluate suitability of software development tools

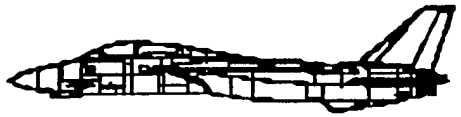


TRANSITION OF SOFTWARE SUPPORT TO TSSA

- Develop In-House Support Capability
  - Establish laboratory requirements
  - Establish personnel, training requirements
- Develop TSSA Transition Plans
- Develop CRLCMP



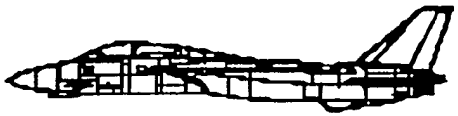
TSSA SCHEDULES



TSSA SCHEDULES

TSSA determines update delivery dates by:

- **Weapon System Changes**
- **Trainer System Changes**
- **Urgent Fleet requirements**
  - **2F95 Fuel Malfunctions**
  - **2F112 Desert Shield Simulation**



TSSA SCHEDULES

Weapon system changes may be trainer "drop-in", or may require trainer h/w-s/w changes. For example, the F14D02 change "Air-to-Ground" required massive MFT/WST software changes, while the "Updated TSD Functions" change was fully implemented with the installation of the tactical tape.

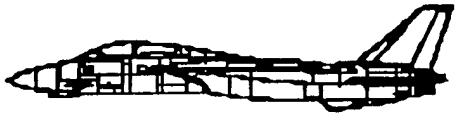
"Drop-in" refers to the process of installing the new tactical s/w load, and is a misnomer. In all cases of the F-14 trainer suites, s/w mods must be made to enable the new tactical load to run correctly with the host computer suite.

In the FY95/F14D02 update to the F-14D Trainer Suite, over 4700 SLOC were written/modified to incorporate F14D02.

TSSA SCHEDULES

Comprised of AWG-9, AYK-14, DP, DEU, APG-71, CADC, CSDC, Airframe, EW, and Missile changes.

Changes are usually defined by Engineering Change Proposals, Functional Requirements Documents, and Software Change Requests. Other tactical documentation is utilized as required. (Interface Design Documentation, NATOPS, Program Performance Specifications, etc.)



TSSA SCHEDULES

Each weapon system change is analyzed by TSSA for its impact to the F-14 Trainer Suites. Due to device individuality, each change must be evaluated for each trainer.

F-14D MFT/WST commonality

TSSA has installed new tactical tapes within 60 days of fleet release, unless prevented by trainer scheduling conflicts.

Conflict with contractor update schedules

Trainer hardware problems

Navy Acceptance Test Team Participation

TSSA SCHEDULES

Contractor Trainer System update cycles normally run 18-24 months after contract award. Due to the length of the cycle, TSSA frequently must reinstall previous software updates after the contractor updates the device.

TSSA installed the MT FY91/115B in the middle of the HAC MT FY88 update effort, with full implementation following HAC's delivery of their final FY88 software.

TSSAs F14D01 delivery was formally delivered two years after prime system release, due to continuing contractor software updates (final delivery Sep 94).

TSSA SCHEDULES

TSSA participates in monitoring and evaluating NAWCTSD contractor updates through software CM, document review, and participation in reviews and Navy acceptance testing.

TSSA also obtains and distributes data relevant to contractor updates.

NAVAIR PMA-205 designated TSSA the program manager for the ATIP contract.

TSSA LABORATORIES

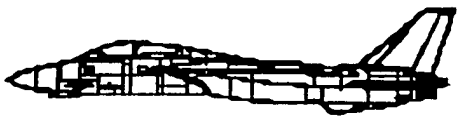
MAJOR FUNCTIONS OF THE TSSA LABS

TRAINER SOFTWARE DEVELOPMENT FACILITY

- Provide a software development environment for F-14 Training Devices
- Provide a configuration management system for F-14 Trainer Suite Software and associated Tools

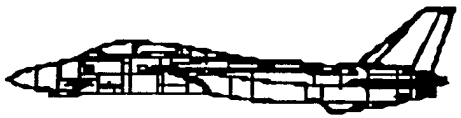
MISSION TRAINER LAB

- F-14A Mission Trainer "A" from NAS Miramar has been installed for development of TSSA Aircrew Trainer Improvement Program



TSDF CAPABILITIES

- Modification and compilation of source code
- Software documentation
- Database Updates
- Building Test Overlays
- Partial F-14D Cold Starts
- Generation of disks for site use
- Generation of tapes for delivery
- F-14D Software CM



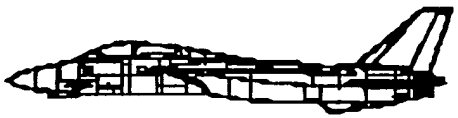
TSSA S/W DEVELOPMENT

TSSA S/W DEVELOPMENT

- Software Design, Development, and Documentation at Point Mugu
  - * TSDF/MT Lab support
  - * DCC
  - * Co-location with F-14 Tactical Software SSA
    - Advance software tapes and documentation
    - Interface with tactical design engineers for many programs
    - Use of SITS, WSIC, EW and Missile support labs

TSSA S/W DEVELOPMENT

- **Software Integration, Development and Testing onsite**
  - * **TDY**
  - * **CSC on-site support transitioning to NAS Oceana**
  - * **Work after hours when possible**
    - **Requirement for F-14D trainer GFE handicaps after hours use of F-14D trainers**
  - * **TSSA office, WRA Loadstation, etc, at NAS Miramar to be moved to NAS Oceana**



APPENDIX H

SUMMARY OF D01 and D02 CODE CHANGES

Trainer Software Support Activity

D01/D02 Design Report

5 July 1996

Aircrew Trainers Branch
Code 451140E

NAWC-WD
Pt. Mugu, CA 93042

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Appendix B D02 designs and the source units associated with each

1.0 Scope

This report covers TSSA software baseline deliveries FY93/F-14D01 and FY95/F-14D02 on the following F-14D training devices:

Device 25153	Mission Flight Trainer
Device 2F154	Weapon System Trainer
	Tactical Environment System

1.1 Purpose

The intent of this report is to address some of the design metrics involved in the implementation of tactical tapes D01 and D02 into the F-14D training devices. It is hoped that the information provided here is useful not only as a historical reference but mainly as a guide for the implementation and measurement of future updates.

ADVEP-HDBK-7 (Rev. 1), Software Metrics Handbook defines the following software metrics as a guide for software development projects:

1) Requirements
2) Size
3) Staffing
4) Quality
5) Capacity
6) Schedule

An effort has been made to adhere to the guidelines provided in the Software Metrics Handbook, although this report deals primarily with the basic software design elements of (2) Size, and (5) Capacity. An effort has been made to include some treatment of each of the other categories, but much of this information is not readily available and some must be provided by other TSSA functions.

1.2 Introduction

The data in this report was derived primarily from two sources; baseline build reports/databases generated during development, and from module difference listings generated post-development. The information contained herein represents design information incorporated into the D01 and D02 software baselines, and design metrics pertaining to Source Lines Of Code (SLOC), memory usage, datapool sizes, and CPU frame time usage.

It should be understood that the information given here is based upon the best information available and has been organized after the fact; allowing for certain inconsistencies and inaccuracies. The information presented is representative of the overall effort, and any deviations from exact data is denoted as such. A more comprehensive study could alleviate some of this error, but given the modest amount of clarification provided and the considerable amount of time which would be required for such an effort, any inaccuracies are considered insignificant.

2.0 Referenced Documents

2.1 Government Documents

ADVEP-HDBK-7 (Rev. 1), Software Metrics Handbook

2.2 Non-Government Documents

TBD

3.0 Design Summary

Information is provided in this section summarizing the software design work incorporated into each delivered baseline.

3.1 D01 Design Incorporation

Table A (below) lists all the designs requiring software modification that were incorporated into D01. It does not include tactical designs that required no specific TSSA modifications outside remote terminal activation and configuration ID changes (a sub-group of RT Activation). All changes devoted to expansion of datapools, datapool partitions, task partitions, task overlays, etc., fall under the heading System Expansion. Macro's written (or modified) specifically for TSSA development such as warmstart and directory backup macros fall under that heading. All other units that were modified were and not directly attributable to a specific design fall under the single category of DR Corrections, Miscellaneous, and Unknown.

Control Number	TSSA Software Design Title
FY93/F14D01-001	Tactical Tape Drop-In (RT Incorporation)
FY93/F14D01-xxx	System Expansion (SYSGEN, RM, or DP)
FY93/F14D01-xxx	TSSA Development Environment
FY93/F14D01-01.02	Sensor Control Mechanization
FY93/F14D01-01.04	JTIDS Fighter-To-Fighter DataLink
FY93/F14D01-01.05	ORT Abort
FY93/F14D01-01.08	Flexible Missile Messages
FY93/F14D01-01.12	RWS Mode Upgrade
FY93/F14D01-01.13	HRWS Default Scan Selection
FY93/F14D01-01.14	AIM-7M Second Missile Message
FY93/F14D01-01.17	Radiation Modes (RRE)
FY93/F14D01-01.18	Spin Arrow Limitation
FY93/F14D01-01.19	HUD Cage/Uncage
FY93/F14D01-01.21	Flight Director Mode
FY93/F14D01-01.23	ALR-67 Radar Warning Receiver
FY93/F14D01-01.28	Infrared Search and Track (IRST)
FY93/F14D01-01.28	Infrared Search and Track (IRST)
FY93/F14D01-01.32	Multiplex Bus Messages
FY93/F14D01-03	OBOGS C/A Light Illumination
FY93/F14D01-xxx	DR Corrections, Miscellaneous, and Unknown

Table A
D01 TSSA Software Designs

3.2 D02 Design Incorporation

Table B (below) lists all the designs requiring software modification that were incorporated into D01. It does not include tactical designs that required no specific TSSA modifications outside remote terminal activation and configuration ID changes (a sub-group of RT Activation). All changes devoted to expansion of datapools, datapool partitions, task partitions, task overlays, etc., fall under the heading System Expansion. Macro's written (or modified) specifically for TSSA development such as warmstart and directory backup macros fall under that heading. Many units were listed as DR corrections but were not identified with a specific design and are listed as Unknown DR Corrections. All other units that were modified were and not directly attributable fall under Unknown.

Control Number	TSSA Software Design Title
FY95/F-14D02-001	Tactical Tape Drop-In (RT Incorporation)
FY95/F-14D02-xxx	System Expansion (SYSGEN, RM, or DP)
FY95/F-14D02-xxx	TSSA Development Environment
FY95/F-14D02-01.01	Medium PRF
FY95/F-14D02-01.02	Precision Velocity Update
FY95/F-14D02-01.03	Air-To-Ground
FY95/F-14D02-01.17	JTIDS
FY95/F-14D02-01.27	MC/ARDP 1553 Interface
FY95/F-14D02-03	Sensor Display Indicator Set
FY95/F-14D02-06	Engine Mode Select Function
FY95/F-14D02-xxx	IRST/VSC
FY95/F-14D02-xxx	Unknown DR Corrections
FY95/F-14D02-xxx	Unknown

Table B
D02 TSSA Software Designs

4.0 Device Implementation

Information regarding device implementation is TBD. Implementation of baselines on the different F-14D training devices is not currently well defined or documented.

5.0 Software Metrics

The goal of obtaining and tracking software metrics is to provide a basis for measuring software development progress and to assist in the projection of software project impact and costs.

5.1 Requirements

The basic requirements for TSSA design work is the Trainer Performance Specification (TPS). In lieu of the TPS, tactical documentation serves as a guideline. See TSSA Configuration Management for D01/D02 TPS's and reference to tactical documentation.

There is no current effort to measure and track requirement revision and scheduling.

5.2 Size

The basic element of software size is Software Lines Of Code (SLOC), both new and reused.

5.2.1 Source Lines of Code (SLOC)

Table C gives the SLOC breakdown for all D01 designs and Table D is the corresponding table for the D02 effort. Appendices A and B lists the units included for each design. An effort has been made to identify new units in the appendices, but no formal tracking of new versus re-used code has been made.

One item of interest derived from the SLOC breakdowns is the size of effort involved in the first three categories (Tactical Tape Incorporation, System Expansion, and TSSA Development Environment). During the D01 and D02 development periods, those categories accounted for approximately 17 and 13 percent, respectively, of the overall efforts.

Note: Spreadsheets are available showing both the individual SLOC counts per unit and the multiple designs impacting individual units, but were not included in this report.

Tables E and F show the average percentage of SLOC modified for effected units per design (total modified SLOC/Original SLOC). The tables also show the average increase in unit SLOC per design. While neither of these figures can be directly related to the amount of new or re-used code, they are indicative of the amount of rework and code added in units for each design effort.

Note : No effort was made to separate individual SLOC counts between multiple designs impacting the same unit. SLOC counts were divided evenly between the multiple designs. It was judged that the extremely time consuming task of accounting each SLOC change to a particular design (post-development) would have been of insignificant impact and value.

Note : All data pertaining to IRST/VSC designs (D01/D02) are for the Encore Host software only. Data was not available for the Silicon Graphics software.

F-14D01 Designs

Control Number	Design Title	Non-Executable	Executable	Total Modified	Original SLOC	Final SLOC
FY93/F14D01-001	Tactical Tape Drop-In (RT Incorporation)	2644	2802	5446	25189	26880
FY93/F14D01-xxx	System Expansion (SYSGEN, RM, or DP)	995	2041	3080	43944	45681
FY93/F14D01-xxx	TSSA Development Environment	1774	1932	3851	20665	23710
FY93/F14D01-01.02	Sensor Control Mechanization	4144	5769	9913	21667	24490
FY93/F14D01-01.04	JTIDS Fighter-To-Fighter DataLink	1314	1736	3051	22177	24385
FY93/F14D01-01.05	ORT Abort	601	1129	1730	4239	4552
FY93/F14D01-01.07	Screen Target Designate	315	854	1168	3626	3993
FY93/F14D01-01.08	Flexible Missile Messages	1352	1968	3321	7676	8883
FY93/F14D01-01.12	RWS Mode Upgrade	2846	4308	7154	23249	24573
FY93/F14D01-01.13	HRWS Default Scan Selection	160	162	322	299	428
FY93/F14D01-01.14	AIM-7M Second Missile Message	563	1028	1590	13610	13940
FY93/F14D01-01.17	Radiation Modes (RRE)	672	1096	1768	6463	7375
FY93/F14D01-01.18	Spin Arrow Limitation	541	1336	1877	3445	3852
FY93/F14D01-01.19	HUD Cage/Uncage	21	71	92	1383	1399
FY93/F14D01-01.21	Flight Director Mode	14	56	70	596	605
FY93/F14D01-01.23	ALR-67 Radar Warning Receiver	1425	522	1947	9439	9693
FY93/F14D01-01.28	Infrared Search and Track (IRST)	3127	5861	8988	12165	18794
FY93/F14D01-01.32	Multiplex Bus Messages	126	133	259	959	1094
FY93/F14D01-03	OBOGS C/A Light Illumination	129	69	198	5235	5282
FY93/F14D01-xxx	Unknown DR Corrections	6329	10540	16868	46570	51969
	Totals	**29091**	**43412**	**72694**	**272596**	**301577**

Table C
SLOC per D01 Design

F-14D02 Designs

Control Number	Design	Non-Executable	Executable	Total Modified	Original SLOC	Final SLOC
FY95/F-14D02-001	Tactical Tape Drop-In (RT Incorporation)	2769	4713	7481	29256	30474
FY95/F-14D02-xxx	System Expansion (SYSGEN, RM, or DP)	419	776	1194	21432	21961
FY95/F-14D02-xxx	TSSA Development Environment	1540	1519	3059	6066	8856
FY95/F-14D02-01.01	MPRF	10916	14441	25356	72824	77523
FY95/F-14D02-01.02	PVU	956	1294	2250	10595	11515
FY95/F-14D02-01.03	Air-To-Ground	7101	6304	13405	41112	49220
FY95/F-14D02-01.17	JTIDS	2877	5295	8171	17182	20575
FY95/F-14D02-01.27	MC/ARDP 1553 Interface	25	29	54	409	448
FY95/F-14D02-03	SDIS	1785	2033	3818	9662	10068
FY95/F-14D02-06	Engine Mode Select Function	561	290	851	584	613
FY95/F-14D02-xxx	IRST/VSC	11223	8511	19734	8115	18628
FY95/F-14D02-xxx	Unknown DR Corrections	2646	2425	5071	24645	25235
FY95/F-14D02-xxx	Unknown	829	1156	2085	12709	13298
	Totals	**43644**	**48785**	**92529**	**254590**	**288412**

Table D
SLOC per D02 Design

F-14D01 Designs

Control Number	Design	% of unit modified	% inc in unit SLOC
FY93/F14D01-001	Tactical Tape Drop-In (RT Incorporation)	22	7
FY93/F14D01-xxx	System Expansion (SYSGEN, RM, or DP)	7	4
FY93/F14D01-xxx	TSSA Development Environment	19	15
FY93/F14D01-01.02	Sensor Control Mechanization	46	13
FY93/F14D01-01.04	JTIDS Fighter-To-Fighter DataLink	14	10
FY93/F14D01-01.05	ORT Abort	41	7
FY93/F14D01-01.07	Screen Target Designate	32	10
FY93/F14D01-01.08	Flexible Missile Messages	43	16
FY93/F14D01-01.12	RWS Mode Upgrade	31	6
FY93/F14D01-01.13	HRWS Default Scan Selection	108	43
FY93/F14D01-01.14	AIM-7M Second Missile Message	12	2
FY93/F14D01-01.17	Radiation Modes (RRE)	27	14
FY93/F14D01-01.18	Spin Arrow Limitation	54	12
FY93/F14D01-01.19	HUD Cage/Uncage	7	1
FY93/F14D01-01.21	Flight Director Mode	12	2
FY93/F14D01-01.23	ALR-67 Radar Warning Receiver	21	3
FY93/F14D01-01.28	Infrared Search and Track (IRST)	74	54
FY93/F14D01-01.32	Multiplex Bus Messages	27	14
FY93/F14D01-03	OBOGS C/A Light Illumination	4	1
FY93/F14D01-xxx	Unknown DR Corrections	36	12
	Averages	27	11

Table E
Unit Percentage SLOC Modified/Increased per D01 Design

F-14D02 Designs

Control Number	Design	% of unit modified	% inc in unit SLOC
FY95/F-14D02-001	Tactical Tape Drop-In (RT Incorporation)	26	4
FY95/F-14D02-xxx	System Expansion (SYSGEN, RM, or DP)	6	2
FY95/F-14D02-xxx	TSSA Development Environment	50	46
FY95/F-14D02-01.01	MPRF	35	6
FY95/F-14D02-01.02	PVU	21	9
FY95/F-14D02-01.03	Air-To-Ground	33	20
FY95/F-14D02-01.17	JTIDS	48	20
FY95/F-14D02-01.27	MC/ARDP 1553 Interface	13	10
FY95/F-14D02-03	SDIS	40	4
FY95/F-14D02-06	Engine Mode Select Function	146	5
FY95/F-14D02-xxx	IRST/VSC	243	130
FY95/F-14D02-xxx	Unknown DR Corrections	21	2
FY95/F-14D02-xxx	Unknown	16	5
	Averages	36	13

Table F
Unit Percentage SLOC Modified/Increased per D02 Design

5.3 Staffing

Personnel and Man Hour figures are TBD.

5.4 Quality

Quality Trend measurements are TBD. TSSA software problem reports exist in the form of Trainer Software Trouble Reports (TSTR's) and Discrepancy Reports (DR's). Formal tracking, prioritization, and final disposition are done by CM and Systems groups, and no effort was made to obtain final data for this report. This is at least partly due to the on-going effort to clear outstanding DR's.

There are no efforts to judge complexity of units, pre-existing or modified.

5.5 Capacity

Capacity measurements deal with computer resource usage. The data given here is not perceived to be a complete picture of the computer resource utilization of the training device. It does show the general trends over the recent development periods and points out areas where further study is needed.

ADVEP-HDBK-7 (Rev. 1), Software Metrics Handbook points out three areas of capacity measurement:

a) processor throughput for each individual processing element
b) memory for each type of memory and for each processing element
c) Input/Output, which includes bus and frame timing, for each individual bus or internal data network

The F-14D training devices have utilities which measure spare memory and frame time and these are dealt with in the succeeding sections. The memory reports would seem to correlate directly to item b above. The computation of frame time is slightly more ambiguous, but would appear to correlate more to item a. I/O bandwidth and I/O frame timing measurements are not available.

Also included here is a section on datapool impact. While this is normally a part of the overall memory measurements, it is of note here due to the significant impact on specific datapools and how it corresponds to the loss of memory in related processors.

5.5.1 Spare Memory

Spare Memory data is obtained from original contractor developed utilities and is measured to the nearest Page (2048 Byte) in size. The only contributing factor (non-constant) in the memory reports is the CPU task size, which accounts for the growth.

Node	Pre-D01	D01 Final	D02 Final	% change
A1/A2	49	48	48	-2.04
A3/A4	72	72	72	0.00
B1/B2	74	71	71	-4.05
B3/B4	39	39	38	-2.56
B5/B6	63	63	63	0.00
B7	58	58	58	0.00
C1/C2	69	67	67	-2.90
C3/C4	70	69	69	-1.43
C5/C6	52	50	50	-3.85
C7	50	46	44	-12.00
D1/D2	50	48	48	-4.00
D3/D4	69	67	67	-2.90
D5/D6	52	51	51	-1.92

Table G
Spare Memory Comparison

Note: Pre-D01 data is from early D01 baselines (dated 8/93 and 4/94). D01 Final data is from D01 B15 (dated 1/95) and D02 Final data is from D02 B14 (dated 2/96).

5.5.2 Datapool Impact

Table H shows the datapool usage comparison for the Pre-D01, D01, and D02 baselines. It also gives the current spare (in bytes).

Datapool Dictionary	Partition Size (Bytes)	Pre-D01 (Bytes)	D01 Final (Bytes)	D02 Final (Bytes)	Current Spare (Bytes)
MFT00DPD	65536	55322	58616	60035	5501
MFT10DPD	8192	4388	4388	4388	3804
MFT11DPD	114688	101414	101423	101423	13265
MFT12DPD	32768	18694	18694	18694	14074
MFT20DPD	16384	14898	14904	14908	1476
MFT21DPD	8192	3916	3920	3920	4272
MFT22DPD	8192	5190	5204	5633	2559
MFT23DPD	8192	5145	5145	5145	3047
MFT24DPD	8192	2634	2634	2634	5558
MFT30DPD	49152	38944	41686	42582	6570
MFT31DPD	8192	5296	5296	5295	2897
MFT32DPD	8192	2642	2642	2642	5550
MFT33DPD	32768	26715	26715	26715	6053
MFT34DPD	32768	27895	29246	30372	2396
MFT40DPD	507904	497902	497902	498840	9064
MFT41DPD	32768	29343	29344	29344	3424
MFT42DPD	8192	3701	3702	4165	4027
MFT43DPD	24576	20593	20593	20593	3983
MFT45DPD	16384	7022	8224	9160	7224
MFT51DPD	491520	471543	471543	471543	19977
MFT52DPD	131072	127420	127420	128825	2247
MFT53DPD	417792	385736	385736	385736	32056
MFT70DPD	335872	232958	232958	232958	102914
MFT80DPD	221184	108984	108984	108984	112200
MFT81DPD	24576	19712	19712	19712	4864
MFT82DPD	425984	409624	409624	409624	16360
MFT83DPD	196608	192504	192504	192504	4104
MFT84DPD	65536	56824	56824	56824	8712
MFT85DPD	24576	19712	19712	19712	4864
MFT86DPD	425984	406248	406248	406248	19736
MFT87DPD	212992	192200	192200	192200	20792
MFT88DPD	65536	56584	56584	56584	8952
MFT89DPD	458752	447412	447412	447412	11340
MFT90DPD	278528	271700	271700	271880	6648
MFT91DPD	450560	441624	441624	441624	8936
MFT92DPD	270336	264984	264984	264984	5352

Table H
Capacity/Datapool Dictionary

Table I shows the percentage spare for the same baselines. It should be noted that percentage spare figures are based upon the current datapool partition size and does not account for any partition restructuring that may have occurred over the course of development.

Dictionary	Pre-D01 % Spare	D01 Final % Spare	D02 Final % Spare	% growth
MFT00DPD	16	11	8	9
MFT10DPD	46	46	46	0
MFT11DPD	12	12	12	0
MFT12DPD	43	43	43	0
MFT20DPD	9	9	9	0
MFT21DPD	52	52	52	0
MFT22DPD	37	36	31	9
MFT23DPD	37	37	37	0
MFT24DPD	68	68	68	0
MFT30DPD	21	15	13	9
MFT31DPD	35	35	35	0
MFT32DPD	68	68	68	0
MFT33DPD	18	18	18	0
MFT34DPD	15	11	7	9
MFT40DPD	2	2	2	0
MFT41DPD	10	10	10	0
MFT42DPD	55	55	49	13
MFT43DPD	16	16	16	0
MFT45DPD	57	50	44	30
MFT51DPD	4	4	4	0
MFT52DPD	3	3	2	1
MFT53DPD	8	8	8	0
MFT70DPD	31	31	31	0
MFT80DPD	51	51	51	0
MFT81DPD	20	20	20	0
MFT82DPD	4	4	4	0
MFT83DPD	2	2	2	0
MFT84DPD	13	13	13	0
MFT85DPD	20	20	20	0
MFT86DPD	5	5	5	0
MFT87DPD	10	10	10	0
MFT88DPD	14	14	14	0
MFT89DPD	2	2	2	0
MFT90DPD	2	2	2	0
MFT91DPD	2	2	2	0
MFT92DPD	2	2	2	0

Table I
Percentage Spare/Datapool Dictionary

The following items should be noted:

1. The spare datapool for dictionary MFT00DPD (Global RM Datapool, Nodes A1-3, B1-4, C1-2, D1-2) has been cut in half over the D01/D02 efforts.

2. MFT30DPD (Node C local RM datapool) and MFT34DPD (Node C7 local datapool) have had significant reductions to available space and currently have extremely

limited spare capacity. Due to the functionality of the C Nodes and the expected future expansions to this functionality, this is an area of concern.

3. MFT22DPD (B3/B4 Local), MFT42DPD (D3/D4 Local), and MFT45DPD (Node D local RM datapool) have also experienced significant growth.

It should also be noted that available datapool space is a function of the datapool partition as defined in the SYSGEN. TSSA has accomplished some restructuring of the SYSGEN partitions before (addition of a C7 overlay task during the D01/D02 effort), but this is currently a little understood/documented area that requires further study to determine the true allowable spare memory.

5.5.3 Frame Time

Frame time measurements are taken from contractor developed utilities. Frame time measurements are run against a standard pre-defined max threat scenario. Due to the high amount of variation in frame time measurements (pre-D01 baselines showed a standard deviation in measurement of over 15 percent) averages from several baselines are presented here, i.e., an average of five baselines from 7/92 to 5/93 comprises the Pre-D01 average measurements.

Node	Pre-D01 Avg	D01 Avg	D02 Avg	% change (from Pre-D01)
A1	36	39	38	-7.08
A2	54	60	64	-18.96
A3	68	56	48	29.13
B1	35	38	38	-8.57
B2	63	62	62	1.90
B3	36	46	43	-18.52
B4	58	68	61	-5.75
B5	61	64	65	-6.21
B6	76	80	80	-4.99
C1	56	55	49	13.71
C2	33	71	85	-159.15
C3	78	93	90	-15.22
C4	80	40	29	64.17
C5	41	52	48	-15.14
C6	69	90	76	-9.34
C7	62	63	46	26.05
D1	60	74	57	4.76
D2	70	83	63	10.22
D3	73	92	82	-12.18
D4	92	100	97	-5.30
D5	49	68	29	40.62
D6	59	83	64	-8.11
average	**59.59**	**67.15**	**59.70**	**-4.73**

Table J
Percentage Spare Frame Time

From the data presented here, the accuracy of the current frame time measurement technique can be questioned. This would certainly appear to be an area that requires further TSSA study.

5.5.4 I/O Channel Utilization

No effort is currently made to analyze or capture I/O bandwidth and I/O frame timing data.

5.6 Schedule

Final delivery schedules, anticipated and actual, are TBD.

Subbuild information for both D01 and D02 baselines is available but has not been included in this report. It should be noted however, that approximately 19 subbuilds were incorporated into the D01 baseline, and 17 into D02.

6.0 Conclusions

The purpose of this report is twofold: to present historical information on the D01/D02 baselines and their impact on the F-14D training devices, and to provide a guideline for the future software developments on those baselines.

It is felt that this report provides adequate information in some areas, and points to other areas where data is needed. In some cases the needed data is available but not in a readily accessible format, in other cases the information is not collected.

Appendix A
F-14D01 Designs and Associated Units

FY93/F14D01-001 Tactical Tape Drop-In (RT Incorporation) (52 Files)

A.XADA2P	A.XCIU2P	D.DEKOFP	F.XDPVS2	I.XDPVS2
A.XADA2U	A.XCIU2U	D.DP1OFP	F.XDPVSC	I.XDPVSC
A.XARD1P	A.XINS2P	D.DP2OFP	F.XVSAD1	I.XVSAD1
A.XARD1U	A.XINS2U	D.MC1OFP	F.XVSAD2	I.XVSAD2
A.XARD2P	A.XRWR1P	D.MC2OFP	F.XVSADC	I.XVSADC
A.XARD2U	A.XRWR1U	F.EAEXEC	I.EAEXEC	M.I.VSA00
A.XARDCP	A.XSAH1P	F.ERBIT	I.ERBIT	M.I.VSA01
A.XARDCU	A.XSAH1U	F.NSAMCL	I.NSAMCL	M.I.VSA02
A.XBIU1B	A.XSDS1U	F.XABIRT	I.XABIRT	
A.XBIU2B	A.XSMS2P	F.XDCEIC	I.XDCEIC	
A.XBIUCB	A.XSMS2U	F.XDPVS1	I.XDPVS1	

FY93/F14D01-xxx System Expansion (SYSGEN, RM, or DP) (82 Files)

A.XCNTRL	D.MGLOBC	I.XFRRST	J.GPLLNK	T1D1.D
ACTA3A4	D.MGLOBD	J.BLDCTM	J.HANDLER	T1D3.D
ACTC1C2	D.WST00	J.CAT	J.OLIBR	T1D5.D
ACTD1D2	D.XSTA1M	J.CLDSTF	M1A1.D	W1A1.D
D.DPMADD	D.XSTC7M	J.CLDSTT	M1A3.D	W1A3.D
D.MCGLOB	D.XSTC7W	J.COMP	M1B1.D	W1B1.D
D.MFT00	F.MFRMIF	J.COPY	M1B3.D	W1B3.D
D.MFT11	F.MFRMTS	J.CTA3	M1C1.D	W1C1.D
D.MFT20	F.SPRMEM	J.CTLBMG	M1C3.D	W1C3.D
D.MFT21	F.XFRCFG	J.CTNH	M1C5.D	W1C5.D
D.MFT22	F.XFRMIT	J.CTNN	M1C7.D	W1C7.D
D.MFT30	F.XFRRST	J.CTSPRMEM	M1D1.D	W1D1.D
D.MFT34	I.MFRMIF	J.CTXFRMIT	M1D3.D	W1D3.D
D.MFT41	I.MFRMTS	J.CTYLOD	M1D5.D	W1D5.D
D.MFT42	I.SPRMEM	J.DPD	STARTUP	
D.MFT45	I.XFRCFG	J.GBLPRT	T1A1.D	
D.MGLOBB	I.XFRMIT	J.GPL	T1A3.D	

FY93/F14D01-xxx TSSA Development Environment (82 Files)

CD	J.CATW	J.COPY	J.GBLPRT	J.OLIBR
COMPT	J.CLDSTF	J.CTA3	J.GPL	J.TSSA
D.XMNTFL	J.CLDSTT	J.CTLBMG	J.GPLLNK	M.KEY.TSSA
D.XMNTFL.TSSA	J.CLEANALL	J.CTNH	J.HANDLER	MKSDTF
J.BACKUP	J.CLEANDPD	J.CTNN	J.LIBDEL	STARTUP
J.BLDCTM	J.CLEANGPL	J.CTSPRMEM	J.LIBLOG	
J.BLDCTT	J.CLEANIOS	J.CTXFRMIT	J.LIBNEW	
J.BLDCTW	J.CLEANTSK	J.CTYLOD	J.MAC	
J.CAT	J.COMP	J.DPD	J.MAKEDIR	

Appendix A
F-14D01 Designs and Associated Units

FY93/F14D01-01.02 Sensor Control Mechanization (41 Files)

A.XARD1P	F.SRLVID	F.SRTWS	I.SRLTGT	I.SRSIF
A.XARD1U	F.SRMRL	F.SRVSL	I.SRLVID	I.SRTWS
A.XDCEIC	F.SRMSL	F.SSSP	I.SRMRL	I.SRVSL
A.XSDS1P	F.SRPAL	F.STCLOS	I.SRMSL	I.SSSP
A.XSDS1U	F.SRPDS	F.STMODE	I.SRPAL	I.STCLOS
F.SRAGR	F.SRPDST	F.XABIRT	I.SRPDS	I.STMODE
F.SRDDP	F.SRPLM	I.SRAGR	I.SRPDST	I.XABIRT
F.SRGM	F.SRPS	I.SRDDP	I.SRPLM	
F.SRHTGT	F.SRPSTT	I.SRGM	I.SRPS	
F.SRHVID	F.SRRWS	I.SRHTGT	I.SRPSTT	
F.SRLTGT	F.SRSIF	I.SRHVID	I.SRRWS	

FY93/F14D01-01.04 JTIDS Fighter-To-Fighter DataLink (41 Files)

A.DSSINI	D.OSWDFM	F.OJTDS1	I.OACNTL	I.ONLSW
A.XBIU2B	D.OSWDFW	F.OJTDS2	I.OCLASS	I.OTAC2D
A.XDSS2P	D.XSTB3M	F.OJTDS3	I.OCLOCK	I.OTMACD
A.XDSS2U	D.XSTB3W	F.OJTDS4	I.ODATL2	I.VCIU1
A.XJTD2P	F.OACNTL	F.ONLSW	I.ODATLK	I.XABIRT
A.XJTD2U	F.OCLASS	F.OTAC2D	I.OJTDS1	
D.ODS5M	F.OCLOCK	F.OTMACD	I.OJTDS2	
D.ODS5T	F.ODATL2	F.VCIU1	I.OJTDS3	
D.ODS5W	F.ODATLK	F.XABIRT	I.OJTDS4	

FY93/F14D01-01.05 ORT Abort (10 Files)

F.SRCM	F.SRORT	F.SRTRAN	I.SRDDS	I.SRTMDS
F.SRDDS	F.SRTMDS	I.SRCM	I.SRORT	I.SRTRAN

FY93/F14D01-01.07 Screen Target Designate (10 Files)

F.SROBSF	F.SRTFMT	G.SRTTCG	I.SROBSF	I.SRTFMT
F.SRTDEL	F.SRTTFS	G.SRTTFG	I.SRTDEL	I.SRTTFS

FY93/F14D01-01.08 Flexible Missile Messages (21 Files)

A.XARD1P	F.SRJVGP	F.SRTTFS	I.SRJVGP	I.SRTTFS
A.XARDCP	F.SRMFK	G.SRTTFG	I.SRMFK	
F.SDDENT	F.SRPDST	I.SDDENT	I.SRPDST	
F.SRCME	F.SRTDEL	I.SRCME	I.SRTDEL	
F.SRJVFD	F.SRTFMT	I.SRJVFD	I.SRTFMT	

Appendix A
F-14D01 Designs and Associated Units

FY93/F14D01-01.12 RWS Mode Upgrade (60 Files)

F.OAWPN1	F.SRJRD	F.SRTMDS	I.SRDDS	I.SRMODE
F.OPILOT	F.SRJRPT	F.SRTOFS	I.SRHDET	I.SROBSF
F.ORIO	F.SRJVFD	F.SRTRAN	I.SRJCGS	I.SROTC
F.OTACPM	F.SRJVGP	F.SRTTD	I.SRJCO	I.SRPDST
F.SRCURS	F.SRMFK	F.SRVID	I.SRJMFR	I.SRTBIT
F.SRDDBS	F.SRMFKS	F.SRXMIT	I.SRJPRN	I.SRTIDS
F.SRDDS	F.SRMODE	I.OAWPN1	I.SRJRD	I.SRTMDS
F.SRHDET	F.SROBSF	I.OPILOT	I.SRJRPT	I.SRTOFS
F.SRJCGS	F.SROTC	I.ORIO	I.SRJVFD	I.SRTRAN
F.SRJCO	F.SRPDST	I.OTACPM	I.SRJVGP	I.SRTTD
F.SRJMFR	F.SRTBIT	I.SRCURS	I.SRMFK	I.SRVID
F.SRJPRN	F.SRTIDS	I.SRDDBS	I.SRMFKS	I.SRXMIT

FY93/F14D01-01.13 HRWS Default Scan Selection (2 Files)

F.SRRWS	I.SRRWS

FY93/F14D01-01.14 AIM-7M Second Missile Message (26 Files)

F.VOWFIR	I.VRDRML	F.OMSLSC	I.M05V4101.F	I.OWPCAP
F.VRDRML	I.VWPNLD	F.OPMWPN	I.OLMPRS	I.SRMSL
F.VWPNLD	I.WLDMSL	F.OPRSET	I.OMSLSC	
F.WLDMSL	I.WMFLY	F.OTMWPN	I.OPMWPN	
F.WMFLY	F.M05V4101.F	F.OWPCAP	I.OPRSET	
I.VOWFIR	F.OLMPRS	F.SRMSL	I.OTMWPN	

FY93/F14D01-01.17 Radiation Modes (RRE) (18 Files)

D.XSTC7M	F.SRNCTR	F.SRTDFS	I.SRNCTR	I.SRTDFS
D.XSTC7W	F.SRRAM	F.SRXMIT	I.SRRAM	I.SRXMIT
F.SRDDP	F.SRRRE	I.SRDDP	I.SRRRE	
F.SRDFDT	F.SRTDEL	I.SRDFDT	I.SRTDEL	

FY93/F14D01-01.18 Spin Arrow Limitation (6 Files)

A.XARD1U	F.SRTIDS	G.SRTIDG	I.NINS	I.SRTIDS
F.NINS				

FY93/F14D01-01.19 HUD Cage/Uncage (2 Files)

F.XDCEWR	I.XDCEWR

FY93/F14D01-01.21 Flight Director Mode (2 Files)

F.XDCEC5	I.XDCEC5

Appendix A
F-14D01 Designs and Associated Units

FY93/F14D01-01.23 ALR-67 Radar Warning Receiver (31 Files[1])

EMIT.*	F.ERDPLY	F.OACTON	I.ERBIT3	I.MACT2
F.CICS1	F.EREXEC	F.QF14A	I.ERDPLY	I.OACTON
F.CICS1	F.ERINIT	I.CICS1	I.EREXEC	I.QF14A
F.ERAUD	F.EROFF	I.CICS1	I.ERINIT	
F.ERBIT1	F.ERTES	I.ERAUD	I.EROFF	
F.ERBIT2	F.ERTRCK	I.ERBIT1	I.ERTES	
F.ERBIT3	F.MACT2	I.ERBIT2	I.ERTRCK	

[1]Note: An indeterminant number of emitter files were updated with this design and are denoted by EMIT.* files in the tactical directory.

FY93/F14D01-01.28 Infrared Search and Track (IRST) (180 Files)

A.XBIU1B	F.SIMSGC	F.SIRTC	I.SICHNR	I.SIPDSA
A.XIRS1P	F.SIMSGH	F.SIRTI	I.SICOOL	I.SIPDSC
A.XIRS1U	F.SIMSGT	F.SIRTRAN	I.SIDET	I.SIPDSR
D.XSTC1M	F.SINSSM	F.SISAM	I.SIDETI	I.SIPDST
D.XSTC1W	F.SINTWM	F.SISCAN	I.SIDETP	I.SIPDTA
D.XSTC3M	F.SIOSD	F.SISCNC	I.SIDETS	I.SIPLM
D.XSTC3W	F.SIPAL	F.SISOUT	I.SIDISC	I.SIPODC
D.XSTC4M	F.SIPDAA	F.SISTT	I.SIFOV	I.SIPODD
D.XSTC4W	F.SIPDAT	F.SISTTP	I.SIGIMB	I.SIPTL
F.DHBTWE	F.SIPDCB	F.SISYSI	I.SIHTGT	I.SIPTLG
F.DHBWEA	F.SIPDCI	F.SIT1ST	I.SIHTIR	I.SIPTLI
F.OAWPN1	F.SIPDCP	F.SITACT	I.SILMOD	I.SIRACDM
F.OTMWPN	F.SIPDCR	F.SITRKF	I.SIMRG	I.SIRBACK
F.OVISCN	F.SIPDCT	F.SITRKH	I.SIMRGR	I.SIRCLUT
F.SIASID	F.SIPDDG	F.SITWSA	I.SIMSG	I.SIRPATH
F.SIBPNT	F.SIPDDM	F.SITWSM	I.SIMSGC	I.SIRTC
F.SIC1B	F.SIPDDP	F.SRDDS	I.SIMSGH	I.SIRTI
F.SIC1TG	F.SIPDEA	F.SRSIF	I.SIMSGT	I.SIRTRAN
F.SIC2B	F.SIPDRM	F.XDPVS1	I.SINSSM	I.SISAM
F.SIC4B	F.SIPDRN	F.XINICI	I.SINTWM	I.SISCAN
F.SICFD	F.SIPDRV	F.XVSAD1	I.SIOSD	I.SISCNC
F.SICHNR	F.SIPDSA	G.SRMFKG	I.SIPAL	I.SISOUT
F.SICOOL	F.SIPDSC	G.SRSYMG	I.SIPDAA	I.SISTT
F.SIDET	F.SIPDSR	G.SRTIDG	I.SIPDAT	I.SISTTP
F.SIDETI	F.SIPDST	I.DHBTWE	I.SIPDCB	I.SISYSI
F.SIDETP	F.SIPDTA	I.DHBWEA	I.SIPDCI	I.SIT1ST
F.SIDETS	F.SIPLM	I.OAWPN1	I.SIPDCP	I.SITACT
F.SIDISC	F.SIPODC	I.OTMWPN	I.SIPDCR	I.SITRKF
F.SIFOV	F.SIPODD	I.OVISCN	I.SIPDCT	I.SITRKH
F.SIGIMB	F.SIPTL	I.SIASID	I.SIPDDG	I.SITWSA
F.SIHTGT	F.SIPTLG	I.SIBPNT	I.SIPDDM	I.SITWSM
F.SIHTIR	F.SIPTLI	I.SIC1B	I.SIPDDP	I.SRDDS
F.SILMOD	F.SIRACDM	I.SIC1TG	I.SIPDEA	I.SRSIF

Appendix A
F-14D01 Designs and Associated Units

FY93/F14D01-01.28 Infrared Search and Track (IRST) (continued)

F.SIMRG	F.SIRBACK	I.SIC2B	I.SIPDRM	I.XDPVS1
F.SIMRGR	F.SIRCLUT	I.SIC4B	I.SIPDRN	I.XINICI
F.SIMSG	F.SIRPATH	I.SICFD	I.SIPDRV	I.XVSAD1

FY93/F14D01-01.32 Multiplex Bus Messages (2 Files)

A.XARD1P	A.XARDCP

FY93/F14D01-03 OBOGS C/A Light Illumination (8 Files)

F.ALTCWP	F.OMBLKD	I.ALTCWP	I.OMBLKD	I.ONRLTS
F.ALTCWR	F.ONRLTS	I.ALTCWR		

FY93/F14D01-xxx DR Corrections, Miscellaneous, and Unknown (116 Files)

A.XARD1P	F.SRPSTT	F.SSSP	I.SRPDST	I.SSCU
A.XARD1U	F.SRRRE	F.STCLOS	I.SRPSTT	I.SSSP
A.XARDCP	F.SRRWS	F.VCIU1	I.SRRRE	I.STCLOS
A.XSDS1P	F.SRTDBS	F.XFHIFC	I.SRRWS	I.VCIU1
D.XSTC7M	F.SRTDFS	G.SRMFKG	I.SRTDBS	I.XFHIFC
D.XSTC7W	F.SRTDHF	G.SRSYMG	I.SRTDFS	F.FSP42G
F.GETREC	F.SRTDRO	G.SRTIDG	I.SRTDHF	F.MPRSW3
F.RADAGE	F.SRTDUL	I.GETREC	I.SRTDRO	F.OCVREC
F.SDBLNK	F.SRTDUR	I.RADAGE	I.SRTDUL	F.SRINIT
F.SDDENT	F.SRTFDT	I.SDBLNK	I.SRTDUR	F.SRRFDP
F.SIDISC	F.SRTFMT	I.SDDENT	I.SRTFDT	F.SRWRAS
F.SRANTC	F.SRTIDS	I.SIDISC	I.SRTFMT	G.SRCDTG
F.SRCDTS	F.SRTIRS	I.SRANTC	I.SRTIDS	G.SRTDFG
F.SRCURS	F.SRTMDS	I.SRCDTS	I.SRTIRS	G.SRTWPG
F.SRDATA	F.SRTNGS	I.SRCURS	I.SRTMDS	I.FSP42G
F.SRDDBS	F.SRTOFS	I.SRDATA	I.SRTNGS	I.MPRSW3
F.SRDDP	F.SRTRAN	I.SRDDBS	I.SRTOFS	I.OCVREC
F.SRDDS	F.SRTTCS	I.SRDDP	I.SRTRAN	I.SRINIT
F.SRDFDT	F.SRTTFS	I.SRDDS	I.SRTTCS	I.SRRFDP
F.SRDIRS	F.SRTWPS	I.SRDFDT	I.SRTTFS	I.SRWRAS
F.SRIC	F.SRTWS	I.SRDIRS	I.SRTWPS	
F.SRLARC	F.SRVID	I.SRIC	I.SRTWS	
F.SRMFKS	F.SRXMIT	I.SRLARC	I.SRVID	
F.SRPDST	F.SSCU	I.SRMFKS	I.SRXMIT	

Appendix B
F-14D02 Designs and Associated Units

FY95/F-14D02-001 Tactical Tape Drop-In (RT Incorporation) (30 Files)

A.XADA2P	A.XBIU2B	A.XSMS2P	F.SRPDST	I.SRPDST
A.XARD1P	A.XCIU2P	D.DP1CFG	F.SRPS	I.SRPS
A.XARD1U	A.XINS2P	D.DP2CFG	F.SRPSTT	I.SRPSTT
A.XARD2P	A.XINS2U	D.MC1CFG	F.SRSIF	I.SRSIF
A.XARD2U	A.XIRS1P	D.MC2CFG	F.XABIRT	I.XABIRT
A.XARDCP	A.XSDS1P	F.SRPDS	I.SRPDS	M.I.VSA02

FY95/F-14D02-xxx System Expansion (SYSGEN, RM, or DP) (41 Files)

D.MFT00	D.MFT45	F.SRTDHF	I.SRLARC	M.I.VSA02
D.MFT11	D.MFT51	F.SRTIRS	I.SRTDBS	M1C3.D
D.MFT20	D.MFT52	F.SRTMDS	I.SRTDHF	M1C7.D
D.MFT22	D.MFT90	F.SRTNGS	I.SRTIRS	W1C3.D
D.MFT30	D.WST00	F.SRTOFS	I.SRTMDS	W1C7.D
D.MFT31	F.GETREC	F.SRTTCS	I.SRTNGS	
D.MFT34	F.RADAGE	F.SRTWPS	I.SRTOFS	
D.MFT40	F.SRLARC	I.GETREC	I.SRTTCS	
D.MFT42	F.SRTDBS	I.RADAGE	I.SRTWPS	

FY95/F-14D02-xxx TSSA Development Environment (31 Files)

OD	*J.BASELMPX*	J.CLEANALL	J.COMP	*J.SMTINSTALL*
D.ODSEDT	*J.BASELSCT*	J.CLEANDPD	J.COPY	J.TSSA
J.BACKUP	*J.BASELTSK*	J.CLEANIOS	J.DPD	MKSDTF
J.BASELALL	J.BLDCTM	J.CLEANMAC	J.GPL	
J.BASELDPD	J.BLDCTW	J.CLEANMPX	J.IPRBG	
J.BASELIOS	J.CAT	J.CLEANSCT	J.MAC	
J.BASELMAC	J.CATW	J.CLEANTSK	J.RESTORE	

FY95/F-14D02-01.01 MPRF (148 Files)

D.ONLDAT	F.SRJCRS	F.SRRWS	I.SRCDTS	I.SRMTGT
D.ONRDAT	F.SRJMFR	F.SRSIF	I.SRCME	I.SRNCTR
D.OSWDFM	F.SRJN	F.SRTFMT	I.SRCURS	I.SROBSF
D.OSWDFW	F.SRJPRN	F.SRTIDS	I.SRDATA	I.SROTC
F.ERTES	F.SRJPT	F.SRTOFS	I.SRDDP	I.SRPAL
F.MPRSW3	F.SRJRD	F.SRTRAN	I.SRDDS	I.SRPDS
F.MPRSW4	F.SRJRGP	F.SRTSIG	I.SRFLYC	I.SRPDST
F.OAWPN1	F.SRJVFD	F.SRTWS	I.SRGM	I.SRPLM
F.OMBLKD	F.SRJVGP	F.SRVID	I.SRHVID	I.SRPS
F.ONRS01	F.SRLVID	F.SRVSL	I.SRIFFV	I.SRPSTT
F.OPILOT	F.SRMDET	*F.SRXFER*	I.SRINIT	I.SRRAM
F.ORIO	F.SRMDI	F.SRXMIT	I.SRJCGS	I.SRRGP
F.OTACPM	F.SRMFK	F.SSSP	I.SRJCO	I.SRRGST
F.OTMWPN	F.SRMFKS	F.YGPOVY	I.SRJCRS	I.SRRWS

Appendix B
F-14D02 Designs and Associated Units

FY95/F-14D02-01.01 MPRF (continued)

F.SDDENT	F.SRMODE	F.YINSCN	I.SRJMFR	I.SRSIF
F.SRACQF	F.SRMRL	G.SRCDTG	I.SRJN	I.SRTFMT
F.SRANTC	F.SRMSL	G.SRTMDG	I.SRJPRN	I.SRTIDS
F.SRCDTS	F.SRMTGT	I.ERTES	I.SRJPT	I.SRTOFS
F.SRCME	F.SRNCTR	I.MPRSW3	I.SRJRD	I.SRTRAN
F.SRCURS	F.SROBSF	I.MPRSW4	I.SRJRGP	I.SRTSIG
F.SRDATA	F.SROTC	I.OAWPN1	I.SRJVFD	I.SRTWS
F.SRDDP	F.SRPAL	I.OMBLKD	I.SRJVGP	I.SRVID
F.SRDDS	F.SRPDS	I.ONRS01	I.SRLVID	I.SRVSL
F.SRFLYC	F.SRPDST	I.OPILOT	I.SRMDET	*I.SRXFER*
F.SRGM	F.SRPLM	I.ORIO	I.SRMDI	I.SRXMIT
F.SRHVID	F.SRPS	I.OTACPM	I.SRMFK	I.SSSP
F.SRIFFV	F.SRPSTT	I.OTMWPN	I.SRMFKS	I.YGPOVY
F.SRINIT	F.SRRAM	I.SDDENT	I.SRMODE	I.YINSCN
F.SRJCGS	F.SRRGP	I.SRACQF	I.SRMRL	
F.SRJCO	F.SRRGST	I.SRANTC	I.SRMSL	

FY95/F-14D02-01.02 PVU (26 Files)

F.OPILOT	F.SRPVU	F.SRVID	I.SRMODE	I.SRTRAN
F.ORIO	F.SRTDRO	I.OPILOT	I.SRPVU	I.SRVID
F.OTACPM	F.SRTDUL	I.ORIO	I.SRTDRO	
F.OTMWPN	F.SRTDUR	I.OTACPM	I.SRTDUL	
F.SRDDS	F.SRTIDS	I.OTMWPN	I.SRTDUR	
F.SRMODE	F.SRTRAN	I.SRDDS	I.SRTIDS	

FY95/F-14D02-01.03 Air-To-Ground (132 Files)

A.XSMS2P	F.VARMW	F.WPAAI2	I.SREOP	*I.WIMPAC*
A.XSMS2U	*F.VASSEL*	F.WPAAI3	I.SRJRGP	I.WINIT1
D.XSTD3M	*F.VBMREL*	F.WRDQUE	I.SRRRE	I.WLDBMB
D.XSTD3W	F.VCLRW	F.WRLPSN	I.TSP30X	I.WPAAI1
F.AAIL14	*F.VCONF1*	F.WSLOT	I.VARMW	I.WPAAI2
F.CURVFT	*F.VCONF2*	F.WTRMHT	*I.VASSEL*	I.WPAAI3
F.DPCWPS	F.VEMJET	F.XABIRT	*I.VBMREL*	I.WRDQUE
F.FWTBD1	F.VEVNTS	F.XCRASH	I.VCLRW	I.WRLPSN
F.FWTBL1	F.VGNFIR	*I.AAIL14*	*I.VCONF1*	I.WSLOT
F.OERDAT	F.VPBIT	*I.CURVFT*	*I.VCONF2*	I.WTRMHT
F.OLMPRS	F.VPWRST	I.DPCWPS	I.VEMJET	I.XABIRT
F.OMBLKD	F.VRDRML	I.FWTBD1	I.VEVNTS	I.XCRASH
F.OMMENU	F.VSMJET	I.FWTBL1	I.VGNFIR	
F.OMSMAC	F.VSMOFF	I.OERDAT	I.VPBIT	
F.OPILOT	F.VSMSEX	I.OLMPRS	I.VPWRST	
F.OPILT2	F.VSMSI	I.OMBLKD	I.VRDRML	
F.OPLS01	F.VSMTAC	I.OMMENU	I.VSMJET	

Appendix B
F-14D02 Designs and Associated Units

FY95/F-14D02-01.03 Air-To-Ground (continued)

F.OPMWPN	F.VSRSEL	I.OMSMAC	I.VSMOFF
F.OPRSET	F.VSWL	I.OPILOT	I.VSMSEX
F.OSTAT	F.VWINV	I.OPILT2	I.VSMSI
F.OTMWPN	F.VWPNLD	I.OPLS01	I.VSMTAC
F.OWYPTC	F.W14EXC	I.OPMWPN	I.VSRSEL
F.PINST1	*F.WBFLY*	I.OPRSET	I.VSWL
F.SRAGR	*F.WBOMB*	I.OSTAT	I.VWINV
F.SRANTC	F.WF14DM	I.OTMWPN	I.VWPNLD
F.SRDIRS	*F.WFMU*	I.OWYPTC	I.W14EXC
F.SREOP	*F.WIMPAC*	I.PINST1	*I.WBFLY*
F.SRJRGP	F.WINIT1	I.SRAGR	*I.WBOMB*
F.SRRRE	F.WLDBMB	I.SRANTC	I.WF14DM
F.TSP30X	F.WPAAI1	I.SRDIRS	*I.WFMU*

FY95/F-14D02-01.17 JTIDS (35 Files)

A.XJTD2P	F.RADAGE	F.SRTTFS	I.OEWJAM	I.SRDFDT
F.OACNTL	F.SDBLNK	F.SRTWPS	I.OJTDS1	*I.SRJTDR*
F.OEWJAM	F.SRDFDT	G.SRTDFG	I.OJTDS3	*I.SRJTID*
F.OJTDS1	*F.SRJTDR*	G.SRTIDG	I.OJTDS4	I.SRTDFS
F.OJTDS3	*F.SRJTID*	G.SRTTFG	I.OWYPTC	I.SRTIDS
F.OJTDS4	F.SRTDFS	G.SRTWPG	I.RADAGE	I.SRTTFS
F.OWYPTC	F.SRTIDS	I.OACNTL	I.SDBLNK	I.SRTWPS

FY95/F-14D02-01.27 MC/ARDP 1553 Interface (1 File)

A.XARD2P

FY95/F-14D02-03 SDIS (24 Files)

A.XSDS1P	F.ONLS01	F.SRPS	I.ONLS01	I.SRPS
D.ONLDAT	F.ONLSW	F.SRRWS	I.ONLSW	I.SRRWS
D.OSWDFM	F.ONRS01	F.SSCU	I.ONRS01	I.SSCU
D.OSWDFW	F.ORDSWD	F.SSSP	I.ORDSWD	I.SSSP
F.ONLLTS	F.SRPDS	I.ONLLTS	I.SRPDS	

FY95/F-14D02-06 Engine Mode Select Function (2 Files)

F.PENGCS	I.PENGCS

Appendix B
F-14D02 Designs and Associated Units

FY95/F-14D02-xxx IRST/VSC (184 Files)

D.XSTC3M	F.SILMOD	F.SIRBACK	I.SIE5HZA	I.SIPDEA
D.XSTC3W	F.SIMRG	F.SIRPATH	I.SIE5HZB	I.SIPDRM
D.XSTC4M	F.SIMRGR	F.SIRTC	I.SIE5HZC	I.SIPDRN
D.XSTC4W	F.SIMSG	_E.SIRTI	I.SIEBLKD	I.SIPDRV
F.SIASID	F.SIMSGC	F.SIRTRAN	I.SIEEND	I.SIPDSA
F.SIBPNT	F.SIMSGH	F.SISAM	I.SIEENV	I.SIPDSC
F.SIC1B	F.SIMSGT	F.SISCAN	I.SIEISM	I.SIPDSR
F.SIC1TG	F.SINSSM	F.SISCNC	I.SIESET	I.SIPDST
F.SIC2B	F.SINTWM	*F.SISIMG*	I.SIFOV	I.SIPDTA
F.SIC4B	F.SIOSD	F.SISOUT	I.SIGIMB	I.SIPLM
F.SICALC	F.SIPAL	F.SISTT	I.SIHTGT	I.SIPODC
F.SICFD	F.SIPCLUT	F.SISTTP	I.SIHTIR	I.SIPODD
F.SICHNR	F.SIPDAA	F.SISYSI	I.SIISCZ	I.SIPTL
F.SICOOL	F.SIPDAT	F.SIT1ST	I.SIISPT	I.SIPTLG
F.SIDET	F.SIPDCB	F.SITACT	I.SIISZA	I.SIPTLI
F.SIDETI	F.SIPDCP	F.SITRKF	I.SIISZE	I.SIRACDM
F.SIDETP	F.SIPDCR	F.SITRKH	I.SILMOD	I.SIRBACK
F.SIDETS	F.SIPDCT	F.SITWSA	I.SIMRG	I.SIRPATH
F.SIDISC	F.SIPDDG	F.SITWSM	I.SIMRGR	I.SIRTC
F.SIE1HZA	F.SIPDDM	F.XIOSGC	I.SIMSG	I.SIRTI
F.SIE1HZB	F.SIPDDP	I.SIASID	I.SIMSGC	I.SIRTRAN
F.SIE5HZA	F.SIPDEA	I.SIBPNT	I.SIMSGH	I.SISAM
F.SIE5HZB	F.SIPDRM	I.SIC1B	I.SIMSGT	I.SISCAN
F.SIE5HZC	F.SIPDRN	I.SIC1TG	I.SINSSM	I.SISCNC
F.SIEBLKD	F.SIPDRV	I.SIC2B	I.SINTWM	I.SISIMG
F.SIEEND	F.SIPDSA	I.SIC4B	I.SIOSD	I.SISOUT
F.SIEENV	F.SIPDSC	I.SICALC	I.SIPAL	I.SISTT
F.SIEISM	F.SIPDSR	I.SICFD	I.SIPCLUT	I.SISTTP
F.SIESET	F.SIPDST	I.SICHNR	I.SIPDAA	I.SISYSI
F.SIFOV	F.SIPDTA	I.SICOOL	I.SIPDAT	I.SIT1ST
F.SIGIMB	F.SIPLM	I.SIDET	I.SIPDCB	I.SITACT
F.SIHTGT	F.SIPODC	I.SIDETI	I.SIPDCP	I.SITRKF
F.SIHTIR	F.SIPODD	I.SIDETP	I.SIPDCR	I.SITRKH
F.SIISCZ	F.SIPTL	I.SIDETS	I.SIPDCT	I.SITWSA
F.SIISPT	F.SIPTLG	I.SIDISC	I.SIPDDG	I.SITWSM
F.SIISZA	F.SIPTLI	I.SIE1HZA	I.SIPDDM	I.XIOSGC
F.SIISZE	F.SIRACDM	I.SIE1HZB	I.SIPDDP	

Appendix B
F-14D02 Designs and Associated Units

FY95/F-14D02-xxx Unknown DR Corrections (60 Files)

F.BFNDT	F.OAFLD2	F.VSMSEX	I.MKULST	I.OGCATS
F.EXPDSN	F.OAFLIB	F.XAB1VS	I.MTSIOC	I.OMALTR
F.IMPDSN	F.OAFRMP	F.XEMPTY	I.OAFADD	I.PRPLD
F.KILRAS	F.OAFTO	F.XSPIF	I.OAFCN2	I.SRJTDR
F.MIOSKB	F.OAFWT2	F.YGPACT	I.OAFDEF	I.SRTIDS
F.MKBIOC	F.OAFWTH	G.SRTIDG	I.OAFGEN	I.SRTIRS
F.MKULST	F.OGCATS	I.BFNDT	I.OAFLD2	I.VSMSEX
F.MTSIOC	F.OMALTR	I.EXPDSN	I.OAFLIB	I.XAB1VS
F.OAFADD	F.PRPLD	I.IMPDSN	I.OAFRMP	I.XEMPTY
F.OAFCN2	*F.SRJTDR*	I.KILRAS	I.OAFTO	I.XSPIF
F.OAFDEF	F.SRTIDS	I.MIOSKB	I.OAFWT2	I.YGPACT
F.OAFGEN	F.SRTIRS	I.MKBIOC	I.OAFWTH	M.I.VSA02

FY95/F-14D02-xxx Unknown (29 Files)

F.OCVREC	F.SRHTGT	F.SRTTD	I.SDDCAK	I.SRRFDP
F.ONLBEM	F.SRJRPT	F.STCLOS	I.SRDETR	I.SRSCNV
F.ONRBEM	F.SRLTGT	G.SRMFKG	I.SRHDET	I.SRTIDP
F.SDDCAK	F.SRRFDP	I.OCVREC	I.SRHTGT	I.SRTTD
F.SRDETR	F.SRSCNV	I.ONLBEM	I.SRJRPT	I.STCLOS
F.SRHDET	F.SRTIDP	I.ONRBEM	I.SRLTGT	

Note: Units in *Italics* are units that were original to the baseline (new units).

APPENDIX I

WRA LOAD STATION OPERATION MANUAL (Excerpts)

WRA Load Station

Operations Manual

P/N A55U70006

GRUMMAN

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FIGURES

FIGURE 1 3

FIGURE 2 4

FIGURE 3 6

1 INTRODUCTION

This Operation Manual describes the procedures necessary for the operator to initiate, operate and monitor the WRA Load Station.

2 OPERATIONAL ENVIRONMENT

2.1 ENVIRONMENTAL RANGE

Temperature: 41 to 90 degrees F (5 to 32 degrees C) operating

2.2 PROGRAM MATERIALS

5 1/4 inch low density diskettes (360 kb)
90M Bernouili disk

2.3 SUPPORTING DOCUMENTATION

2.3.1 Interface Control Document For the Memory Loader/Verifier with Sea-Based Tactical Avionic System, date 8 July 1985, issued by:
Naval Air Deveiopment Center, Code 3021,
Warminster Pennsylvania 18974-5000.

2.3.2 Operations Manual For the Development Memory Loader/Verifier (DMLV), P/N A55U20710-1, date 16 May 1990, issued by Grumman Aircraft and Electronic Group.

3 SETUP

3.1 PC

3.1.1 Place the "Source" switch in the DMLV position (see figure 2).

3.1.2 Switch on Power Strip (see figure 1).

3.1.3 Place the Bernoulli disk in drive C.

3.1.4 The WRA load station software is run automatically on power up.

3.2 LVTS/DMLV

3.2.1 When performing LVTS operations place the "Source" switch in the LVTS position (see figure 2).

3.2.2 Connect the LVTS aircraft connectors to the MLV Panel (see figure 1).

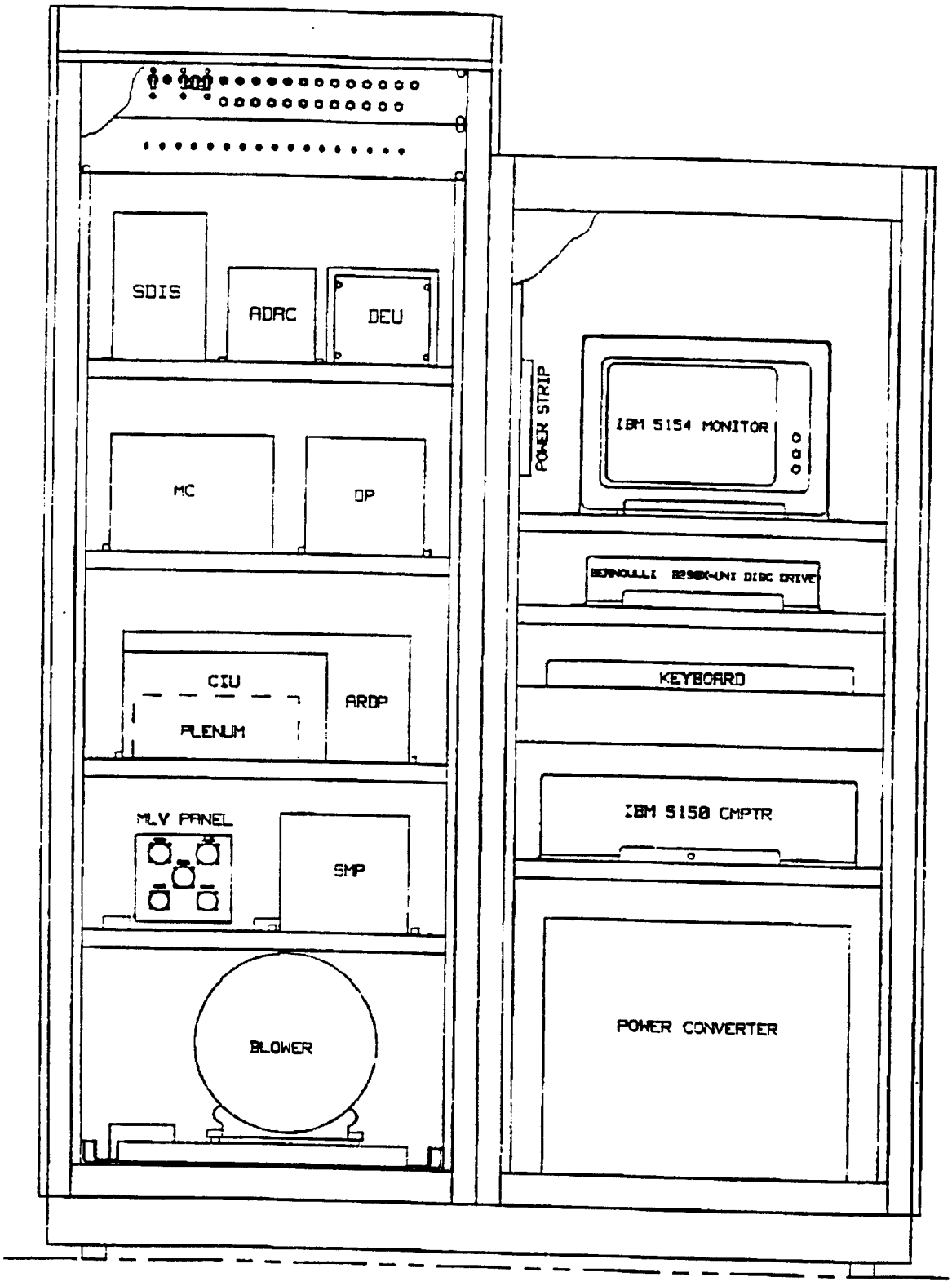


FIGURE 1

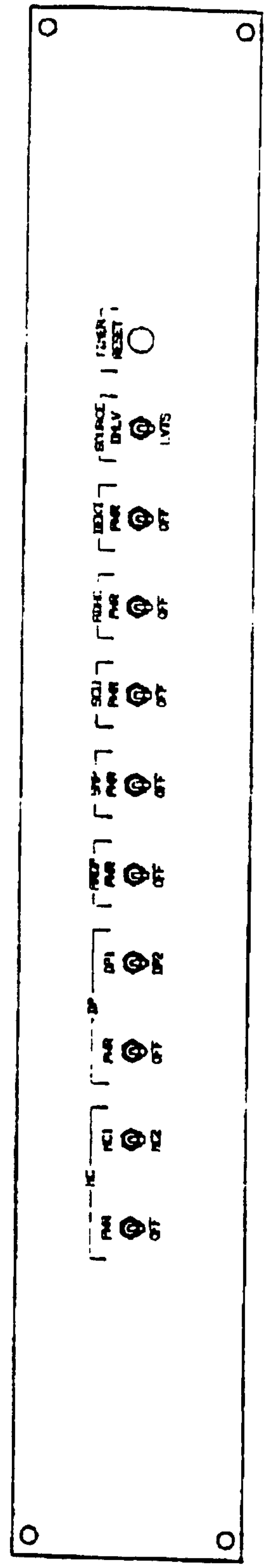


FIGURE 2

3.3 WRA

3.3 Place the desired WRA in its allocated slot (figure 1).

NOTE: Two people are required to lift the ARDP.

3.3.2 Connect appropriate WRA cables.

3.3.3 MISSION COMPUTER (MC)

3.3.3.1 MC1 operations
Place the "MC" switch in the MC1 position (see figure 2).

3.3.3.2 MC2 operations
Place the "MC" switch in the MC2 position (see figure 2).

3.3.4 DISPLAY PROCESSOR (DP)

3.3.4.1 DP1 operations
Place the "DP" switch in the DP1 position (see figure 2).

3.3.4.2 DP2 operations
Place the "DP" switch in the DP2 position (see figure 2).

3.3.5 Converter Interface Unit (CIU)

3.3.5.1 Place the CIU Air Plenum Adapter in front of the Airborne Radar Data Processor (ARDP) Air Plenum.

3.3.5.2 Place the CIU Adapter Guide in the Adapter Guide Location on the ARDP shelf.

3.3.5.3 Connect the CIU Adapter Cables to the CIU and the ARDP cables.

3.3.6 Turn ON the 400HZ Power Converter, if installed (see figure 1).

3.3.7 Place the 60HZ power switch to the ON position (see figure 3).

3.3.8 Place the 400HZ power switch to the ON position (see figure 3).

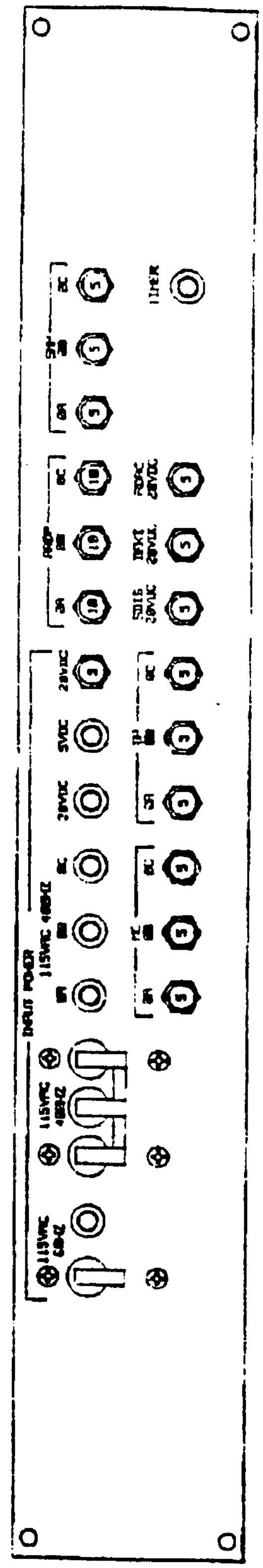


FIGURE 3

3.3.9 Place the power switch for the desired WRA in the ON position (see figure 2).

NOTE: Only one WRA can be loaded at a time.
Only one WRA power switch should be on at a time.

4 MENU OPERATIONS

At power up, the PC will display a title screen which identifies the unit. This consists of the following information:

- o Title
- o WRA Load Station part number
- o Serial number
- o Classification
- o Current time
- o Current date

At this time the operator should verify that the time and date displayed are correct. Functions are provided to set time (F1 key) or date (F5 key). The proper formats for time and date entry are displayed in their respective prompt windows. After the title screen is displayed the Discrete I/O Card Confidence Test is run. This verifies that the computer is able to communicate with the GAC Discrete I/O card. When the test is completed the Main Menu is displayed. The menu appears as follows:

LOAD W/AUTO VERIFY
VERIFY
SAVE
DISPLAY LIBRARY
DELETE FILE
DISK OPERATIONS
SHUTDOWN

The UP and DOWN arrow keys are used by the operator to highlight the operation desired. Press RETURN key to perform the selected operation. The Main Menu will return after the completion of the selected operation.

APPENDIX J

TSDF UPGRADE RECOMMENDATIONS

4 Sep 96

Memorandum

To: Cheryl McCombs, Hector Diaz
From: The TSSA Design/Lab Team

Subj: TSDF Equipment Upgrades

Encl: (1) Equipment Lists and Approximate Costs
(2) IBM Compatible PC Usage

1. The near term focus for upgrades to the TSDF is on increased efficiency/capabilities with the current development environment and on developing automated systems for software tracking and documentation efforts. This memo does not cover TSDF upgrade efforts covered by the procurement of the 2F169 development system, the ATIP Phase I upgrades to the MT suite, or the PAX Best Value OFT update.

2. The major areas of immediate concern in the TSDF are;

a) Storage capacity on the F-14D system.
b) The development environment (all training devices).
c) Automated documentation capabilities (all training devices).
d) Development of automated software CM tools.

3. In order to accomplish the most with the smallest financial outlay, the purchase of Personal Computer based systems is proposed. The feasibility of utilizing PC interfaces with the Encore system has already been demonstrated in the TSDF using the Gateway PC purchased for the 2F169 system. See enclosure (2) for summaries of the proposed tasks/applications that a few multi-purpose systems can provide. See enclosure (1) for approximate system costs of hardware and supporting software.

4. Until alternative PC based storage devices for the F-14D can be demonstrated, there is an immediate need to purchase SCSI disks for the TSDF. The need to maintain spare disks on the East Coast for development, and the need to store multiple baselines and SMT databases (cross-references, etc) for upcoming documentation/development efforts requires added capacity in the TSDF. The current non-availability of 1.2GB SCSI's will also necessitate a MPX patch to support the newer 4GB disks. See enclosure (1) for approximate system costs of hardware and supporting software.

5. A switching unit is needed to select the magnetic tape unit to either F-14D computer (the 9780 or the 9750) in the TSDF. This is currently accomplished by opening the unit and manually disconnecting/reconnecting the ribbon cables for each machine. This is an unacceptable method which is prone to eventually breakage. A low cost switching unit could alleviate this problem.

6. The costs and equipment detailed here are based upon the complete lack of knowledge of available funds for TSDF improvements. When an approximate budget and procurement schedule is made available, these estimates can be tailored to fit the most immediate needs. Especially in the area of the individual PC systems, the flexibility in packaging options from vendors provides extensive opportunities to customize systems to fiscal constraints. The list is also unprioritized, again based upon the lack of scheduling/funding availability.

Enclosure 2: IBM Compatible PC Usage

1. UNIX operating system. The 2F169 operates on a UNIX based computer system. Until we have the 2F169 system in the lab, it is important that we maintain at least one system with the UNIX O/S. We not only need to develop script files that will assist us our development efforts, but we also have to maintain proficiency with the O/S.

2. MS Access database management. The 2F169 symbol database is a Microsoft Access based relational database. We need access to this application to evaluate NG software tools and processes, as well as developing our own.

3. CM development. We currently are in need of automated CM tools to track software changes. A PC connected to the development systems in the lab will not only allow us to access files, but we can build a software interface that will track file revision levels, associated changes, responsible engineers, etc.

4. File storage. On the F-14D system, we have a shortage of SCSI disks. By utilizing PC based storage media, we can alleviate this problem. There are multiple PC storage configurations that can be used for backups, and that are readily transported to other platforms.

5. Transportability. Being able to load software baselines, CM databases, and even executable tasks onto PC based storage devices allows us to readily and conveniently transport files between sites. Mailing SCSI disks between sites seems unrealistic due to the reliability of the SCSI and our lack of them. A PC based media would provide us a reliable and more transportable backup to the magnetic tapes.

6. Maintainability. If data on the maintainability and upgradability of IBM compatible PC's vice that of our current equipment is needed, it will be provided.

7. Terminal Emulation. The current lab configuration utilizes out of date text terminals which display 80x24 characters. The 120 character mode is illegible. Many files exceed the 80 column display area and are difficult to work with. Replacing the current terminals with PC based monitors would not only provide acceptable user friendly displays, but when combined with file transfer capability, would also give multi-window editors (vice the current Encore line editor).

8. TSSA Documentation Efforts. With a file transfer capability, design documentation can be automatically generated in an already accepted format. This has been demonstrated on the F-14D already by generation of DBDD change pages. Generation of the 300+ pages was accomplished by downloading the needed files (< 2hrs) and then reformatting the document. The file transfer ability improves not only the speed at which documents can be generated, it also improves accuracy.

9. Log file generation. The PC can be used to capture screen data and also to build a log file, such as used during the on-site coldstart process. This is a useful function in documenting processes (captures not only output, but also the input commands) and in logging output that is echoed to the screen only.

10. Classified Work. PC's with removable hard disks could readily be used in the lab for classified efforts.

11. Contractor Documentation Review. Several documents (Classified appendix for the F-14B/A SDDD and the unclassified SDDD appendices for the F-14D) have already been delivered in media format. The PC's in the TSDF could also be utilized for the review efforts there.

APPENDIX K

CONFIGURATION MANAGEMENT SOFTWARE TOOL DATA SHEETS

TRUE software

October 24, 1996

Mr. Clark L. Morris
Dual Inc.
30 Skyline Inc.
Lake Mary, FL 32746
USA

Dear Mr. Morris :

Thank you for your interest in ADC/Pro™. True Software has brought a "natural approach" to version control and change management with its TRUEchange rapid team development solution that manages the implementation and roll-out of software changes.

ADC/Pro's TRUEchange rapid team development system helps software teams dramatically reduce the time it takes to respond to changing market conditions by enabling them to efficiently implement and roll-out changes to stay on top of ever accelerating release cycles. Unlike version control and configuration management tools that treat each change to a file as a separate delta, ADC/Pro groups related modifications across multiple files in a single logical unit: a change-set™. Developers can add or remove specific change-sets to software releases and variants, managing projects in the natural context of problem fixes and/or enhancements.

ADC/Pro is ideally suited for Information Technology departments who perform a high volume of software changes; who operate across Windows, Windows NT, Unix, and VMS platforms; who require a secure environment to protect their software assets; and who must synchronize work across teams, locations, releases, and customized application variants.

I am enclosing literature that will introduce you to the power of ADC/Pro. If, after looking over the enclosed literature you would like more detailed technical information about ADC/Pro, please feel free to call your account representative, Stephan Reckie, at (508) 369-7398 x226. You may want to check out our web site at www.truesoft.com! Thanks again for considering ADC/Pro for your software configuration management needs.

Sincerely,

Pat Bolis
Marketing Specialist

200 Baker Avenue, Suite 300, Concord, MA 01742 / Tel: 508-369-7398 / Fax: 508-369-8272 / e-mail: info@truesoft.com

TRUE software
The *logical* approach to software configuration management.

Change

If you develop software, you battle daily with change.

- Changing market demands.
- Changing technology.
- Changes to your products.

You can't hide from it, you can't stop it, you can't control it, but with True Software's Aide-de-Camp™/Pro SCM solution, you can finally manage change effectively.

As a sophisticated developer, you want more than file versioning and release support. You want to manage the logical changes required to meet shifting marketing and technical specifications. You need Aide-de-Camp/Pro, the logical approach to software configuration management.

Every other software configuration management (SCM) tool manipulates individual edits to individual files. Aide-de-Camp/Pro (ADC™/Pro) treats software changes the way experienced developers do: as logical change sets, each of which contains all the edits that implement the change. While you focus on the functional changes as a whole, ADC/Pro takes care of the details.

Shorter Time To Market With Team Development

With ADC/Pro, your teams can work concurrently on the same files and in parallel on multiple development paths. Code reuse, version configuration, and impact analysis promote high-quality code across multiple changes by multiple users - without maintenance headaches and version proliferation, which are as ubiquitous as change itself.

Smart Code Reuse for Lower Costs

With ADC/Pro's extraordinary software migration capabilities, you can reduce costs by making the most of existing code. ADC/Pro is the only SCM solution that empowers you to migrate a single logical change to any other version or product. You pick the change set, and ADC/Pro automatically integrates the correct code with the desired release. You also can merge multiple branches of development paths. ADC/Pro consolidates any number edits, across any number of files, within any number of change sets.

To keep costs down, however, you need to get it right the first time. As you merge and migrate software, ADC/Pro automatically detects conflicts. You resolve the conflicts simply by clicking on the desired variant or editing the target version in an easy-to-understand display.

You save precious days - or even weeks - traditionally wasted reworking changes across multiple development paths.

Ultimate Quality Control

ADC/Pro continuously enforces criteria for version configuration. You define each release up front. You and your colleagues develop and test software throughout the entire development phase in the context of the release - without the nightmare of mismatched software subsystems and unintentional, last-minute mix-ups.

ADC/Pro is the only SCM solution to support intelligent impact analysis. You can use any of ADC/Pro's language-specific scanners (for C, C++, COBOL, FORTRAN, or Ada), which dynamically capture the relationships and dependencies established by software structures within the source code. With this information, you can determine the impact of any change before you make it. ADC/Pro itself uses this information to ensure that releases contain all the required files.

Managing the SCM Process Your Way

You want a well-defined software development process that fosters productivity and quality. Some SCM tools leave process management up to the project leaders themselves. Other tools provide fixed rules that "transparently" control the SCM process. With ADC/Pro's customizable Process Manager, you can manage the development process your way.

The Process Manager manages all ADC/Pro operations per your preferences. It determines the steps of the software development process: file checkout and checkin, branching and merging, change migration, version definition, code freezes, and releases, etc. It also governs role-based user privileges, table-driven phases of development, definition of attributes and relationships, version naming conventions, and user notification of events via electronic mail. The Process Manager not only manages change; it accommodates it. You can put the Process Manager to use straight out of the box, taking advantage of the clear, predefined scripts. You also can modify the Process Manager or build entirely new scripts to meet company-specific requirements. You adjust the Process Manager to serve your needs today and well into the future.

A Match For Any Development Environment

You want an SCM solution that works in the same environment you do. ADC/Pro can handle whatever you can - including all your files, software tools, and networked platforms.

Whether you build procedural, functional, or object-oriented source code, ADC/Pro handles your source files, specifications, documentation, test plans, SQL programs, and even binary files. ADC/Pro manages the primary and ancillary files you need to fully define your product.

ADC/Pro even facilitates integration and customization of third-party software source code. The graphical load, impact analysis, merge, and conflict resolution tools automatically incorporate vendors' updates into your current version of their products while protecting the

local changes you have already made. You no longer have the headache of wading through all the changes, file by file. ADC/Pro is platform independent to run without modification in both homogeneous and heterogeneous environments and across distributed networks of UNIX®, VMS™, DOS® and Windows™ 95 and Windows NT systems. ADC/Pro clients everywhere on the network use the same commands and procedures to access ADC/Pro servers running on any supported operating system. Your users can sit at any workstation or PC on the network without compromise.

Working With the Experts

You want to work with the experts. True Software consultants offer you an average of ten years of SCM experience. Our services staff is available before you select an SCM product, to help define your SCM needs. After you install ADC/Pro, our professionals can jump-start your SCM process. As you continue to work with ADC/Pro, we can maximize the benefits of the only change management solution available in the SCM marketplace.

ADC/Pro Helps You Manage Change

Logical change management vs. arbitrary file management

- Intelligent repository
- Patent-pending change set technology
- Customizable Process Manager
- Change-set-based version configuration

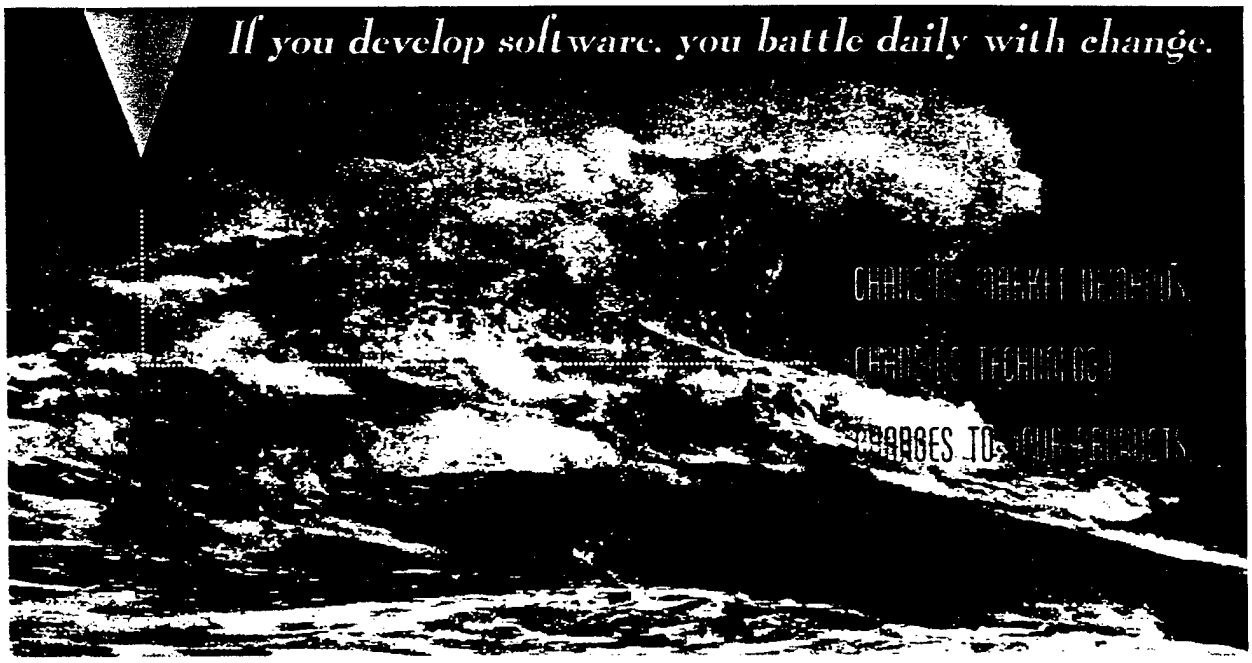
Faster programming

- Concurrent development
- Parallel development
- Version merging
- Migratable change sets

Cleaner code

- Conflict detection and resolution
- Impact analysis
- Tracking and management tools
- Flexible, productive development environment
- Platform-independent development scripts and user interface
- Distributed code management
- Customizable graphical interface
- Accessible command-line interface
- Support for all source code and other text files, extended by language-specific scanners for code written in C, C++, COBOL, FORTRAN, and Ada

CHANGE.



YOU CAN'T HIDE FROM IT,

YOU CAN'T STOP IT,

YOU CAN'T CONTROL IT, BUT...

WITH AIDE-DE-CAMP/PRO SCM SOLUTION, YOU CAN FINALLY MANAGE CHANGE EFFECTIVELY.

TRUE **software**

The *logical* approach to software configuration management.

As a sophisticated developer, you want more than file versioning and release management. You want to manage the logical changes required to meet shifting marketing and technical specifications. You need Aide-de-Camp™/Pro, the logical approach to software configuration management.

Every other software configuration management (SCM) tool manipulates individual edits to individual files. Aide-de-Camp/Pro (ADC™/Pro) treats software changes the way experienced developers do: as logical change sets, each of which contains all the edits that implement the change. While you focus on the functional change as a whole, ADC/Pro takes care of the details.

SHORTER TIME TO MARKET WITH TEAM DEVELOPMENT

With ADC/Pro, your teams can work concurrently on the same files and in parallel on multiple development paths. Code reuse, version configuration, and impact analysis promote faster development of high-quality code across multiple changes by multiple users – without maintenance headaches and version proliferation, which are as ubiquitous as change itself.

SMART CODE REUSE FOR LOWER COSTS

With ADC/Pro's extraordinary change migration capabilities, you can reduce costs by making the most of existing code. ADC/Pro is the only SCM solution that empowers you to migrate a single logical change to any other version or product. You pick the change set, and ADC/Pro automatically integrates the correct code with the desired release. You also can merge multiple branches of development paths. ADC/Pro consolidates any number of edits, across any number of files, within any number of change sets.

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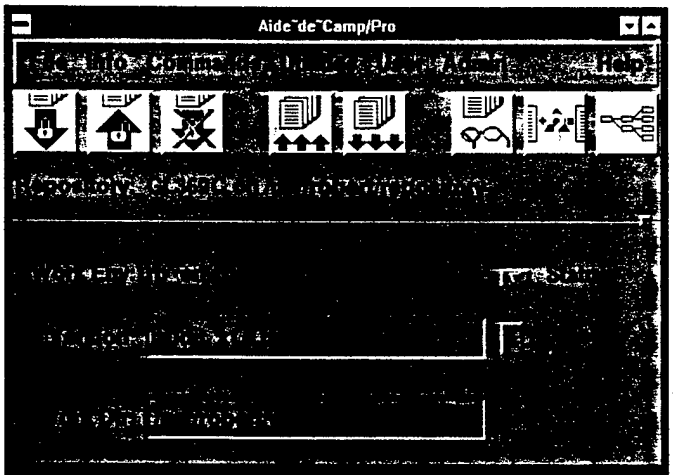

The graphical user interface provides a rich and functional means to take advantage of ADC/Pro functions.

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Today's engineering manager copes with virtually unmanageable complexity while delivering more in less time. Something that you can't avoid – *change* – further confounds this paradoxical dilemma. Complexity and change run rampant in the world of engineering:

- Technology advances in hardware, software, and communications
- Evolving software development tools and techniques
- Increasingly large software systems
- Fluctuating customer requirements
- Ever-rising expectations for better quality and performance at a lower cost
- Rapidly diminishing time-to-market opportunity

This shifting environment stumps even the most diligent efforts to produce high quality software on time. In fact, the result is often poor quality and lower productivity.

The problem of change escalates exponentially when organizations implement a team engineering environment or require teams to work in concert on a suite of products. Their problems do not lie in managing the work of individual developers but in coordinating the work of multiple team members at different locations across many projects. These organizations face critical obstacles to growth and excellence.

To handle the vagaries of *change*, intelligent software engineers are turning to software configuration management (SCM) solutions. At True Software™, we understand that software developers have to *manage* change in a manner that actually *accommodates* it. We help engineers solve the problems of today with SCM solutions that embrace the inevitable changes of tomorrow.

TRUE software

The *logical* approach to software configuration management.

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WORKING WITH THE EXPERTS

You want to work with the experts. True Software consultants offer you an average of ten years of SCM experience. Our services staff is available before you select an SCM product, to help define your SCM needs. After you install ADC/Pro, our professionals can jump-start your SCM process. As you continue to work with ADC/Pro, we can maximize the benefits of the only change management solution available in the SCM marketplace.

ADC/PRO HELPS YOU MANAGE CHANGE:

LOGICAL CHANGE MANAGEMENT VS. ARBITRARY FILE MANAGEMENT

- Intelligent repository
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- Customizable Process Manager
- Change-set-based version configuration

FASTER PROGRAMMING

- Concurrent development
- Parallel development
- Version merging
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CLEANER CODE

- Conflict detection and resolution
- Impact analysis
- Tracking and management tools

FLEXIBLE, PRODUCTIVE DEVELOPMENT ENVIRONMENT

- Platform-independent development scripts and user interface
- Distributed code management
- Customizable graphical interface
- Accessible command-line interface
- Support for all source code and other text files, extended by language-specific scanners for code written in C, C++, COBOL, FORTRAN, and Ada

WITH

AIDE-DE-CAMP/PRO

SCM SOLUTION,

YOU CAN FINALLY

MANAGE CHANGE

EFFECTIVELY.

- ❑ I want more information about Aide-de-Camp/Pro.
- ❑ I want more information about True Software's professional services.
- ❑ I want a True Software sales representative to call me.

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Organization _____

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State/Province _____

Zip/Postal code _____

Country _____

Phone _____

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E-mail _____

TRUE SOFTWARE: THE LOGICAL APPROACH TO SOFTWARE CONFIGURATION MANAGEMENT

True Software Inc. offers logical software configuration management (SCM) solutions to companies that recognize they need more than file versioning and release management. We have established a reliable reputation worldwide delivering software and services that shorten time to market, reduce costs, and improve quality.

We have been consulting in software configuration management for over ten years. We have evolved ADC/Pro from an adjunct to consultation into a flagship product. As software developers ourselves, we take advantage of ADC/Pro to produce high-quality leading-edge software within the ever-changing, technology-driven environment.

True Software customers are experienced software development organizations [illegible] selected ADC/Pro [illegible] both accommodates and [illegible] their unique [illegible] development processes [illegible] sophisticated [illegible] remain loyal to the ADC/Pro solution [illegible] logical choice for their business and technical needs.

Founded in 1981 as Software Maintenance and [illegible] Systems, Inc., in 199[illegible] the company changed its name to True Software Inc.

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TRUE software

The *logical* approach to software configuration management

SUCCESSES

AlliedSignal Engines

AlliedSignal Engines, a Division of AlliedSignal, Inc., of Phoenix, Arizona, is the world's largest supplier of engines and auxiliary power units for the aviation industry. The company manufactures many of the engines that run in today's private and commuter-type aircraft. The company also produces virtually all of the auxiliary power units that provide electricity to commercial jets while they are on the ground. As part of this effort, the division develops software that helps AlliedSignal engineers design products and allows customers to test AlliedSignal engines within the aircraft they are building.

The AlliedSignal Engines software group concurrently supports over 1,500 versions of their software that run on 33 operating systems and 93 hardware platforms. "With every engine, we ship a customer deck — a set of software programs that help our customers evaluate engine performance within their aircraft," explains David Stoklas, Senior Systems Programmer in charge of software configuration management (SCM). "Each software deck is complex, often consisting of over 750 lines of code. We tailor each deck to the particular computer platforms and aircraft engine configurations at each customer site. Because no customer receives every module or subroutine, there can be as many as 25 layers of if-then statements just to decide what code to compile."

AlliedSignal Engines also faces the transitions associated with ever-changing technology. They recognized the need to migrate from their mainframes to a client/server environment for more flexibility, lower costs, and increased performance at the hands of the developers and designers. The department was moving their software development from two Control Data Corp. mainframes to a configuration of

Concludes Stoklas:

"We needed an SCM engine that was up to the challenge."

Hewlett-Packard's HP 715-50 and HP 715-100 workstations networked to three HP G70 servers, including a Model 800 with dual Model 700 CPUs. While the HP systems run HP/UX, several SPARC workstations run Solaris, and DEC VAX workstations, which drive engine performance analysis on the production floor, run ULTRIX. In all, over 400 workstations run on the network.

Concludes Stoklas: "We needed an SCM engine that was up to the challenge."

AlliedSignal Engines installed Aide-de-Camp™ (ADC™) in February of 1994. "We chose Aide-de-Camp because it was extremely flexible and easy to adapt to our situation," Stoklas recounts.

"We chose ADC because it was the only one that can handle the kind of thing we need to feed it."

"Too many code maintenance environments make the assumption that you're a C programmer working in a university environment; they only do little, short things like quick tests and compiles — fun and games. The custom code we write involves complex algorithms employing advanced physics and thermodynamic parametric equations."

"Some of these programs are so long that an IBM 3090 mainframe FORTRAN compiler can't handle them. While other tools would go belly up and die, ADC can digest 200-thousand-line FORTRAN programs with no problem. We chose ADC because it was the only one that can handle the kind of thing we need to feed it." Stoklas' group came up to speed quickly and found ADC easy to use. Within six months, the group had already loaded in over three million lines of code. The organization took advantage of ADC's multiplatform support and its adaptability to different environments. Stoklas says, "ADC is platform independent, meaning we can use one database for all our development, and all the commands work the same way everywhere on the network."

AlliedSignal uses an internal SCM process called DUCK — short for Darn Ugly Code Killer — to track each piece of code in terms of its function, platform, operating system, and product. ADC now manages the AlliedSignal SCM process — per DUCK specifications. To accomplish this, ADC handles changes in terms of their logical functions.

"Your configuration management system can be a lifeline, when everything around you is changing." reports Stoklas. "We would be in deep trouble without ADC."

While most SCM systems only track edits to physical files, ADC uses change sets to manage all the edits that implement a single logical change, such as an engine test modification. Change sets allow AlliedSignal Engines to identify each software component or change by function. Change sets underlie AlliedSignal's ability to do the logical labeling and packing necessary to make sure that everything ends up where it is supposed to.

ADC also accommodates the need for security. AlliedSignal maintains separate ADC repositories to guarantee the split between government and civilian code. The company can build the software decks with confidence and then ship them in machine-readable format to protect the proprietary algorithms and data used internally to build the engines.

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TRUE software

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PRODUCTS

PROCESS MANAGER

Achieve any current or evolving SCM process to suit your organizational preferences

The Aide-de-Camp™/Pro environment includes a fully defined Process Manager that allows you to manage your software development process exactly the way you want. You can employ the customizable Process Manager right out of the box to carry out any current or evolving SCM process.

The Aide-de-Camp (ADC™)/Pro Process Manager guides you through the steps of software configuration, invoking ADC/Pro routines so that you maintain complete control. The Process Manager consists entirely of easily edited scripts — collections of ADC/Pro commands that define and govern user access privileges, naming conventions, preferred phases of development, and available attributes and relationships. The Process Manager scripts also regulate all ADC/Pro operations, including checkin and checkout, migration and merging, and reference-area updates.

Governing Daily Operations

The Process Manager actually underlies all ADC/Pro operations, automating and controlling how you and your colleagues work with the software. The Process Manager is powerful enough to perform a series of operations based on users' actions. For example, whenever a developer checks in a change set, ADC/Pro can place the changes in a holding directory and inform you, the project leader, that the files are ready. You can promote the changes when you have reviewed and approved them.

True Team Development

The Process Manager not only supports team engineering — it encourages it. The Process Manager is ideal for teams that work in parallel on multiple versions of the same set of source code; ADC/Pro is the only SCM solution that makes it easy to merge changes from one branch to another and to selectively migrate changes from one version to another. The Process Manager also can prevent or support concurrent development by either prohibiting simultaneous checkout or by facilitating fast, painless, safe coordination of simultaneous changes.

TRUE software

You want a well defined software development process that fosters productivity and quality. Some SCM tools implement expensive workflow models that rely on existing file-versioning mechanics. Others address only a limited area of the SCM process, such as build management. Only ADC's customizable Process Manager empowers you to manage true team development — exactly the way you want — with ease and reliability.

Totally Configurable Security

As a security tool, the Process Manager offers a logical, flexible way to manage access privileges, based on user types and the commands that they may invoke. Table-driven scripts and associated attributes make it easy to add user types and tailor their names and definitions. You can assign user-type privileges to team members on a project-by-project basis.

Accommodating Your Organization's Phases of Development

The ADC/Pro Process Manager provides the framework for any number of development phases. By editing the Process Manager script tables, you can set up the phases to match your software development process. You can add, skip, or rename phases, as desired.

Automated Version Naming for Easy File Management

The ADC/Pro Process Manager administers version naming conventions for easy file management. Based on these conventions, ADC/Pro names new versions to capture internal milestones, phases of development, and branches. This history-controlled process is flexible enough to handle any project and release naming preferences, while promoting a clean file structure.

Controllable Tracking Criteria

ADC/Pro's power lies in its unique ability to recognize code based on attributes and relationships. You can populate and maintain the tables of allowable attributes and relationships to structure how your teams apply these logical characteristics. This feature of ADC/Pro maximizes consistency and avoids problems associated with the proliferation of tracking criteria.

Unlimited Flexibility — Ultimate Utility

The Process Manager can meet your every requirement. You can modify the Process Manager scripts by editing internal tables, or you can build entirely new scripts, as desired. To accomplish advanced modifications more quickly and confidently, take advantage of True Software's training programs or Engineering & Consulting Services support.

Like all of ADC/Pro, the Process Manager is platform independent, so your scripts are highly portable; the same interface will run without modification in any supported environment to ensure smooth operation across heterogeneous hardware and operating systems.

projectname_optional-branch_v1.2.3

You define the naming conventions that ADC/Pro automatically applies to new versions. When you move a version to the next phase, ADC/Pro automatically changes the character in the version name (the v in the default naming convention above) that specifies the phase. Moreover, if you merge two branches of a version — x1.2.3 and custom_x1.2.1 — into a single development path, ADC/Pro supplies two possible names — x.1.2.4 and custom_x1.2.2 — and allows you to select the name you prefer.

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SERVICES

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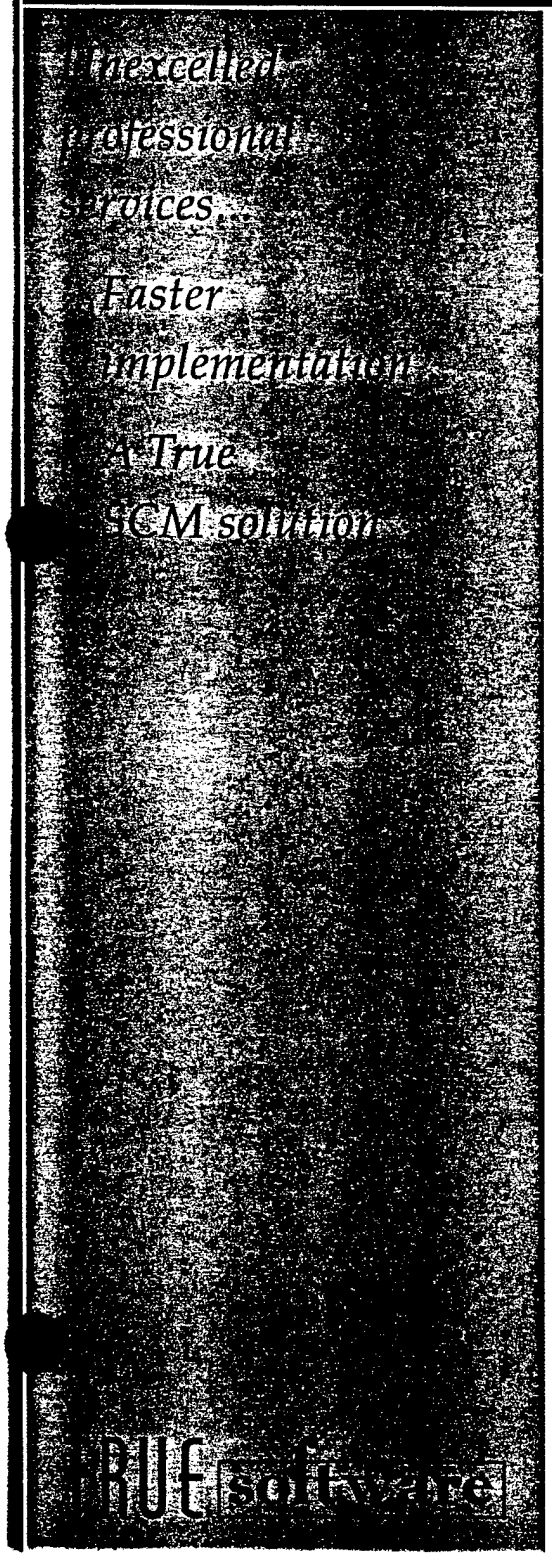

Sophisticated software engineers recognize that true software configuration management (SCM) requires more than a new tool — that it must resolve methods of coordination between everyone on the project team. Experienced developers want more than a tracking application — they want fast implementation of a complete SCM solution. They demand unexcelled professional services to support this implementation.

True Software™ Professional Services give you direct access to a wealth of knowledge in Aide-de-Camp™/Pro, SCM theory and practice, industry-specific applications, and software development. By combining True Software Professional Services with Aide-de-Camp(ADC™)/Pro, you achieve an even faster, smoother implementation than you could on your own. As a result, you will see an immediate improvement in team management, product quality, delivery times, and cost savings.

True Software Professional Services deliver more than piece-meal products; we offer a suite of flexible, coordinated services. Our team of technical support, training, and engineering & consulting services work in concert to ensure that you profit from a total SCM solution. Choose from this suite of professional services to launch a tailored support program that will meet your specific implementation requirements and timetable.

True Software Engineering & Consulting Services

When you elect to implement True Software strategic solutions, you are committing to improve your current software development process. Our engineers immediately apply the strengths of True Software products to your development environment. They serve as teachers and mentors, giving your staff easy access to targeted support and advanced techniques. Engineering & Consulting Services include a wide range of options.

The ***Jump-Start Program*** is the best way to get your organization up and running with ADC/Pro. A dedicated True Software consul-

tant works with you to establish and document system and SCM operations, the roll-out process, and longer-term plans. The *Jump-Start Program* will prove invaluable as you realize the benefits of our SCM technology immediately after purchasing ADC/Pro.

Companies that are considering — or committed to — the transition to ADC/Pro can take advantage of ***Planning for Migration to Aide-de-Camp/Pro***. As part of this program, a True Software consultant synthesizes extensive knowledge of best SCM practices and ADC/Pro, along with research into your company's existing software development processes. The resulting migration plan provides comprehensive documentation that will enable you to efficiently migrate to an ADC/Pro environment.

Whether or not you have selected ADC/Pro as your SCM solution, you can benefit from True Software's ***Building a Software Development Process*** program. Through in-depth interviews with engineers, project leaders, and managers, an SCM-savvy consultant will formulate and refine a tailored software development process. You will receive a software standards manual delineating every aspect of the software development process that will best fit your organization. An option to this program includes on-site implementation of the documented SCM process.

For organizations that already have an SCM process in place, True Software's ***Assessing your SCM Process*** will evaluate its effectiveness. The resulting manuscript highlights existing strengths, identifies weak areas, recommends improvements, and offers new solutions.

True Software consultants can tailor ADC/Pro to meet the needs of any SCM process with the ***Customizing Aide-de-Camp/Pro*** program. They can also work with your organization to integrate ADC/Pro with your existing development environment, including other software tools.

True Software Training

True Software Professional Services offer dedicated training for every ADC/Pro user, including developers, project leaders, and SCM/system administrators. While standard courses provide a cost-effective means to build success into an organization's SCM system implementation, on-site courses offer customized training around any required focus. We have designed our training courses so that any organization can apply ADC/Pro quickly and easily, deriving the benefits of the only object-based SCM solution available today.

True Software Technical Support

As a True Software Technical Support customer, you benefit directly from future releases, documentation updates, and telephone access to ADC/Pro technical advice and problem resolution. With ADC/Pro and SCM expertise at your fingertips, you can make the most efficient use of ADC/Pro — to achieve an SCM solution that truly delivers.

Working With the Experts

No matter what True Software Professional Services you choose, you can count on working with full-time, dedicated experts who truly understand software development, the ADC/Pro line, and your need for a complete SCM solution that will satisfy the most demanding requirements for excellence.

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TECHNOLOGIES

CHANGE SETS

ARE YOU DELUGED WITH THE BUREAUCRACY OF TRACKING DOWN LOST FILES AND OBSCURE DELTAS?

DO HOURS OF UNRECOVERABLE TIME WASH AWAY AS YOU TRY TO UNDERSTAND THE PURPOSE OR SOURCE OF A PARTICULAR CHANGE?

HOW OFTEN ARE YOUR OWN BRILLIANT TRAINS OF THOUGHT DROWNED OUT BY THE TEDIOUS MECHANICS OF VERSIONING?

NOW, WITH TRUE SOFTWARE™'S AIDE-DE-CAMP™/PRO, YOU CAN TAKE THE LOGICAL APPROACH TO SOFTWARE CONFIGURATION MANAGEMENT. AIDE-DE-CAMP (ADC™)/PRO CHANGE SETS GIVES YOU A CRYSTAL-CLEAR PERSPECTIVE ON CHANGE WITHIN YOUR SOFTWARE, ALLOWING YOU TO MANAGE, TRACK, AND CONTROL THE ENTIRE SOFTWARE DEVELOPMENT PROCESS. START RELYING ON THE INTELLIGENCE OF ADC/PRO CHANGE SETS AND SAIL THROUGH THE COMPLEXITIES OF MANAGING CHANGE.

The Power of Change Set Technology Comes to Light

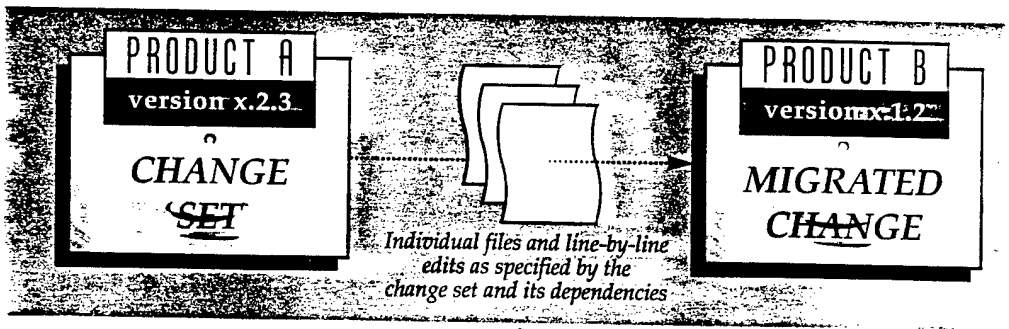
ADC/Pro is the only software configuration management (SCM) solution to support change sets. Our patent-pending, object-based change set technology allows you to focus on the functional changes required to meet ever-shifting market and technical requirements.

Change sets work the way you do. Each change set embodies a particular new function or feature. Before you begin working with your files, you designate the purpose of the task at hand: perhaps a bug fix or an enhancement or a new feature. As you check out files and make edits, ADC/Pro captures every one of your modifications, across any number of files, as part of the single change set.

Change sets accommodate more than individual edits. They capture and maintain a wealth of information about your software system. This information gives you an easy, reliable way to audit changes, versions, and releases.

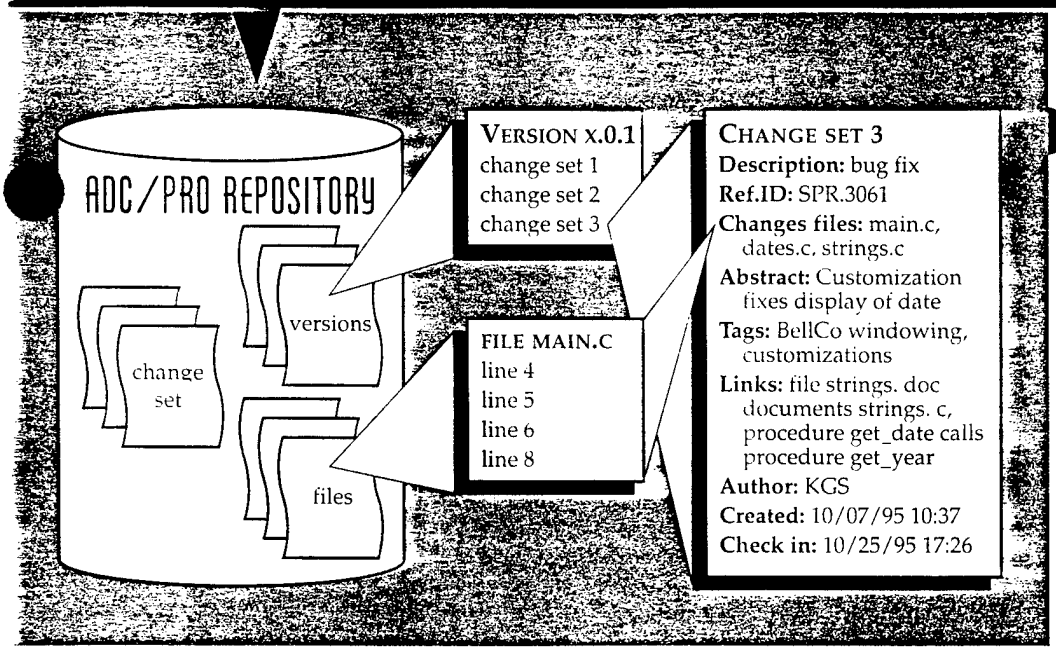
ADC/Pro change sets give you access to any previous state of your software. When you select a version, ADC/Pro brings up the files as they existed based on the definitions of the change sets within that version. You can query any line of code to ascertain the change set that implements the code, including the author and reason for the change.

Change sets also guarantee a clear audit trail of every change made by every developer on the project.



Aide-de-Camp/Pro is the only SCM solution to support true change migration.

TRUE software



The ADC/Pro repository contains versions, change sets, and files. Each ***version*** *identifies the change sets that implement its functions. Each* ***change set*** *identifies the purpose of the change, the files it affects, and any user- and software-specified attributes. Each* ***file*** *contains all the edits ever made over the life of the file. ADC/Pro displays (and activates) or hides (precludes) each line, depending on the change sets that are in effect.*

Teams can work in parallel on multiple branches, can implement concurrent development practices, and can make major revisions — all without fear of burning bridges behind them.

Change sets are to software configuration management what relational databases were to file-based databases.

ADC/Pro change set technology gives you the power to manage complex parallel development — with unparalleled ease. Only with Aide-de-Camp/Pro, can teams effortlessly:

- Merge two separate develop branches into one
- Migrate designated changes from one version to another
- Selectively back out particular bug fixes or features

ADC/Pro is the only SCM solution to illuminate your development path with a simple, logical approach to incorporating or excluding specific functional changes.

The Sky's the Limit...

As an experienced developer, you know that other SCM tools limit you with mere file and version administration. They leave you inundated with the complexities of file and delta tracking. Set your sights on ADC/Pro's logical change set technology. With ADC/Pro, the sky's the limit.

True Software Inc.
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TRUE software

The *logical* approach to software configuration management.

TECHNOLOGIES

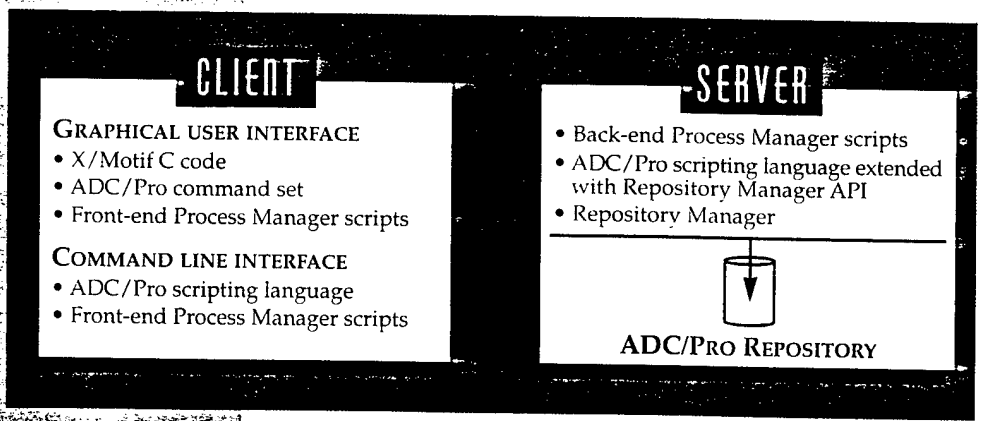
ARCHITECTURE

Logical software configuration management for the sophisticated developer

Aide-de-Camp™/Pro gives software engineers an intuitive way to manage change. More than a tracking tool, Aide-de-Camp (ADC™)/Pro delivers a client/server architecture that allows you to control, track, and understand the software development changes you deal with every day.

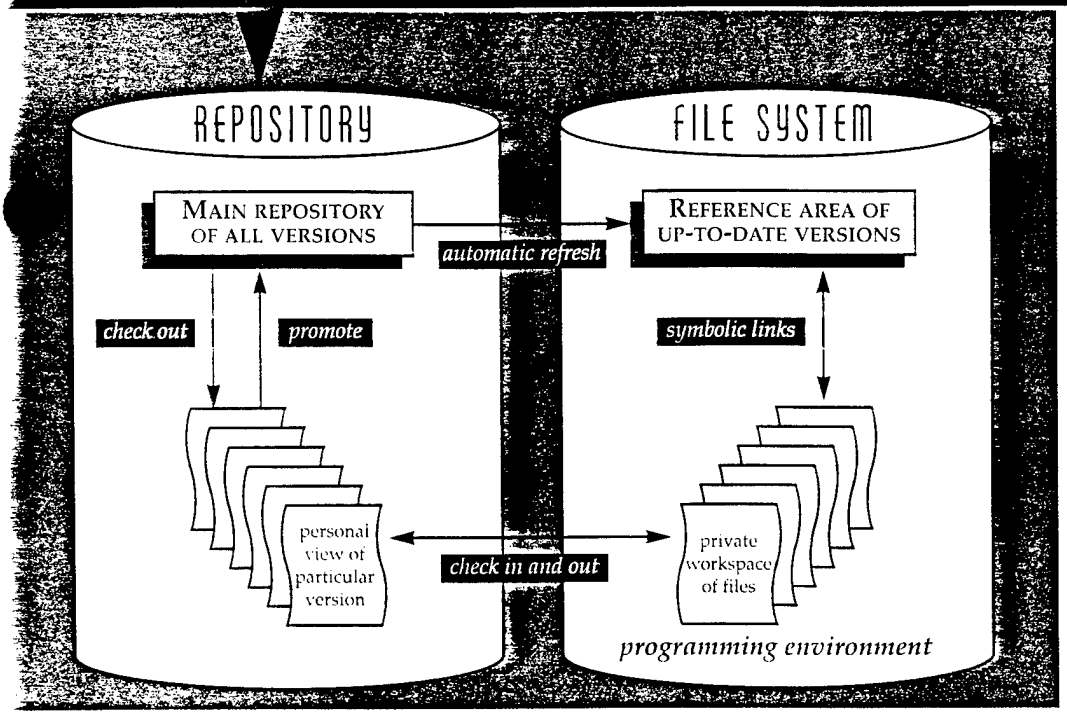
ADC/Pro captures the underlying purpose and function of each code change using patent-pending, object-based change sets. Each change set includes the physical changes across multiple files plus the logical characteristics of the changes: their purpose, their relationships to other code, their attributes, and even their details (author, time stamps, etc.). ADC/Pro change sets empower you to define, track, and control changes with ease; you can even migrate specific changes from one branch of software to any other.

ADC/Pro takes advantage of client/server technologies that enable you to work in the context of platform-independent, heterogeneous development networks. The ADC/Pro environment offers intelligent repository and workspace management, a predefined Process Manager, and a comprehensive client-based user interface, all of which are customizable to suit your particular software development process.



The client/server architecture of ADC/Pro allows users anywhere on the network to take advantage of ADC/Pro repository and workspace management, the Process Manager, and the graphical and command-line interfaces.

TRUE software



Guaranteed version integrity and easier release builds.

Guaranteed Integrity: Repository and Workspace Management

ADC/Pro intelligently manages the repository, reference area, and private workspaces to ensure that you work on the correct files as they operate within the correct state of the software project as a whole.

The object-based ADC/Pro repository particularly suits incremental software development. Each repository holds all the development work pertaining to a particular software system — for example, a window manager, data converter, or communication module. Each repository manages the changing versions of the software system while optimizing storage security and space. Each repository contains:

- All the change sets made to the system, each of which includes the names of the files that were edited to implement the change, plus any number of logical characteristics
- A single copy of every file in the software system, each of which contains all the changes made to the file over the life of the system
- All the versions of the system, each of which identifies its parent version and its change sets

ADC/Pro generates and manages private user workspaces and a reference area — outside the repository in the file system — that mirror the versions of the software systems in the repository. When you work on a particular version of a software system, ADC/Pro automatically presents the version as a whole — including its files, attributes, and relationships — in the correct state for that version. You have instant access to the most up-to-date status of the software system for any version in the repository.

Tailored Control: The ADC/Pro Process Manager

The ADC/Pro environment includes a fully defined, customizable Process Manager that gives your organization the power to manage your software development process exactly the way you want. As you work with source code and other files, the Process Manager guides you. The Process Manager regulates all ADC/Pro operations, including checkin and checkout, migration and merging, and reference-area updates.

Ease of Use: Graphical and Command-Line Interfaces

With ADC/Pro, all members of your project team can work the way they like. While the graphical user interface simplifies the most challenging ADC/Pro functions — including change migration, merging, and conflict resolution — the command-line interface places even the most arcane ADC/Pro functions in the hands of your power users. Both user interfaces are platform independent; they run identically, regardless of the underlying operating system.

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TRUE software

The *logical* approach to software configuration management.

Aide-de-Camp/Pro

Reviewed by William Wimberly of Cost Care Inc., Newport Beach, Calif.

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TRUE software

PLATFORMS: Cost Care is using Aide-de-Camp/Pro (ADC/Pro) on Digital/Open VMS and Digital/UNIX platforms.

FUNCTIONALITY: Cost Care purchased ADC/Pro as a part of its overall Software Quality Assurance efforts. At Cost Care, the goal was twofold: to focus on improving software quality for our legacy applications and to manage the next generation client/server application development. ADC/Pro's ability to do dependency linking, its support of concurrent development, and its powerful merge and migration capabilities were critical components in Cost Care's selection process.

As Cost Care had no formal configuration management process in place, ADC/Pro's "out-of-the-box" Process Manager represented a good starting point that will be adapted to Cost Care's environment over time. ADC/Pro is a configuration management system for all programming languages, extended by language-specific scanners for C, C++, COBOL, FORTRAN and Ada code; the COBOL scanner, and the ability to customize it, was of particular importance to Cost Care.

STRENGTHS: ACD/PRO's ability to migrate discrete changes gives it unprecedented capabilities to support team development and fully integrated change management. Cost Care developers can manage projects on multiple platforms, establish baselines, identify all the changes that implement a particular feature or bug fix, migrate discrete changes from different development paths, detect physical conflict, and retrieve and build any version of the software.

ADC/Pro's flexible development environment and its ability to manage change logically are key strengths, as is its customizability. And True Software's excellent support—both pre- and post-sale—is a real strength.

WEAKNESSES: While ADC/Pro supports a wide variety of platforms, it would benefit from support of Windows 3.1, Windows 95 and Windows NT, which is forthcoming in 1996.

PRODUCT CHARACTERISTICS: Cost Care is realizing its greatest benefit through automatic dependency linking and automation of the merge/migration process. The system administrator—with no prior software configuration management experience and limited experience with the Digital operating systems environments—was able to get ADC/Pro up and running, evaluate it, and put it into a production environment in just a few months.

SELECTION CRITERIA: Cost Care had several key requirements. The first was cross-platform support of both the Open VMS and UNIX environments. ADC/Pro does this seamlessly. The second, because of Cost Care's development environment, was the ability to perform change migration—to migrate discrete changes both forward and backward among versions and releases. ADC/Pro's migration capability is unique in the industry. ADC/Pro's Process Manager allowed Cost Care to get started with a process immediately, but gives us the flexibility to modify the process as we move forward. Finally, our trust in True Software's support and communications was a very critical piece of the selection decision.

VENDOR SUPPORT: One word sums it up—outstanding! True Software provides customers with a full suite of professional services including consulting, integration services, and a complete training curriculum, as well as hot line and on-site support. True Software was very responsive—both on the phone and on site—to any problems or questions we had during the evaluation process during and after implementation. The expertise of their people is first-rate, as is their level of support and their commitment.

TRUE SOFTWARE: THE LOGICAL APPROACH TO SOFTWARE CONFIGURATION MANAGEMENT

True Software Inc. offers logical software configuration management (SCM) solutions to companies that recognize they need more than file versioning and release management. We have established a reliable reputation worldwide, delivering software and services that shorten time to market, reduce costs, and improve quality.

We have been consulting in software configuration management for over ten years. We have evolved ADC/Pro from an adjunct to consultation into a flagship product. As software developers ourselves, we take advantage of ADC/Pro to produce high-quality, leading edge software within an ever-changing, technology-driven environment.

True Software customers are experienced software development organizations who have selected ADC/Pro because it both accommodates and accelerates their unique software development processes. These sophisticated customers remain loyal to the ACD/Pro solution because it is the logical choice for their business and technical needs.

Founded in 1981 as Software Maintenance and Development Systems, Inc., in 1995 the company changed its name to True Software Inc.

HEADQUARTERS

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Norway
The Netherlands
United Kingdom

TRUE software

The *logical* approach to software configuration management.

P L A T I N U M

CCC/Harvest

THE ENTERPRISE-WIDE CHANGE AND CONFIGURATION MANAGEMENT SOLUTION FOR CLIENT/SERVER ENVIRONMENTS

PLATINUM TECHNOLOGY

The Open Enterprise Management Company

Manage Software Changes and the Application Development Process

When building large, distributed application systems, the ability of your staff to track and manage change during the development lifecycle can mean the difference between a successful project and pandemonium. Today's development teams often work from heterogeneous platforms at remote locations, and simultaneously make changes to a multitude of interrelated software modules and system documentation.

The only way to effectively keep track of this kind of complex activity is with a comprehensive, repository-based change and configuration management (CM) solution. Relying on manual methods or unsophisticated file control systems just doesn't allow you to meet the challenges of enterprise-wide application development.

PLATINUM CCC/Harvest enables you to synchronize development activities across heterogeneous platforms, throughout your enterprise, during the entire A/D lifecycle. CCC/Harvest can scale up to serve project teams working on your largest enterprise systems or scale down to meet the needs of your smallest teams. There's no need to expend additional resources mixing and matching tools and then training developers to use a hodgepodge of platform-dependent CM tools—CCC/Harvest provides a single, enterprise-wide CM solution.

Keep Your Production Applications Operational with Automated Change Migration

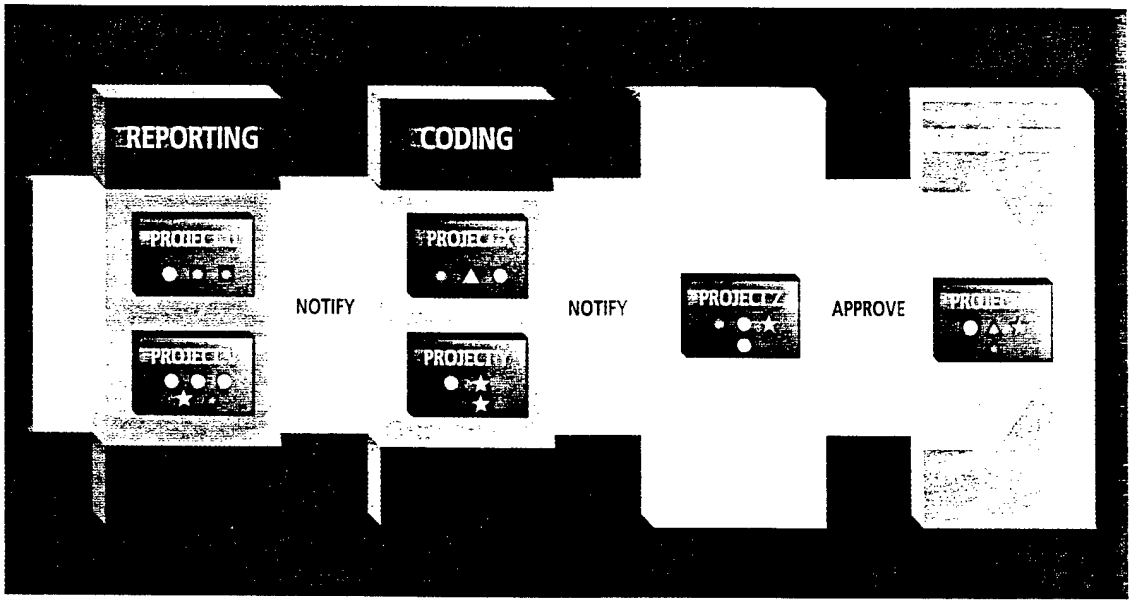
Production-oriented development environments are geared toward keeping existing applications operational. Typically, there is a constant flow of "small" changes to the production version. Changes are continually incorporated as they are completed, so that new features and new information can be made available to users. CCC/Harvest provides a centralized management point for streamlining and coordinating software change processes throughout your distributed environment. It tracks and "packages" application components in practically any format, including source, binaries, bitmaps, documents, and more. These components can all be logically centralized and controlled, regardless of their origin.

By automating the introduction of changes and then streamlining their migration into production, CCC/Harvest prevents your production application from being contaminated with undesired changes. As a result, CCC/Harvest eliminates development crises and ensures a smooth transition between development lifecycle stages.

Automate the Application Development Process

Traditional CM tools make assumptions about how your organization works. They force you into using a proprietary methodology, and require programming resources for any modification. With CCC/Harvest, you can continue to do business the way you're accustomed to doing it. CCC/Harvest enables you to create or modify a model of your own development processes through simple point-and-click operations. It then uses your model to keep software changes under control, development schedules on track, and everyone up to date. By automating the workflow, many of the routine tasks of application development are also automated, including notifications, approvals, and migrations of changes from one stage to another.

CCC/Harvest ensures that only approved changes, and all necessary components are migrated into production. Changes are grouped by "package," providing excellent visibility and control. In this example, test staff see only those changes associated with packages that have been promoted into the test state.



Stay in Sync with Automated Support for Concurrent Development

CCC/Harvest provides you with the option to select concurrent development for a project through a simple setup procedure. If you choose concurrent development, you are assured that one developer cannot overwrite another developer's changes. CCC/Harvest automatically isolates changes into separate sets. Participating developers can be automatically notified whenever concurrent development takes place, and reports can be easily generated to show what changed, why the changes were made, who made them, and when. Combining the changes of all concurrent developers is simplified by the integrated merge facility, which enables you to view and resolve any conflicts among versions.

Manage In-house Changes to Vendor Code

CCC/Harvest enables you to do in-house modifications to third-party software, and retrofit those changes seamlessly into subsequent releases from the vendor. Differences between vendor and in-house releases are easily determined and maintained without physical duplication. Changes go into production only as they are certified, and the original release is never lost.

Manage Parallel Development Activities

If you need to maintain multiple releases of the same application, CCC/Harvest provides you with the tools you need to manage parallel development. For example, you can easily create an "environment" for emergency maintenance, and keep those changes separate from any ongoing changes made in another release. The integrated merge facility enables you to automate the merging of some or all of those changes into a subsequent development process, eliminating labor-intensive manual merges. Both short and long-term projects can be developed simultaneously without inadvertently affecting one another.

Customize CCC/Harvest to Meet Your Needs

CCC/Harvest can easily adapt to your company's standards, requirements, and procedures. Its solutions-oriented structure addresses the most common requirements of development organizations today. CCC/Harvest provides an open architecture and customization options that enable you to completely tailor your CM solutions. The Forms Customization Package (FCP) enables you to modify the problem tracking features of CCC/Harvest. The Software Integration Kit (SIK) enables you to integrate your software development environment (construction tools, including Visual Basic and PowerBuilder, testing tools, other methodologies, help desk, etc.) into CCC/Harvest.

Benefit from Comprehensive Configuration Management

- Version control
- Release management
- Concurrent and parallel development support
- Interactive merge
- Reusable component management
- Emergency maintenance management
- Vendor code management

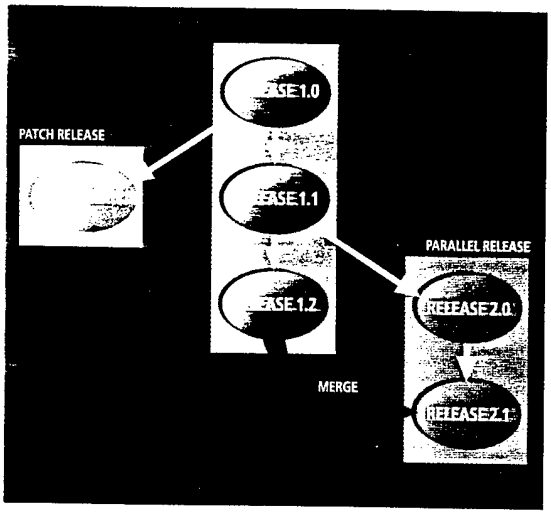
Automate Software Processes

- Flexible lifecycle modeling
- Project status information
- Automatic notification
- Online approvals
- Automatic change migration
- Process metric reports

Track Problems

- User-definable forms
- Problem forms linked to actual changes

Combining changes from concurrent or parallel development is simplified by using the integrated merge facility in CCC/Harvest.



Manage Change in Client/Server Environments

- Consistent interface on a wide range of platforms
- Central management point
- Support for distributed development
- Platform-independent security
- Open architecture

Gain End-to-End Change Management Support

CCC/Harvest works seamlessly with other tools in your environment, such as PLATINUM Process Continuum (methods-driven process and project management suite), PLATINUM Apriori (comprehensive help desk solutions), PLATINUM AutoXfer (electronic software distribution), and most third-party tools. Together, CCC/Harvest, Apriori, and AutoXfer comprise an end-to-end change management suite that supports software development, from initial request to deployment.

Receive Professional Services and Support Every Step of the Way

At PLATINUM, we are committed to providing professional consulting services and support to help you before, during, and after implementation of all your PLATINUM products.

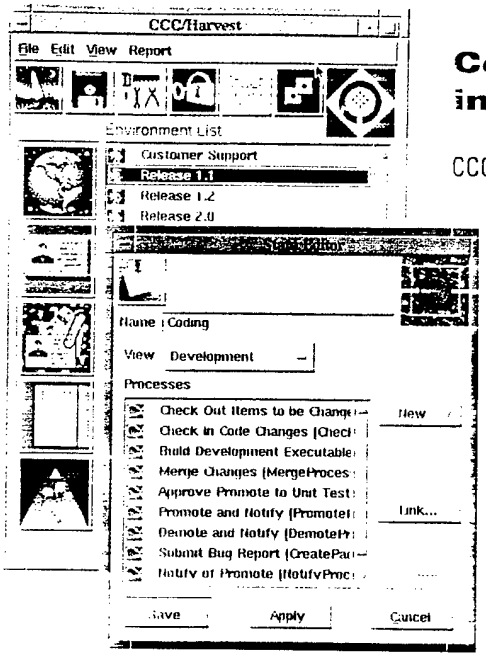
PLATINUM Solutions, Inc., our professional services division, provides consulting and integration services in five areas of expertise:

- Application Lifecycle
- Systems Management
- Data Warehousing
- Database Management
- Business Intelligence

These services cover the full project life cycle, including needs analysis, requirements study, architecture definition, business and technical design, product evaluation, product customization, and installation and implementation services.

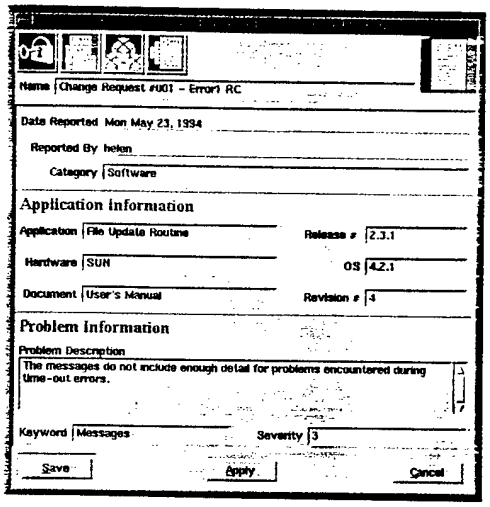
PLATINUM professionals can design and implement a complete project or augment your in-house staff. And comprehensive training services are provided to ensure full knowledge transfer at project completion.

With PLATINUM CCC/HARVEST, you can...



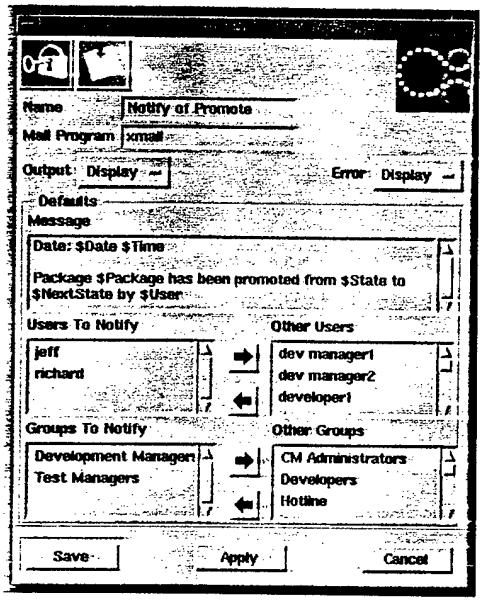
Control the change process in client/server environments

CCC/Harvest provides true interoperability across diverse operating systems. Its intuitive GUI provides a consistent workspace for development teams distributed throughout the enterprise, no matter what platforms they work on.



Track changes through the entire software lifecycle

Through CCC/Harvest's built-in problem tracking, software changes are automatically related back to the original problems that caused them. CCC/Harvest seamlessly integrates with the other tools in your environment, including problem management solutions such as PLATINUM Apriori, and electronic software distribution solutions such as PLATINUM AutoXfer, to provide a trackable release mechanism for software upgrades.



Automate your workflow for developing applications

Through simple point-and-click operations, CCC/Harvest easily models your software development process. Integrated notifications, online approvals, and customizable reports enable all groups involved to see change processes, including developers, testers, project leaders, QA staff, auditors, and customer support representatives.

Supported Platforms

- **Servers:**
  HP 9000/700 or 800
  Sun
  RS/6000
  Digital UNIX
  Windows NT (2Q 1996)
- **Clients:**
  HP 9000/700 or 800
  Sun
  RS/6000
  Digital UNIX
  Windows 3.1
  Windows 95
  Windows NT
  OS/2
- **Relational Databases:**
  Oracle
  ODBC-compliant (4Q 1996)

About PLATINUM *technology, inc.*

Leveraging its expertise in relational technology, PLATINUM *technology, inc.*, formed in 1987, provides open enterprise systems management solutions for today's heterogeneous computing environments. PLATINUM's integrated products and services span multiple platforms, operating systems, and vendors to increase the efficiency and interoperability of information systems across the enterprise.

PLATINUM
TECHNOLOGY

The Open Enterprise Management Company

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Martial Eagle photo by Lee Kuhn (FPG International).

The endangered animal featured in this publication symbolizes PLATINUM's commitment to preserving the earth's environment. To support this commitment, the PLATINUM Wildlife Foundation has been established. For information, call 800-442-6861 or send e-mail to wildlife@platinum.com.

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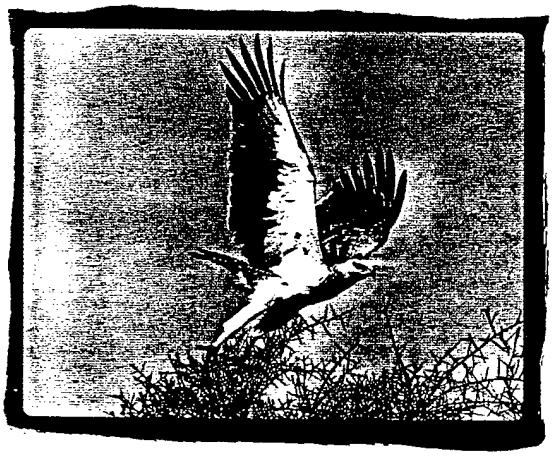
PLATINUM

CCC/Harvest



THE ENTERPRISE-WIDE CHANGE AND CONFIGURATION MANAGEMENT SOLUTION FOR CLIENT/SERVER ENVIRONMENTS

Manage Software Change and the Application Development Process

Managing enterprise-wide application development projects can be extremely complex. Changes to code, design specs, and documentation can come in from remote project teams on a regular basis. PLATINUM CCC/Harvest simplifies enterprise development by enabling your teams to synchronize concurrent and parallel development across remote heterogeneous platforms. And it provides a repository-based, central management point for coordinating enterprise-wide change. CCC/Harvest increases productivity, improves software quality, and accelerates development cycles.

With CCC/Harvest, you can:

- Control your software change process from a central management point
- Synchronize development activities across diverse operating systems with true interoperability
- Track all your changes through the entire development and maintenance lifecycle
- Automate the workflow for developing and maintaining your applications
- Ensure that your production application is free from change regression and overwritten changes
- Support concurrent and parallel development with an integrated merge facility
- Manage in-house changes to vendor code.

Establish a Systematic Approach for Managing Software Changes

CCC/Harvest organizes related code, design objects, and documentation into change "packages" and tracks these packages through the application lifecycle. By using simple "point-and-click" operations, you can create or modify a model of your application development workflow that dictates the stages through which your change packages are migrated. This feature brings order to your development process by ensuring that changes are introduced according to the workflow you define. Many of the routine tasks of development are automated, including notifications, approvals, and migrations of changes from one stage to another.

Benefit from Built-in Problem Tracking

CCC/Harvest's process modeling capability and customized forms automate information gathering, assist in the management of problems, and give you a consolidated view of problem components.

Capitalize on a Three-tier Client/Server Architecture

CCC/Harvest's flexible three-tier client/server architecture enables you to capitalize on today's inexpensive, high-powered computing hardware, minimize network traffic, and provide platform-independent security. Plus, with multiple platform support, CCC/Harvest provides uniform availability of project data across heterogeneous computing environments.

Integrate CCC/Harvest with Other Tools

CCC/Harvest is designed to easily adapt to and support the changing needs of your organization. Using a relational database, user-defined processes, and its Software Integration Kit, CCC/Harvest works seamlessly with other tools in your environment, such as PLATINUM Process Continuum (methods-driven process and project management suite), PLATINUM Apriori (comprehensive help desk solutions), PLATINUM AutoXfer (electronic software distribution), and most third-party tools. Together, CCC/Harvest, Apriori, and AutoXfer comprise an end-to-end change management suite that supports software development, from initial request to deployment.

Comprehensive Configuration Management

- Version control
- Release management
- Concurrent and parallel development support
- Interactive merge
- Reusable component management
- Emergency maintenance
- Vendor code management

Software Process Automation

- Flexible lifecycle modeling
- Project status information
- Automatic notification
- Online approvals
- Automatic change migration

Built-in Problem Tracking

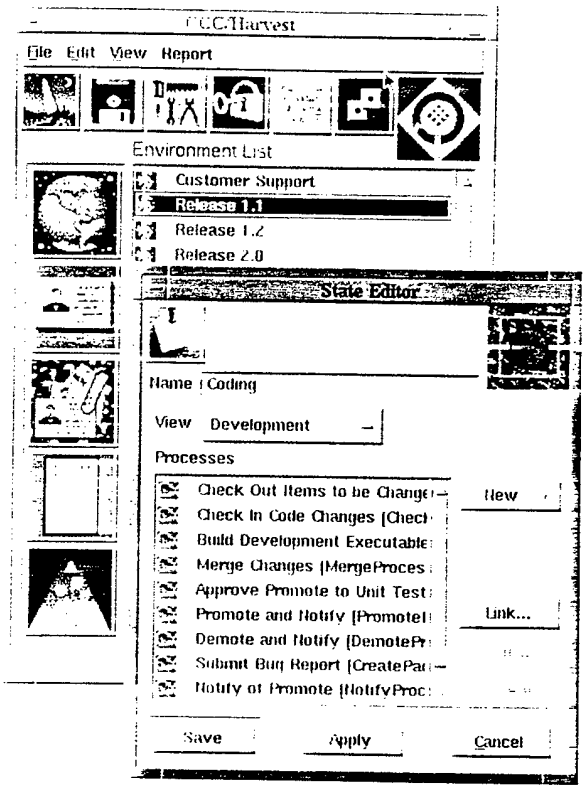
- User-definable forms
- Problem report linked to actual change

Flexible and Open Architecture

- Complete interoperability across all platforms
- Central management point
- Support for distributed development
- Consistent interface on a wide range of platforms
- Platform-independent security
- Open architecture

Platform Support

Servers:	*Relational Databases:*	*Clients:*
HP 9000/700 or 800	Oracle	HP 9000/700 or 800
Sun	ODBC-compliant (4Q 1996)	Sun
RS/6000		RS/6000
Digital UNIX		Digital UNIX
Windows NT (2Q 1996)		Windows 3.1
		Windows 95
		Windows NT
		OS/2



CCC/Harvest features a consistent GUI across all platforms.

PLATINUM CCC/Harvest FAX-Back Form

Fill out the information below and FAX this page to:

1.708.691.0718 (worldwide)

Or call your PLATINUM sales representative at:

1.800.442.6861 (U.S. and Canada)
1.708.620.5000 (worldwide)

❑ Please send me additional information about CCC/Harvest.

Name Job Title

Company

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Email Address

PP-SL-33-FX-050196

PLATINUM TECHNOLOGY

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Martial Eagle photo by Lee Kuhn (FPG International)

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PTI960501

CCC®/Harvest Technical Note

Softool Corp
THE CONFIGURATION MANAGEMENT LEADER

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An Overview of CCC/Harvest

The new client/server generation of the CCC product family

INTRODUCTION

CCC/Harvest represents the next generation in the evolution of the CCC product family from Softool Corporation. CCC/Harvest continues the tradition of the CCC/Manager family. Like other CCC products, it provides a comprehensive software change and configuration management (CM) solution for the corporate development environment. However, CCC/Harvest builds on Softool's many years of experience in this field to address the growing needs of client/server environments.

Why is CCC/Harvest Needed?

The computing environment of the 90s is rapidly becoming more and more complex. Isolated data centers running on a single platform and standalone technical workstations are becoming environments of the past. Instead, an enterprise-wide network of different, specialized platforms is increasingly common. Such a heterogeneous set of platforms supports a software life cycle with many different functional groups, application domains, and procedural methodologies.

Cross-platform life cycles have created a new set of challenges for the software development/maintenance organization. Some of these challenges include the following:

- Internal procedures and processes are evolving rapidly. Development tools must be able to adapt to and support these changing processes.
- Client/server applications are being developed on multiple platforms and update cycles must be coordinated and tightly controlled.
- New applications are being built relying on 4GLs, databases, CASE tools, and reusable code. All of these generate increased quantity and complexity from the control and auditing aspect.
- With many different computing platforms, it is essential that common methodologies, interfaces and processes be presented to the development organization.

CCC/Harvest Features

CCC/Harvest has been designed to address the needs of today's computing environment. The following list indicates some of the important requirements that CCC/Harvest satisfies:

- Supports distributed development in client/server environments
- Provides support for the entire development and maintenance life cycle
- Can be used easily by all people in the software development/maintenance and support organization
- Adapts to widely diverse corporate software development and maintenance styles
- Facilitates integration with other development tools
- Is easy to implement
- Minimizes impact on computing resources and staff

All of these features of CCC/Harvest can be summarized in six major categories: client/server support, an integrated approach, adaptability, openness, ease of implementation, and usability.

Client/Server Support

Client/server computing solutions represent one of the fastest growing types of environments in the computer industry today. These solutions have increased in popularity because they allow organizations to preserve their current hardware investments and still take advantage of the state-of-the art technology provided by faster, friendlier workstations and PCs.

However, the story doesn't end when various diverse hardware platforms have been successfully interconnected. Moving to a client/server environment can have a significant

impact on the software development and maintenance process. Often, the old ways of doing business no longer make sense. New procedures must be established, new tools purchased, and time and money spent retraining personnel.

In fact, the move to a client/server architecture can leave an organization especially vulnerable to losing control of critical software assets. It is often difficult to determine how auditing standards can be satisfied in such a dynamic environment. This fact may leave many managers wondering if the client/server relationship is creating a "black hole" through which unwanted changes can enter the system. As a result of the distribution of computer resources, the quality, integrity, and security of software can suffer.

CCC/Harvest is the only product that provides an integrated CM solution in client/server environments with *interoperability across all platforms*. Users will find that CCC/Harvest is a powerful tool, easy to implement and use, that adapts readily to their way of doing business.

An Integrated Approach

However, client/server support is not all that's different about CCC/Harvest. CCC/Harvest incorporates a whole new approach to software configuration management in general. Traditional CM tools have often viewed CM as an isolated, technical function that can be performed off to the side of the main flow of development activities.

CCC/Harvest, on the other hand, provides an environment flexible enough to support and integrate many different kinds of work processes under one general umbrella. This integrated approach allows problem tracking to be unified with change management, through CCC/Harvest forms. But any other kind of work flow that is associated with software development can be managed through CCC/Harvest.

The basic purpose of CCC/Harvest is to provide a unified framework supporting all the core functions in the software development and maintenance process. This includes problem reporting and tracking, software inventory management, change and version management, application management, release and baseline control, support for parallel and concurrent development, and the distribution of updated software and related information.

All functional groups involved in the development and maintenance process can benefit from CCC/Harvest, not just programmers. It includes extensive management reporting capabilities and supports the auditing function.

Adaptability

Traditional CM tools usually made a lot of assumptions about how an organization does its work. Users had to squeeze their own procedures into a pre-defined mold that was often a poor match for their needs. One of the most powerful features of CCC/Harvest, in contrast, is its adaptability. An organization can define and follow any kind of software life cycle and process model. Users can continue to do business the way they are accustomed to.

Furthermore, CCC/Harvest allows a site to synchronize development activities across all platforms involved in development, maintenance, and problem tracking activities. An organization can integrate its own tools and processes into CCC/Harvest and provide notification using its own mail system.

Openness

CCC/Harvest is a client/server application. The client and server portions may both execute on the same machine or be distributed across multiple platforms. The client portion of CCC/Harvest consists of the graphical user interface (GUI), the command line, and the application programming interface (API). The server portion contains most of the program logic, including the delta engine, which allows CCC/Harvest to calculate and store only the differences between one version of a file and another. The server portion also includes an SQL layer, which communicates with a relational database.

CCC/Harvest's open architecture allows easy access to CM information. Rather than developing yet another database standard, control information is stored within a commercially available relational database. CCC/Harvest table formats are fully documented. Database information is normally accessed from the GUI, but a site may access the database directly to generate reports or integrate with other development tools. Integration is further supported by the API and command line.

Ease of Implementation

CCC/Harvest has been designed with ease of implementation and use as one of its highest priorities. Softool's consulting group is available to assist in the design and implementation of CCC/Harvest, allowing an organization to become operational quickly and derive immediate benefits. The implementation of CCC/Harvest is most successful when built upon a solid foundation that takes into consideration company standards, requirements, processes and procedures. Once such a foundation is in place, the tool investment can be fully recognized.

Usability

The CCC/Harvest user interface is implemented using state-of-the-art GUI technology. It is highly interactive and has been designed with ease of use and minimized training time as primary criteria. Multicolored icons and tool bars are used throughout the interface. Most common functions have keyboard accelerators defined for them. A full on-line, context sensitive, interactive help facility is available.

Each user may customize the appearance of the interface. CCC/Harvest supports OSF/Motif®, OPEN LOOK®, and Microsoft® Windows™ "look and feel" across all platforms. Users also have complete control over fonts, font size, and color schemes.

CCC/Harvest's user interface is object oriented. Users select a CCC/Harvest object through the interface and then choose a related action. Some examples of CCC/Harvest objects are

views, processes, packages, package groups, and users. All of these objects are discussed later in this document.

The objects are represented as icon buttons or selection lists. This approach allows users to apply multiple unrelated methods or processes to individual objects or groups of objects from a single location. It also means that the user never has to remember the name of an object: all are available through lists.

There are two entry points into the CCC/Harvest GUI: the main window and the Workbench.

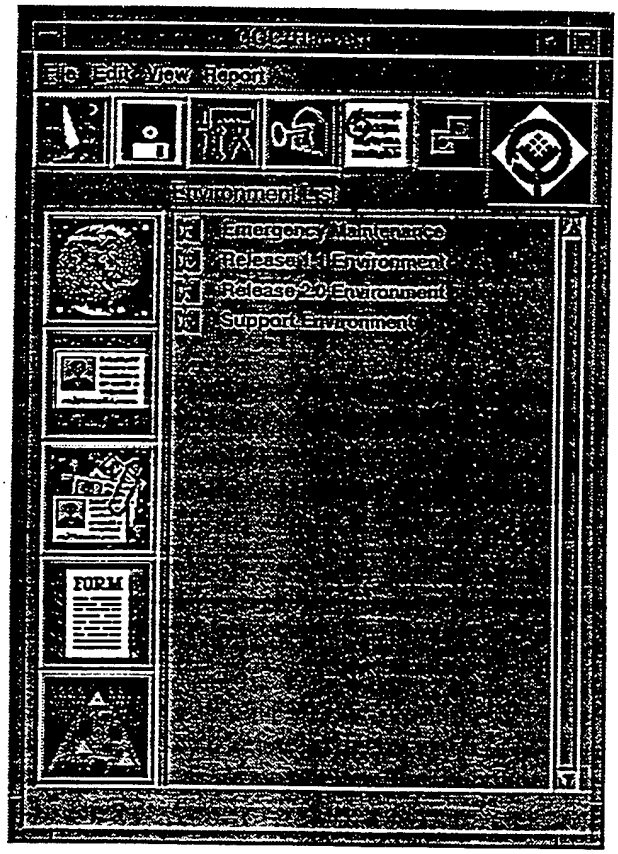


Figure 1: The CCC/Harvest Main Window

Administrators work through the main window to perform setup functions. From the main window, various editors are available that allow administrators to set up environments, define users, and create user groups, forms, and repositories.

Developers and individuals involved with problem management access the Workbench. All of the objects used in day-to-day CM activities can be manipulated through the Workbench interface.

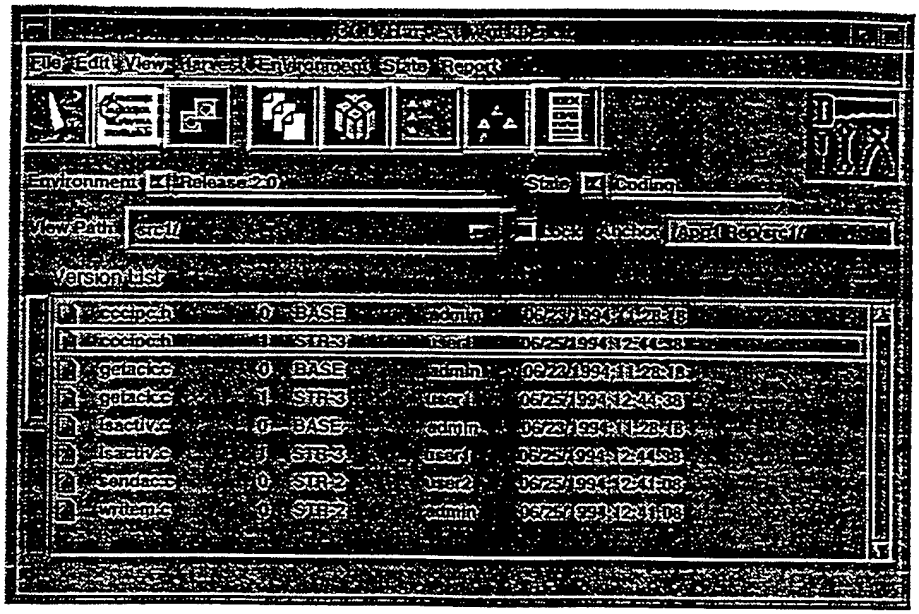


Figure 2: The CCC/Harvest Workbench Viewing Versions

In addition to the graphical user interface, a full application programming interface is available. All important functions that can be performed through the GUI can also be performed through the API. The command line interface allows developers to execute frequent functions like check in and check out directly from the operating system, without having to invoke the GUI.

BASIC CCC/HARVEST CONCEPTS

The use of CCC/Harvest is divided into "setup" tasks and day-to-day operational tasks. The setup tasks are required primarily when first implementing CCC/Harvest. Such tasks include initializing the physical repository, defining within CCC/Harvest the software development and maintenance model employed by an organization, and setting up user groups. Complete default environment models are provided "off the shelf," so that defining a model may be omitted. Alternatively, you can begin with a default model and modify it to adapt to your particular needs.

Modification and maintenance of the repository and life cycle may be needed as requirements and environmental factors change. Typically, these setup activities are limited to a designated administrator of the CCC/Harvest environment.

Once CCC/Harvest is set up, its day-to-day operation is straightforward. Users, based on their operating context, are given access to information, provided a set of processes that can be performed, and notified of actions that need to be taken.

A number of closely related concepts associated with CCC/Harvest provide important building blocks in a life cycle model. These concepts include *environments*, *life cycles*, *views*. *processes*, *packages*, *package groups*, and *forms*. Software development and

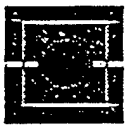
maintenance models matching an organization's way of doing business are built with these objects.

Environments

An *environment* is the control framework driving the development and maintenance process. It specifies how data is accessed, the processes allowed to execute, how changes move through the development cycle, and user responsibilities. Most CCC/Harvest functions are only available when an environment has been selected.

A site may have a number of different environments, depending on the number of applications being controlled and the kind of development activity undertaken. For example, there may be one environment for maintaining an already released version of an application, another for developing the next release, and a third for maintaining code shared among various applications. There might be an entirely different environment used by the support group for tracking incidents and problems.

Life Cycles: States and Processes



The *life cycle* is the part of the environment that defines a model for a particular development and maintenance process. This model reflects the "typical" way changes are made at a particular site. The life cycle describes the path that changes take as development progresses in terms of an ordered set of phases or *states*. The life cycle can be considered the "heart" of an environment, because it controls the flow of development life within it.

A life cycle can include many or few states, depending on each site's individual requirements. A common development scenario might include states for assigning change requests, making changes, testing changes, integrating changes, and releasing a completed product. However, if developers typically do all the testing, the testing phase could be left out. CCC/Harvest gives you complete flexibility to define any kind of model.

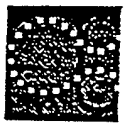
Within each state, processes define the various activities that can occur. This means that each state can have a uniquely defined scope of work. The promote and demote processes have special significance in a life cycle model because they determine how states are related and how changes can move between them.

Views

Views define the kind of data that can be accessed from within an environment. Each environment has one *master view,* which defines the items to be operated on. The items themselves are maintained in a physical repository, which can be shared by more than one environment. A master view may include items from more than one physical repository, if needed, as in the case of shared code.

Additional views can be created based on the master view. Within a life cycle, each state may have a particular view associated with it. The view determines which item versions are accessible to users in that view.

Processes



A set of valid *processes* may be defined for each state in the life cycle. Processes are commands that perform a task. The processes defined for a state determine the activities that can go on in that state, or its scope of work. Additional actions can be associated with each process, based on its success or failure. This allows commands to be linked together to perform more complex tasks.

Processes associated with a state are used differently than those linked to other processes. A process associated with a state appears as an option available to the user on the Workbench. To occur, such a process must be explicitly invoked by a user. Linked processes occur automatically whenever the process they are linked to is invoked.

CCC/Harvest comes with a number of different process types that can be configured by an administrator. In addition, processes can be defined that invoke other user-supplied programs. This feature allows the administrator to integrate the use of existing development tools into the Harvest life cycle. The following table displays a subset of the processes supplied with CCC/Harvest.

Process Type	Action
Approve	Allow electronic sign-off of a package or package group before state change
Check In	Create a new version of an item by bringing the changes made to an operating system file into CCC/Harvest
Check Out	Copy a version of a Harvest item to an external directory and optionally reserve it
Create Package	Create a package and form with the same name and automatically associate them.
Demote	Return a package to a previous state
Merge	Perform merging of parallel versions
Move Package	Move a package from a state in one environment to a state in another environment
Notify	Send electronic messages to users or user groups
Promote	Move a package to another state further in the life cycle
User Defined Process (UDP)	Execute a user defined process on the client machine

The user-defined process (UDP) allows you to define any number of additional processes to CCC/Harvest. UDPs allow a site to easily integrate other tools or utilities into the CM environment.

Figure 3 illustrates the life cycle model of an environment called **Release**. **Release** has been defined with several states, beginning with **Analyze** and ending with **Close**. The **CHECK**

OUT, **CHECK IN**, **BUILD**, and **PROMOTE** processes may take place within the **Develop** state. These processes are optional, meaning that they may be invoked at any time during the **Develop** phase of the **Release** life cycle. The **PROMOTE** process causes a package to move from one state to the next.

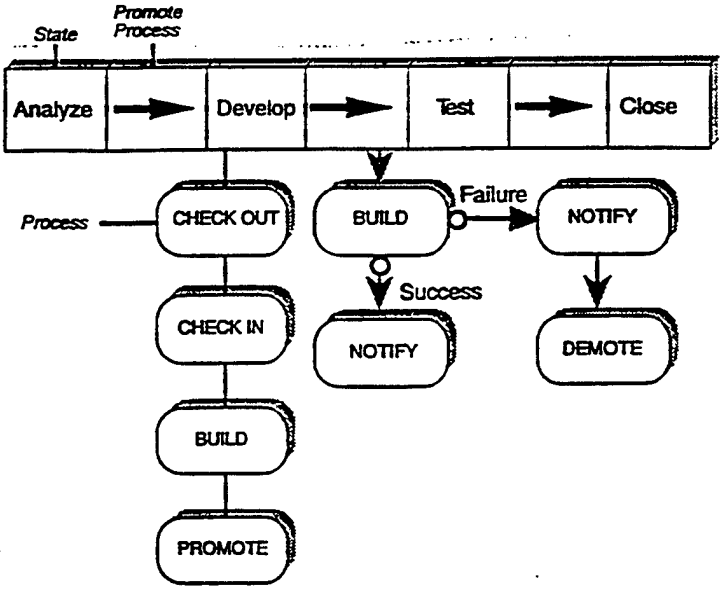


Figure 3: The Release Environment Model

The process that promotes packages from the **Develop** to the **Test** state has other processes linked to it. These processes are automatically invoked whenever a package is promoted. A key component of the flexibility within CCC/Harvest is the ability to link processes together in a dependent fashion. In Figure 3, the **NOTIFY** process linked to the promote is defined to be invoked only if the build process succeeds. If the **BUILD** process fails, the **NOTIFY** and **DEMOTE** processes are invoked and the state returned to **Develop**.

Packages and Package Groups

A *package* is the basic unit of work that moves through the life cycle. It typically represents a problem or an incident that needs to be tracked, the changes made in response to the problem or incident, and any other associated information.

A *package group* provides a higher logical level for operating on related packages. A particular package may belong to one group or several, or it may not belong to any. Any operation that can be performed on a package can be performed on all packages in a package group. For example, a user can promote all packages in a group from one state to the next. If an approval is required before packages can be promoted, another user can approve the promotion of the group.

Package groups can also be used as the basis for filtering operations. This allows you to easily set up variant events for special kinds of packages. Referring to Figure 3, all packages

in a certain group may need to pass through an extra state (e.g., **Integration**) before going to the **Test** state in the life cycle.

The package is the user's link to the actual data accessed during the change process. Each package must be within a particular state of the life cycle. Associated with a state is a view. The view defines the data and its versions accessed by a package in that state. All packages in the same state share the same view.

For example, consider a set of packages that share a **Development** view of an application. Changes made for each package sharing the view are immediately visible to the others sharing the same view. However, these same changes are not visible from the **Test** view until the changes are promoted to **Test.**

Forms

Forms represent a way of maintaining and organizing information within CCC/Harvest. Harvest forms can be used in much the same way that paper forms are used. For example, they can be used to track issues and problems or as a structured method of communication.

Forms can beaccessed directly from the CCC/Harvest main window or from the Workbench. They do not belong to a particular environment, but can be used by any. Forms attain their greatest usefulness through association with packages. This association provides the link between the problem tracking and change tracking functions in CCC/Harvest. Forms can also be associated with other forms, allowing information to be cross referenced. For example, you might associate a customer contact form with a problem reported by that customer.

All the information gathered through a form is also directly accessible from the associated package.

A number of standard forms are provided with CCC/Harvest, such as a problem tracking form, user contact form, testing information form, question and answer form, and comment form. In addition, custom forms may be created that are tailored to the specific requirements of individual users.

Other Concepts

A number of other concepts are important in completing this overview of the CCC/Harvest functionality. These are discussed in the following subsections.

User Groups

When users are defined to CCC/Harvest they may be placed in *user groups*. User groups exist at the Harvest level and are available in all environments defined in Harvest. A user can belong to any number of user groups, and there is no hierarchy implied by the groups. For example, a user in the **Development Manager** group does not implicitly have the privileges of users in the **Developer** group.

User groups provide a powerful, flexible mechanism that can be employed in association with access control, notification, and approvals.

Access Control

CCC/Harvest access control is designed to allow a site to implement any level of access control granularity required. The access control is based on the combination of user or user group, object, and action. Each user can belong to any number of groups, and there is no hierarchy implied by the groups.

For example, using CCC/Harvest's access methods, user group **PRODCNTL** can be given access to build an executable program when a package is in the final integration phase of its life cycle.

Notification

The notification process is completely user defined. The CCC/Harvest administrator can specify what notifications will be sent, who will receive them, and under what circumstances. For example, the QA user group can be notified when a package is successfully promoted from **Development** to **Test**, or the Project Leader notified when all approvals for a package have been completed.

Approvals

The life cycle can be defined so that certain users or user groups must give their approval before a package can move forward through the life cycle from one state to another. Each state can have uniquely defined approval requirements.

Until each of the specified users or at least one member of a specified user group has given their approval, a package cannot be promoted. The current set of outstanding approvals can be determined on either a user, user group or package basis.

DEVELOPING WITH CCC/HARVEST

From the perspective of a software engineer, CCC/Harvest activity begins with the reviewing of outstanding change requests, or those specifically assigned to the individual. The software engineer interacts with CCC/Harvest to query on the change request forms, and may view the actual change request form contents on the screen. Each change request is associated with a package. The package is used to group and manage changes as they move through the life cycle.

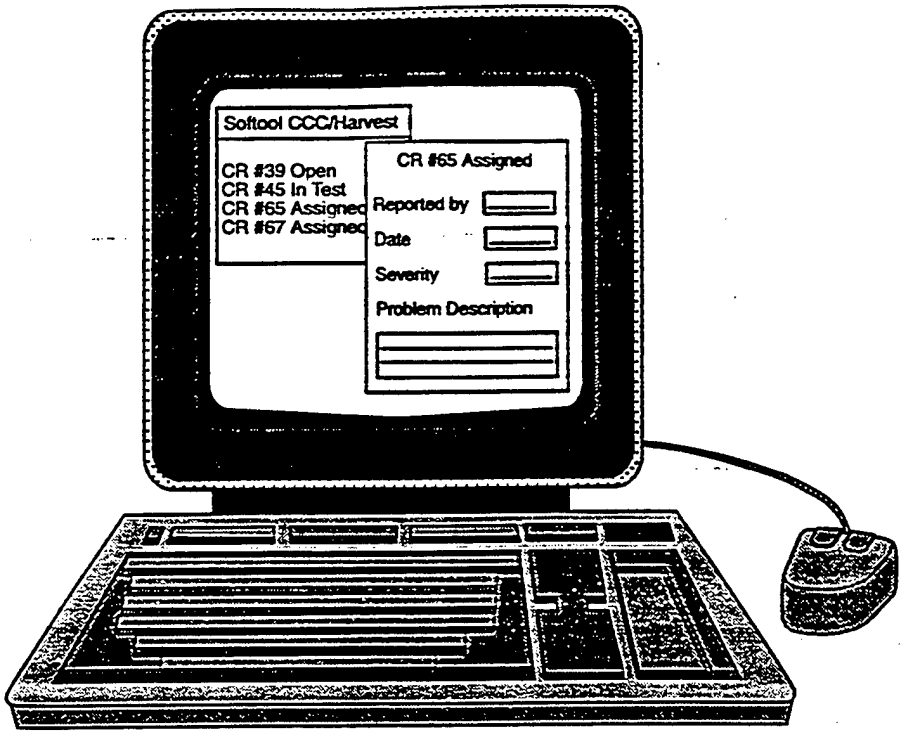


Figure 4: CCC/Harvest Displays

The software engineer then proceeds with the change activity. For example, in the case of new development, this could be the interaction with a CASE design or 4GL tool to create a design object. In the case of maintenance, the engineer may browse various modules of software to determine the cause of failure.

Next, the engineer modifies information through the standard check out and check in operations familiar to CCC users, using the package associated with the change request form. The package/form association allows information about package changes to be accessible from the form. At the same time it allows information about the change request and its history to be accessible from the package.

Changes move through the life cycle as they are reviewed and approved. CCC/Harvest provides for automated notification and on-line approvals. These approvals are integrated automatically into the package history.

CCC/HARVEST ARCHITECTURE

CCC/Harvest is a client/server application built to support the distributed development environment and take advantage of the strengths of various platforms. It also allows you to automatically synchronize repositories maintained on different computers.

Components

Figure 5 illustrates the various components in the CCC/Harvest architecture. The CCC/Harvest **client (1)** consists of the graphical user interface (GUI), command line interface, and application programming interface (API).

The **server (4)** contains the majority of the CCC/Harvest logic. It includes two major pieces:

- The **delta engine** communicates with the CCC/Harvest **repository (5)**. The CCC/Harvest repository is a set of operating system directories used to maintain delta files. The delta files contain the changed lines to items under Harvest's control
- The **SQL layer** communicates with a **relational database (3)** (RDB). The relational database is used to store detailed information about items under CCC/Harvest's control. CCC/Harvest uses the RDB to maintain information about logical structures like packages and package groups. In addition, the RDB maintains control data describing the physical versions, including the version ID, user, date/time, remarks, and package information.

A **communication layer (2)** provides the connection between the CCC/Harvest client and server. The client, server, repository, and relational database may each reside on different heterogeneous platforms.

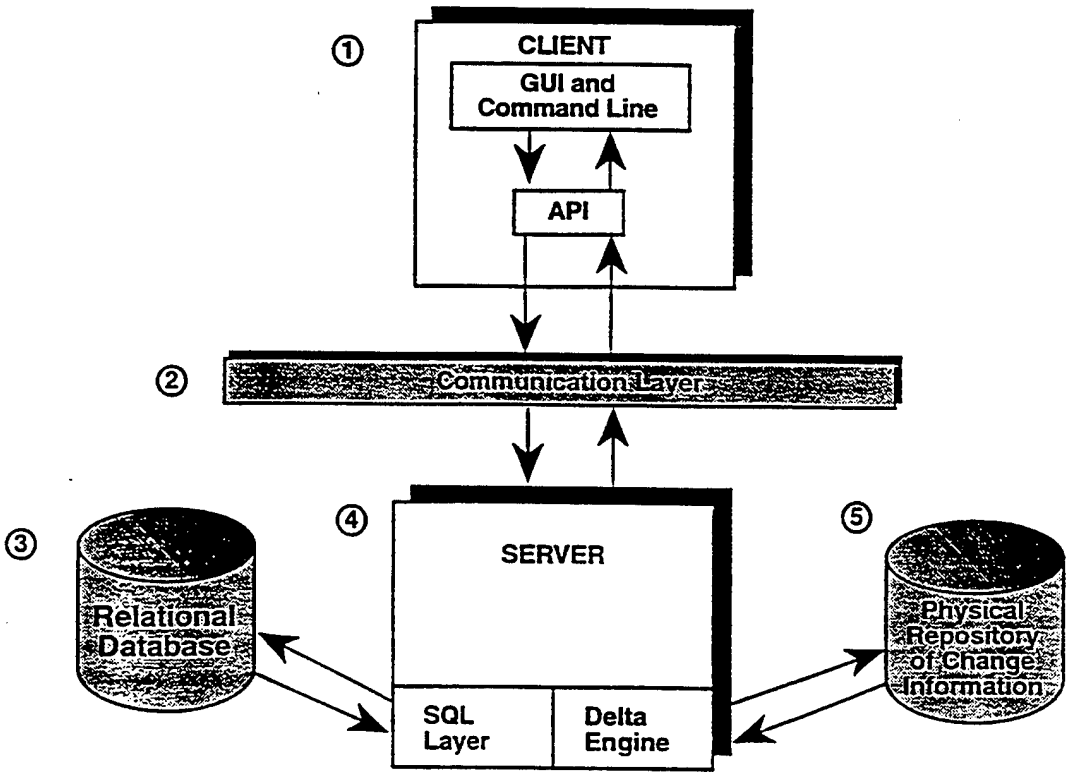


Figure 5: CCC/Harvest Architecture

The communication layer consists of a set of protocols that allow the CCC/Harvest components to work together. This layer is not bound to any particular network protocol. It is

built using a level of abstraction on top of the low-level communication layer. A number of protocols such as DCE/RPC are supported, as well as basic communication mechanisms like sockets.

Requests by the client are queued and processed serially. However, the architecture of CCC/Harvest supports the existence of multiple server processes to improve system performance.

Open Architecture

Softool is committed to a totally open architecture, allowing easy access to all CM information. All CCC/Harvest control information is stored within a relational database. This information is typically accessed through the server from the GUI or API. However, a site may access the database directly for purposes of report generation or integration with other development tools.

The actual data being controlled by CCC/Harvest is stored within the CCC/Harvest change repository. The change repository is accessed by the delta engine, which is part of the CCC/Harvest server. The CCC/Harvest change repository may be distributed anywhere across the file system addressable by the server process. A site may wish to distribute the change repository based on application or target platform. Data of any type from any client environment may be stored in the change repository.

INSTALLATION REQUIREMENTS

CCC/Harvest runs on a number of different platforms and supports a number of commercially available databases. A run-time version of the relational database is required for normal operations on the platform on which the CCC/Harvest control information database will be stored. The CCC/Harvest control information database may reside on the same or different platforms as the CCC/Harvest server process.

SUMMARY

The design of CCC/Harvest combines flexibility with power. CCC/Harvest allows you to take full advantage of the strengths of the client/server environment because it supports a clear separation of data, its logical structure, and its physical location in the enterprise. CCC/Harvest integrates the critical areas of change management, problem management, and process management into one seamless control environment.

But CCC/Harvest does not just provide powerful, integrated functionality. All of this power is wrapped in a state-of-the-art graphical user interface that simplifies the execution of functions and minimizes user training. The easy access to information increases management visibility and provides supports for other functions like auditing.

With CCC/Harvest, an organization defines its environments, without programming, to tailor the system to its needs. Default environments are also provided that may be used as is or further modified. Companies may have one standard environment for all software development and maintenance, or many different environments, each tuned to the dynamics of the particular software development and maintenance effort.

CCC/Harvest can provide an organization with all of the following benefits:

- Adapts easily to site-specific procedures and processes
- Implements quickly, providing a rapid return on investment
- Facilitates integration with other development and maintenance tools through an open architecture and application programming interface
- Provides a consistent interface across all development and maintenance platforms in the environment
- Supports all groups involved in the development and maintenance life cycle
- Protects current investment. CCC/Harvest adapts to homegrown and paper procedures and provides upward compatibility for sites currently using CCC products.

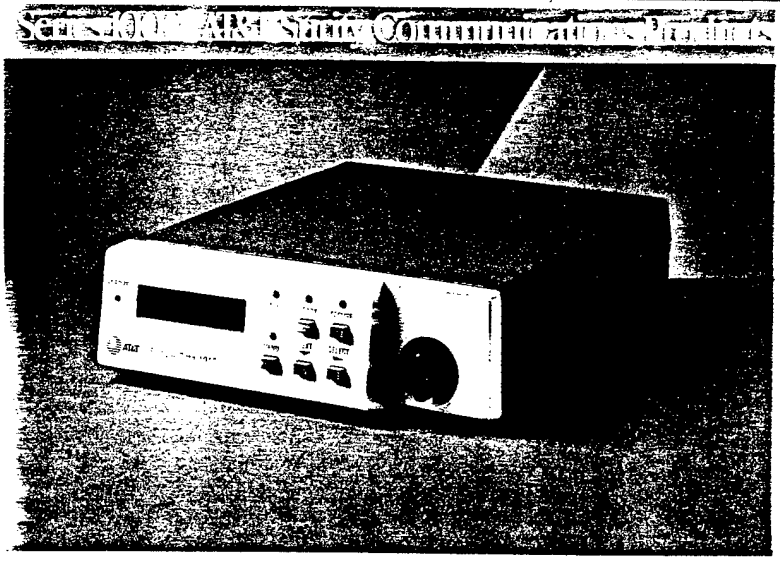
CCC/Harvest, with its flexibility and power, represents the next generation of change and configuration management products. Its design is the culmination of over 17 years of proven change and configuration management experience gained at hundreds of installations by Softool staff worldwide. You too can begin to reap the benefits of this experience with CCC/Harvest.

APPENDIX L

COMPUTER SYSTEM DATA SHEETS

AT&T

AT&T Surity™ Data Device 1910 For Secure, Classified Applications



The AT&T *Surity* Data Device 1910 provides a simple and cost-effective way to protect *classified* government data transmissions. Developed under the U.S. Government's STU-III program, it's approved for use by federal departments, agencies and government contractors.

The *Surity* Data Device is part of an AT&T family of products for secure voice and data applications. Each is full-featured — and compact enough to be carried in your briefcase when you travel.

Doctrine governing these and other STU-III products is established and controlled by the U.S. Government.

Protection for facsimiles, electronic mail and computer communications.

Whether you're accessing a computer database, sending a fax or using electronic mail, you can be sure your information is protected — regardless of the classification level.

Cost-saving transmission over public and government switched networks.

The AT&T *Surity* Data Device can be used to transmit information over any public or government switched network at speeds of up to 14.4 kbps. You won't need an expensive, dedicated transmission path to ensure data security.

Government-approved for unattended operation.

The AT&T *Surity* Data Device is approved by the government for unattended secure data transmission.* As a result, facsimiles and other data communications can be sent to you even while you're away from your office.

Comprehensive service and support.

AT&T's toll-free hotline provides a single point of contact for comprehensive service and support. With a phone call, you can resolve a question, place an order, troubleshoot problems and more.

Repairs are hassle-free. If your terminal fails, we'll send you a replacement overnight. We're the *only* company in the industry to do so. And we stand behind the *Surity* Data Device with a full, two-year warranty with a one-year extension or five-year conversion.

Feature-rich.

AT&T designed the *Surity* Data Device with features and functions that lead the market and support our customers' special needs.

- **Access Control.** The AT&T *Surity* Data Device is equipped with a unique Security Access Control System (SACS) that brings unmatched flexibility to your data applications.

  SACS allows you to establish a secure, closed network and to control access to facsimile machines or data stored on a PC or host computer. You simply program a list of authorized user IDs into your AT&T *Surity* Data Device. SACS automatically screens incoming calls, comparing the ID of the caller to those on your list. Unauthorized attempts are disconnected before the caller has access to your files.

  Access can also be controlled by setting the device for minimum or maximum security levels. Only calls with the appropriate classification level will be accepted.

  As an additional security feature, the AT&T *Surity* Data Device provides the information you need to maintain an audit trail of all attempts to access your network — whether successful or not.
- **Remote operation.** You can control the AT&T *Surity* Data Device remotely from any fax, PC or computer that is connected to its 25-pin RS-232 data port. Remote commands are based on the Hayes SmartModem 2400™ command set.
- **Compatibility.** A full range of data speeds — from 2.4 kbps half duplex to 9.6 kbps full duplex — makes the AT&T device compatible with the secure data operation of any STU-III voice/data terminal. Data compression capability in the Model 1910 provides effective data transmission at speeds of up to 38.4 kbps (when used with a compatible unit that transmits and receives at 38.4 kbps).
- **Easy installation/operation.** The AT&T *Surity* Data Device is easy to install. You plug in the power cord and a telephone jack and connect the unit to your PC, facsimile machine or computer.

  After completing an automated key management procedure, the unit is ready to go secure.

  Operation is simple. No special training or cumbersome routines are required.

For more information.

The AT&T *Surity* Data Device can provide you with significant savings over traditional data security solutions. To find out more, call: 800 243-7883, or 910 279-3411 (outside the U.S. and Canada).

*National and local security policies apply.

AT&T

AT&T Surity™ Data Device 1910

SPECIFICATIONS

Information protected

- U.S. Government top secret, secret, confidential and unclassified

User community

- U.S. Federal Government
- U.S. Government contractors

Security features

- Security Access Control System (SACS)
- Maximum and minimum security-level setting
- Auto-answer, auto-secure
- Tempest
- Crypto-Ignition Key (CIK)
- Active and passive terminal zeroization
- Fully automated STU-III fill procedures
- Display window for authentication identification
- Information to create a call audit trail

Key management

- Master CIK
- Traveling CIK
- Dual key sets
- Eight CIKs per key set

Secure data operational modes

- 14.4 kbps full-duplex sync/async
- 9.6 kbps full-duplex sync/async
- 4.8 kbps full-duplex sync/async
- 2.4 kbps full-duplex sync/async
- 2.4 kbps half-duplex sync

Modem characteristics

- Data compression CCITT V.42 bis
- Near/far echo cancellation
- Frequency offset compensation
- 14.4 kbps: CCITT V.32 bis secure; sync/async; full duplex with optional trellis coding
- 9.6 kbps: CCITT V.32 secure; sync/async; full duplex with optional trellis coding
- 4.8 kbps: CCITT V.32 secure; sync/async; full duplex
- 2.4 kbps: CCITT V.26 bis secure; sync/async; full duplex
- 2.4 kbps: CCITT V.26 bis secure; sync; half duplex
- Input level: 0 to -43 dBm
- Output level: adjustable, 0 to -15 dBm
- Automatic rate fallback: from 14.4, 9.6 and 4.8 kbps to 2.4 kbps
- Remote control using Hayes AT commands

Interfaces

- External power supply
- EIA RS-232 data port with a 25-pin D-connector
- RJ11/RJ13 telephone jack to connect to public switched network, PABX or key systems
- RJ13 auxiliary set jack to connect standard telephone (optional)
- A/A1 leads (for use with key telephone systems)

Physical characteristics

- 8"w x 2.5"h x 9.5"d (20.3 cm x 6.3 cm x 24.1 cm)
- 7 lbs. (3.1 kg)
- Desktop or rack-mountable

Environmental

- Operating temperature: 40º to 100ºF (4.5º to 38ºC)
- Storage temperature: -40º to 150ºF (-40º to 66ºC)
- Relative humidity (storage): 5% to 95% noncondensing

Power

- External power supply selectable 90-134V ac, 186-253V ac
- Input frequency 47-63 Hz
- Input power dissipation 16 watts

Equipment interoperability (data mode)

- STU-III LCT, A and Cellular

Equipment compatibility

- Data devices with RS-232 output
- Digital facsimile

Compliance with standards

- FCC Part 15, Subpart J, Class B
- FCC Part 68
- UL 1459
- UL/TUV/CSA (power supply)
- Tempest NACSIM 5100A
- TSG5 - on-hook acoustic security
- MIL-STD-1472 Acoustical Noise, Curve NC-35
- EMC/EMI MIL-STD-461C
- ESD 20 kV
- 21 host-nation approvals

Warranty

- 24 months standard
- 12-month extension or 5-year conversion
- Post-warranty service available

Options

- Carrying case

Note:
Specifications subject to change without notice. U.S. Government regulations apply for purchase.

AT&T
Surity Communications Products
Customer Service Center
P.O. Box 20046
Greensboro, NC 27420 USA
Phone: 800 243-7883
910 279-3411 (outside U.S. and Canada)

AT&T

AT&T Surity™ Voice/Data Terminal 1100 For Secure, Classified Applications

The AT&T *Surity* Voice/Data Terminal provides secure, classified voice and data communications in one integrated package.

It works both as a full-featured telephone for voice calls and as a smart modem for data applications. Part of an AT&T family of *Surity* products, the Voice/Data Terminal is compact and light enough to carry with you when you travel.

Developed under the U.S. Government's STU-III program, the terminal is approved for use by federal departments, agencies and government contractors.

Doctrine governing these and other STU-III products is established and controlled by the government.

One product for two jobs.

If you need both secure voice and secure data, the AT&T *Surity* Voice/Data Terminal can save you money. You won't need to clutter your desk with a secure phone *and* a secure modem.

Cost-saving transmission over public or government switched network.

AT&T's terminal is designed to secure both voice and data transmissions over public or government switched networks. You won't need an expensive, dedicated transmission path to ensure security. Data can be transmitted at speeds of 2.4, 4.8 and 9.6 kbps — voice at 2.4 and 4.8 kbps.

Protection for facsimiles, electronic mail and computer communications.

Whether you're accessing a computer database, sending a fax or using electronic mail, you can be sure your information is protected — regardless of the classification level.

Government-approved for unattended operation.

The AT&T *Surity* Voice/Data Terminal is approved by the government for unattended secure data transmission.* As a result, facsimiles and other data communications can be sent to you even while you're away from your office.

Superior voice quality.

In the past, making a secure telephone call has meant compromising voice quality. That's not the case with the AT&T *Surity* Voice/Data Terminal. We've made certain that the voice quality of your secure calls will be comparable to that of your clear (non-secure) calls.

Comprehensive service and support.

AT&T's toll-free hotline provides a single point of contact for comprehensive service and support. With a phone call, you can resolve a question, place an order, troubleshoot problems and more.

Repairs are hassle-free. If your terminal fails, we'll send you a replacement overnight. We're the *only* company in the industry to do so. And we stand behind the *Surity* Voice/Data Terminal with a full, two-year warranty and optional one-year extension or five-year conversion.

Feature-rich.

AT&T designed the *Surity* Voice/Data Terminal with features and functions that lead the market and support our customers' special needs.

- **Speakerphone.** A built-in speakerphone gives you hands-free operation for both secure and regular phone calls.
- **Access control.** The AT&T terminal is equipped with a unique Security Access Control System (SACS) that brings unmatched flexibility to applications requiring security.

  SACS allows you to establish a secure, closed network for both voice and data communications. You can control access for secure phone calls or facsimile transmissions and protect data stored on a PC or host computer.

  To do so, you simply program a list of authorized user IDs into your AT&T terminal. SACS automatically screens incoming calls, comparing the ID of the caller to those on your list. Unauthorized attempts are disconnected before the caller has access.

  You can also control access by setting your terminal for minimum or maximum security levels. Only calls with the appropriate classification level will be accepted.

  As an additional security feature, the AT&T *Surity* Voice/Data Terminal provides the information you need to maintain an audit trail of all attempts to access your network — whether successful or not.
- **Easy installation/operation.** Regardless of your application, the AT&T *Surity* Voice/Data Terminal is easy to set up and to operate. To install, you plug in the power cord and a telephone jack and connect the unit to your PC, facsimile machine or computer.

  After completing an automated key management procedure, the unit is ready to go secure.

  Operation is simple, and no special training is required.
- **Remote operation.** For data applications, you can control your AT&T *Surity* Voice/Data Terminal remotely from any fax, PC or computer connected to its RS-232 data port. Remote commands are based on the Hayes SmartModem 2400™ command set.
- **Compatibility.** The AT&T *Surity* Voice/Data Terminal is compatible with STU-III voice/data terminals currently fielded, including the 1000 and 2000 Series of AT&T *Surity* Communications Products.

For more information.

The AT&T *Surity* Voice/Data Terminal provides a cost-effective approach to your security needs. To find out more, call: 800 243-7883, or 910 279-3411 (outside the U.S. and Canada).

*National and local security policies apply.

AT&T

AT&T Surity™ Voice/Data Terminal 1100

Specifications

Information protected

- U.S. Government top secret, secret, confidential and unclassified

User community

- U.S. Federal Government
- U.S. Government contractors

Security features

- Security Access Control System (SACS)
- Fully automated STU-III fill procedures
- Maximum and minimum security level setting
- Display window for authentication identification
- Auto-answer, auto-secure
- Tempest
- Information to create a call audit trail
- Crypto-Ignition Key (CIK)
- Active and passive terminal zeroization

Key management

- Master CIK
- Four key sets
- Traveling CIK
- Eight CIKs per key set

Voice modes

- Clear voice
- Secure voice
  - 4.8 kbps full-duplex CELP
  - 4.8 kbps full-duplex HDLPC
  - 2.4 kbps full-duplex LPC10e
  - 2.4 kbps half-duplex LPC10e

Telephone features

- Speakerphone—clear and secure
- On-hook dialing with speakerphone
- Speakerphone volume control
- Pulse or tone dialing
- Last number redial
- Repertory dialing (32 numbers on single line/20 numbers on multiline)
- Programmable pause
- Dial tone detect
- Secure dialing
- Switch hook flash
- Automatic disconnect
- Ringer volume control
- Ringer cutoff
- Handset volume control
- Microphone mute (disconnects microphone on both handset and speakerphone)
- 2-line by 16-character Liquid Crystal Display (LCD)
- PABX compatible
- Autovon precedence signaling clear and secure
- Autovon preempt detection clear and secure
- Multiline Model 1150 for use with 1A key systems (optional)

Secure data operational modes

- 9.6 kbps full-duplex sync/async
- 4.8 kbps full-duplex sync/async
- 2.4 kbps full-duplex sync/async
- 2.4 kbps half-duplex sync

Modem characteristics

- Near/far echo cancellation
- Frequency offset compensation
- 9.6 kbps: CCITT V.32 secure; sync/async; full duplex with optional trellis coding
- 4.8 kbps: CCITT V.32 secure; sync/async; full duplex
- 2.4 kbps: CCITT V.26 bis secure; sync async; full duplex
- 2.4 kbps: CCITT V.26 bis secure; sync; half duplex
- Input level: 0 to -43 dBm
- Output level: adjustable, 0 to -15 dBm
- Automatic rate fallback: from 9.6 and 4.8 kbps to 2.4 kbps

Interfaces

- External power supply, IEC 320, CEE-22 connector
- EIA RS-232 data port with a 25-pin D-connector
- RJ11/RJ13 telephone jack to connect to public switched network, PABX or key system
- Autovon 2-wire
- A/A1 leads (for use with key telephone systems)

Physical characteristics

- 9"w x 3.25"h x 11"d (22.9 cm x 8.2 cm x 27.9 cm)
- 10 lbs. (4.5 kg)

Environmental

- Operating temperature: 40 to 100ºF (4.5 to 38ºC)
- Storage temperature: -40 to 150ºF (-40 to 66ºC)
- Relative humidity (storage): 5% to 95% noncondensing

Power

- External power supply auto ranging, 90-253V ac
- Input frequency 47-63 Hz
- Input power dissipation 16 watts

Equipment interoperability

- STU-III LCT, A and Cellular

Equipment compatibility

- Data devices with RS-232 output
- Digital facsimile

Compliance with standards

- FCC Part 15, Subpart J, Class B
- FCC Part 68
- UL 1459
- UL/TUV/CSA (power supply)
- NSTISSAM Tempest 1-91
- TSG 5 - on-hook acoustic security
- MIL-STD-1472 Acoustical Noise, Curve NC-35
- EMC, EMI MIL-STD-461C
- ESD 20 kV
- HEMP-NSA 77-27
- 21 host-nation approvals

Warranty

- 24 months standard
- 12-month extension or 5-year conversion
- Post-warranty service available

Options

- Carrying case
- Multiline (5 lines and hold; to be used with 1A key systems)
- Push-to-talk handset
- FWA-1 four-wire/two-line adapter

Note:
Specifications subject to change without notice. U.S. Government regulations apply for purchase.

AT&T
Surity Communications Products
Customer Service Center
P.O. Box 20046
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Phone: 800 243-7883
910 279-3411 (outside U.S. and Canada)

6 94

DIS Daemon

Network Interface Unit

The most flexible, portable DIS toolkit available *anywhere*.

Proven Technology

Developed by Motorola and NAWC-TSD and enhanced by DiSTI, the DIS Daemon is being used on a number of programs, including JSTARS, BFTT, and NASNET. One of the first applications of its kind the DIS Daemon has been in use since 1992.

Flexible and Scalable Architecture

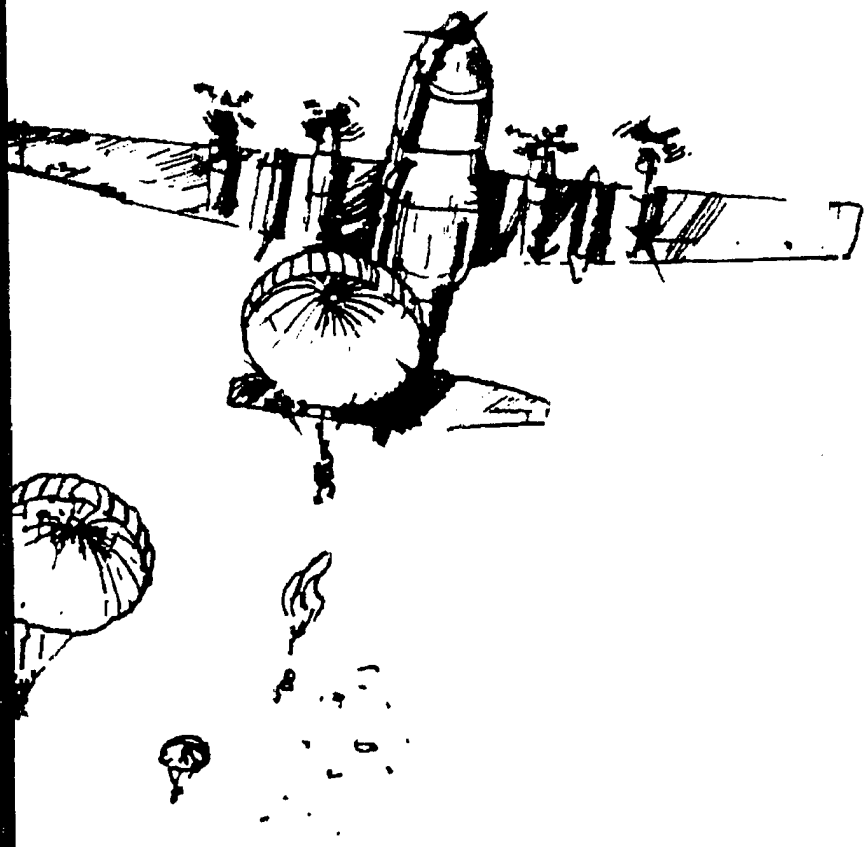
Multiple applications can attach simultaneously to the DIS Daemon to share one DIS network interface, a feature which costs extra with other DIS interfaces. The DIS Daemon can run under UNIX or can be embedded on a VME Single Board Computer (SBC) to free the host system from DIS processing. If more power is needed, then the DIS Daemon can be distributed across up to three processors.

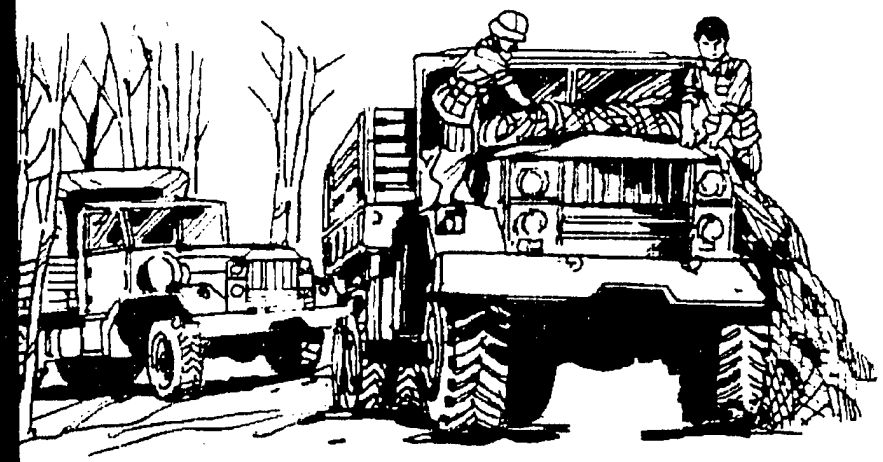
Cross Platform Portability

Applications which use the DIS Daemon are readily portable to most UNIX systems and real-time systems, without the need for special compilers or proprietary libraries. The DIS Daemon itself can easily be ported to new environments, since complete commented source code is available. No other product offers this capability.

Support

DiSTI, the leader in DIS education has the expert staff to answer your questions about DIS and real time systems. Plus, the DiSTI staff is well versed in the issues of DIS compliance testing.





MOTOROLA

NAWC

DiSTI

DIS Daemon
Network Interface Unit

Key Features

Certified DIS Interface supports DIS versions from 2.0.3 to the latest draft standard

Scalable performance--split the DIS load over multiple CPUs

Runs on over a dozen different operating systems

Source code at no extra cost for government purpose customers

One Daemon supports multiple DIS applications simultaneously at no extra cost

Simple but powerful configuration files to configure almost any option

Complete Set of Entity Management Functions
- Built-In support for Simulation Management
- Automatically issues Entity State PDUs
- Implements *all* DIS Dead Reckoning Algorithms
- *Automatic* entity collision detection and PDU generation
- Entity position smoothing

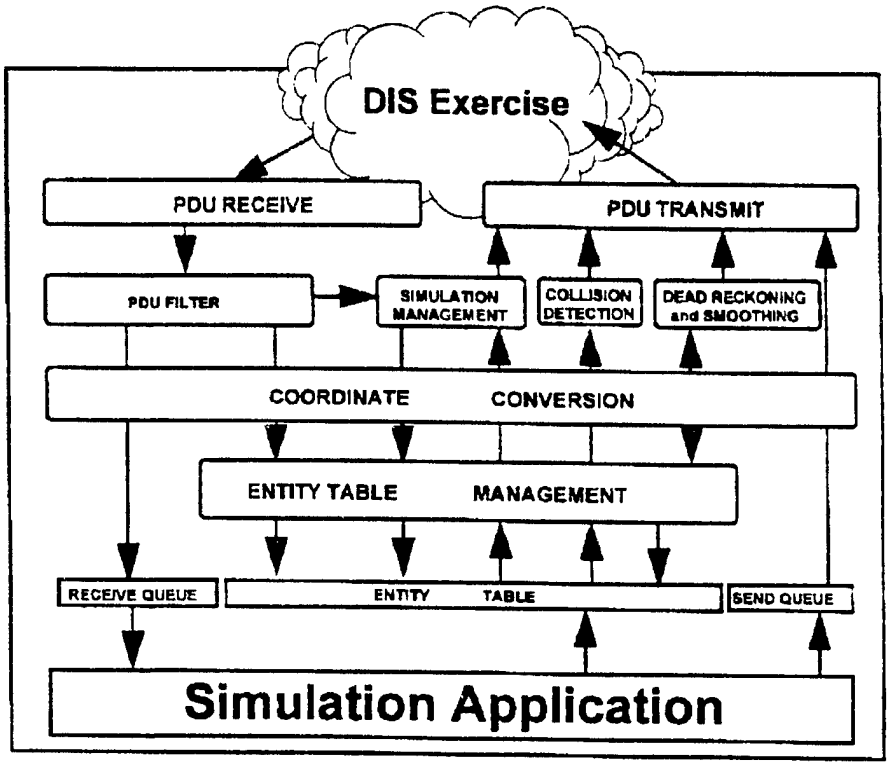
Automatic Conversion to Geodetic, UTM, Topocentric, and Geocentric coordinates

Byte swaps PDUs on little-endian computers

Filter by location, PDU type, exercise, or any part of the entity type field

Intuitive X Windows User Interface

Logger and Playback software included



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SPARCstation 4: The Low-Cost System for High-Performance Network Computing.

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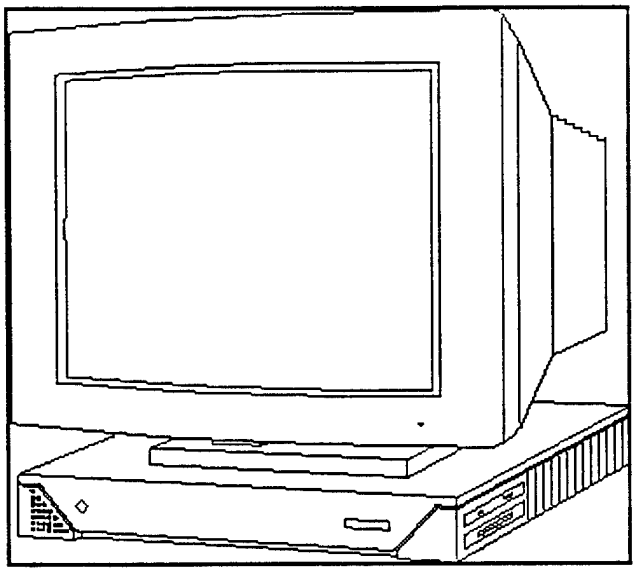
- It's expandable enough to keep pace with your business.
- The Innovative, energy-efficient design saves more than just money.
- SPARCstation 4 Specifications.



In today's hurry-up work world, you can't wait for your computers to catch up. Whatever job your group does -- computer-aided software engineering, management and support, telemarketing, customer service -- your desktop systems have to be responsive enough to keep your people productive, yet inexpensive, so everyone can have one.

That's the essence of the SPARCstation 4 system. Driven by a powerful 110-MHz microSPARC-II processor, the SPARCstation 4 delivers all the balanced application performance you could want in an entry-level system. Accelerated screen performance means fills, text, and scrolling are remarkably fast. Powerful, flexible video memory augments screen speed even more, in resolutions as high as 1280 by 1024 -- with no degradation. And with the pixel accelerator's reduced circuitry, the SPARCstation 4 delivers power and functionality to the desktop at a very affordable price.

Plus, you benefit from the high-performance, feature-rich Solaris® operating environment, the most powerful, popular, and easy-to-use 32-bit operating environment in the industry. Link that with the SPARCstation 4's multitasking ability, and you can run all your UNIX, Macintosh, MS-Windows, and

MS-DOS applications from this single desktop system -- simultaneously.

Advanced networking lets you share files and applications with your coworkers, too, regardless of where they're working. In addition, your entire network has access to the workgroup and enterprise information they need to make well-informed business decisions.

It's expandable enough to keep pace with your business.

Sometimes you don't need just more memory; you need control over what kind, how much, and what it costs. That's the beauty of the SPARCstation 4: you gauge and pay for only the memory you require to make *your* graphics applications run at their peak. Floppy-disk and CD-ROM drives and audio and video memory expansion are options if you need them. Up to 160 MB of memory expansion is available using 8- or 32-MB SIMMs. And the 10-MB/sec SCSI-II bus puts you in touch with a possible 55 GB of external mass storage and lets you access that data with incredible speed.

The innovative, energy-efficient design saves more than just money.

In today's economy, businesses are always on the lookout for innovative ways to reduce costs. And increasingly, those businesses are realizing cost savings by cutting energy consumption. That's why the Energy-Star-compliant SPARCstation 4 has so many features that help cut utility costs built right in.

For example, the system automatically enters a power-save state when it's not in use. And its 50-watt power supply - smaller than on most PCs - cuts power consumption and reduces the demand on air-conditioning systems, while the smaller cooling fan lets the system run quieter, too. Your business wins and so does the environment.

Fast, well-balanced performance, built-in advanced networking, flexible expansion, and stingy with energy, the SPARCstation 4 is a true example of what's best about the open network computing promise.

SPARCstation 4 Specifications

Processor

Architecture: SPARC Version 8, 110-MHz microSPARC-II
Memory management: SPARC reference MMU with 256 contexts
Cache: 8-KB data and 16-KB instruction on chip

Main Memory (Parity)

8- and 32-MB SIMM expansion
40 MB maximum (with 8-MB SIMMs)
160 MB maximum (with 32-MB SIMMs)

Standard Interfaces

Ethernet: 10-Mb/sec twisted-pair standard (10-BaseT); AUI standard
SCSI: 10-MB/sec SCSI-2 (synchronous)
Serial: One RS-232C/RS-423 serial port
Second asynchronous serial port available (adapter cable required)
Parallel: Centronics-compatible parallel port

Audio: Optional 16-bit audio; 48 kHz; internal speaker and external microphone (audio module required)
SBus: One expansion slot; 32-bit data bus width

Mass Storage

Internal floppy disk: Optional 3.5-in. MS-DOS/IBM® compatible (720 KB, 1.2 MB, 1.44 MB formatted)
Internal CD: Optional 644-MB SunCD 2Plus; double speed, PhotoCD compatible
Internal disk: One 3.5-in. x 1-in. pluggable disk (1.05 GB formatted)
External desktop storage: Disk: 1.05 GB 3.5-in.; 2.1 GB 3.5-in.; 4.2 GB 3.5-in.; 55 GB max. (using 4.2-GB external disks); 644-MB CD-ROM; Tape: QIC-150; 5-GB 4mm, 14-GB 8mm DAT; 20-GB 4mm DAT auto loader

Graphics

8-bit pixel-accelerated
1024 x 768, 1152 x 900 res. standard
1280 x 1024 res. optional (video memory expansion SIMM required)

Monitor Options

17-in. entry color:	1024 x 768 resolution, 77-Hz refresh rate, 100 dots per inch
	1152 x 900 resolution, 66-Hz refresh rate, 100 dots per inch
17-in. color:	1152 x 900 resolution, 76- or 66-Hz refresh rate, 100 dots per inc
	1280 x 1024 resolution, 76- or 66-Hz refresh rate, 110 dots per in
20-in. color:	1152 x 900 resolution, 76- or 66-Hz refresh rate, 84 dots per inch
	1280 x 1024 resolution, 76- or 66-Hz refresh rate, 93 dots per inc

Input Devices

Keyboard: Sun Type 5; AT 101 or UNIX layout available; more than 18 international keyboards available
Mouse: Optical, 3-button
Microphone: SunMicrophone II
Color camera: Optional SunVideo

Software

Operating system: Solaris operating environment
Languages: C, C++, Pascal, FORTRAN
Networking: ONC, NFS, TCP/IP, SunNet OSI, MHS
Windowing system: OpenWindows Version 3
Graphics: SunPHIGS, XGL, XIL, SunGKS, Xlib, PostScript

Environment

AC power: 100-240 VAC, 50-60 Hz, 125 VA (74 W max)
Operating: 0° C to 40° C (32° F to 104° F) 5% to 95% relative humidity, noncondensing
Nonoperating: -40° C to 70° C (-40° F to 158° F) 5% to 95% relative humidity, noncondensing
Operating acoustic noise: 4.5 bels (at 28° C)

Idling acoustic noise: 4.1 bels (at 28° C)
Declared noise emissions in accordance with ISO 9296
Energy Star-compliant chassis, 15-in., 17-in., and 20-in. color monitors

Regulations

The initial state of the 50 watt power supply after outage is off. The system must be rebooted manually after a power outage.

Meets or exceeds the following requirements:
Safety: UL 1950, CSA 950, TUV EN 60950
RFI/EMI: FCC Class B, DOC Class B, EN 55022 Class B, VCCI Class 2
X-ray: DHHS 21, Subchapter J; PTB German X-ray Decree

Dimensions and Shipping Weight

SPARCstation 4 chassis
Height: 7.7 cm (3.1 in.)
Width: 41.7 cm (16.4 in.)
Depth: 40.9 cm (16.1 in.)
Weight: 12.7 kg (27.0 lb.)

17-in. color monitor
Height: 41.4 cm (16.4 in.)
Width: 40.6 cm (16.0 in.)
Depth: 45.0 cm (17.7 in.)
Weight: 25.9 kg (57.0 lb.)

17-in. color monitor
Height: 43.0 cm (14.6 in.)
Width: 42.7 cm (14.7 in.)
Depth: 48.3 cm (15.4 in.)
Weight: 19.0 kg (37.4 lb.)

20-in. color monitor
Height: 47.1 cm (18.5 in.)
Width: 47.5 cm (18.7 in.)
Depth: 49.5 cm (19.5 in.)
Weight: 36.3 kg (80.0 lb.)

Upgrades

Upgrades are available for the SPARCstation SLC, SPARCstation ELC, SPARCclassic, SPARCstation IPC, SPARCstation 1, SPARCstation 1+, SPARCstation LX, SPARCstation IPX, SPARCstation 2, Sun-3, and Sun386i systems.

Specifications are subject to change without notice.

SPARCstation 5: System Architecture

SPARCstation 5 System: Fast Application Performance

Technology Overview

Through a fully balanced hardware design, the SPARCstation 5 system delivers the very fast application performance that enterprise desktop users need today.

New microSPARC-II Processor

Features	Benefits
- Choice of 85-MHz or 110-MHz processor	- Fast application performance at a low cost
- 16 KB of instruction cache - 8 KB of data cache - Improved floating-point unit - New memory management unit with 256 context switches - Access to up to 256 MB of memory	

High-Speed Memory Bus

Feature	Benefit
- 64-bit high-speed memory bus	- Provides fast data throughput between CPU/memory and 24-bit graphics

SBus

Feature	Benefit
- 32-bit SBus	- High-performance industry-standard bus for fast graphics and fast I/O performance

Fast SCSI II Bus Interface

Feature	Benefit
- 10-MB/sec. SCSI II	- Fast access and retrieval of mass storage

SPARCstation 5 S24 24-Bit Color Frame Buffer

Feature	Benefit

- 24-bit color, 1152 x 900 resolution	- Lowest-priced 24-bit imaging and fast windows

SPARCstation 5 TurboGX Accelerator

Features	Benefits
- 8-bit accelerated color - 1152 x 900 resolution - 772,000 2-D vectors/sec. and 462,000 3-D vectors/sec.	- Provides swift interactive performance and optimum handling of complex 2-D and 3-D wireframe graphics

SPARCstation 5 TurboGXplus Accelerator

Features	Benefits
- 8-bit accelerated color	- Provides significantly increased 2-D and 3-D wireframe graphics performance
- 1280 x 1024 resolution - More than 1.7 million 2-D vectors/sec. and 564,000 3-D vectors/sec.	- Supports high-resolution monitors - Double-buffered for smooth rendering of complex wireframe objects

SPARCstation 5 ZX Accelerator

Features	Benefits
- 24-bit accelerated color - 1280 x 1024 resolution, - 350,000 shaded triangle mesh/sec., - 750K 3-D vectors/sec. 130K shaded, lit quads/sec., - 450K 3D AA vectors/sec.	- Fastest low-cost 3-D graphics performance in the industry

SPARCstation 5 System: Low-Cost Expandable Package

Innovative Packaging

The SPARCstation 5 system's innovative package furnishes the foundation for the growth and innovation that the network needs, and saves desktop space as well.

Features	Benefits
- 409 mm x 416 mm x 78 mm	- New design saves valuable desktop spac industry-leading internal expansion; m be placed on the box
- Support for up to four internal devices, including one or two 10-MB/sec. 535-MB, 1.05-GB or 2.1-GB pluggable internal disk drives	- Fast access to more than 4 GB of data
- Optional internal CD-ROM drive	- Supports current and future networked media and other application requiremen
- Optional internal floppy disk drive	- Supports current and future applicatio requirements, such as Wabi and SunPC

	software products
- Support for up to 256 MB of memory	- Easy to add memory as requirements gro
- Three 32-bit SBus slots	- Industry standard bus provides for exp allowing for requirements such as SunV SunATM, and SunFastEthernet adapters
- Two synchronous serial ports	- Ensures fast serial support for modems and other I/O devices
- One parallel port (optional cable required)	- Provides bidirectional parallel port f I/O requirements
- Twisted-pair Ethernet; AUI Ethernet (optional cable required)	- Built-in integrated networking allows easy connection into the networked ent
- 16-bit audio, line in/out, headphone, and microphone	- Offers high-quality audio for telephon digital media applications

SPARCstation 5 System: Investment Protection for the Future

Upgradable to a SPARCstation 20 System

One of the unique features of the SPARCstation 5 system is that it offers excellent investment protection. Through a simple board swap, the SPARCstation 5 system can be upgraded to the SPARCstation 20 desktop system.

Features	Benefits
- Identical package used for the SPARCstation 5 and SPARCstation 20 systems	- Offers excellent investment protection; same power supply, internal disk drives CD-ROM, and internal floppy drive
- Simple board swap upgrade to a SPARCstation 20 system	- Provides a very low-cost path to SuperS hyperSPARC, and SuperSPARC-II multiprocessing technologies

SPARCstation 5 S24 System: The Lowest Cost 24-Bit Imaging Solution in the Workstation Industry

SPARCstation 5 S24 Graphics

The SPARCstation 5 S24 is a new 24-bit true color frame buffer that offers the lowest-priced 24-bit imaging solution in the industry. The SPARCstation 5 S24 system provides competitive 24-bit graphics capabilities at the lowest cost in the industry, while taking advantage of the network-ready and multitasking capabilities found standard on Sun workstations. The SPARCstation 5 S24 offers new visual computing capabilities at an exceptional price/performance for a variety of application areas that are becoming increasingly color-intensive, including color document imaging, graphics design, color publishing, GIS, computer-based education and customer service.

Features	Benefits
- 24-bit true color output, 16.7 million simultaneous pixel colors	- Produces highest quality display outpu - Eliminates color map flashing in most

- Interfaces to 64-bit wide memory bus instead of SBus	- High bandwidth interface for fast data between system and video memory provid throughput required by 24-bit applicat
	- Reduces cost by eliminating the need f hardware accelerators
- Simultaneous display of 24-bit true color, direct color, linear color (via gamma correction LUT) and 8-bit indexed color	- 24-bit color applications can run simu 8-bit color or grayscale applications
- Acceleration for block copies and stipples	- Provides fast window and bitmap operat

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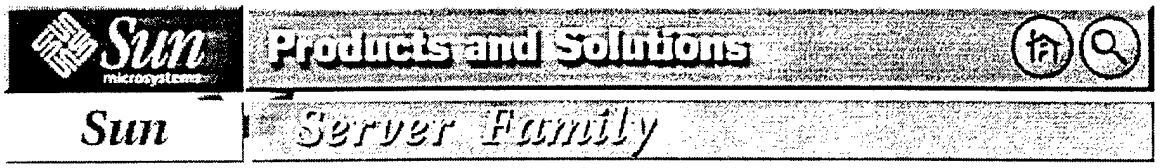

Sun Announces Fastest SPARCstation 20, SPARCserver 20

MENLO PARK, Calif., October 31, 1995- Continuing its drive to provide power desktop users with the best value in the industry, Sun Microsystems Computer Company today announced the fastest multiprocessor and uniprocessor systems in the company's popular SPARCstation™ 20 family of high-performance workstations.

The new desktops sport a powerful 150 MHz SPARC™ processor with 512 Kilobytes of cache and provide a 30 percent performance improvement over current SPARCstation 20 systems. The multiprocessor SPARCstation 20 model 152MP features two 150 MHz SPARC processors. The new SPARCstation 20 TurboGX™ model 151 uses a single 150 MHz SPARC processor. Yet it is priced at only $18,995 for 32 megabytes of memory, a 1-gigabyte disk drive and 20-inch high-resolution color monitor.

Sun, which holds more than 90 percent of the UNIX® multiprocessing workstation market, is pricing the new dual-processor SPARCstation 20 model 152MP as low as $25,495.

The company also unveiled the first desktop server based on the 150 MHz SPARC processor, the SPARCserver™ 20 model 151 and model 152MP, which provides a 30 percent boost in compute server performance. Additionally, Sun announced repricing of the most popular SPARCstation 20 and SPARCserver 20 systems by up to 15 percent, as well as new pricing for upgrades and SPARC™ module x-options.

"Our customers are anticipating the announcement of our UltraSPARC systems," said Gene Banman, vice president and general manager of Sun's Desktop Systems Group. "But these new SPARCstation 20 desktops are another major milestone in Sun's ongoing strategy to offer the best value in the industry to power desktop users. The new systems, plus the price reductions and upgrade program for current users, emphasize Sun's commitment to deliver increasing performance while preserving the users' investments in hardware and software, especially for Solaris 1 users."

The new high-end SPARCstation 20 desktop is a general-purpose system designed for performance-conscious users running a range of applications, including modeling, simulation, MCAD and EDA, or any application with compute-intensive requirements.

Systems With 30 Percent Better Performance; Excellent Upgrade Options

The uniprocessor SPARCstation 20 model 151 features 169.4 SPECint92 and 208.2 SPECfp92. The dual-processor SPARCserver 20 model 152MP features 7310 SPECrate_int92 and 8758 SPECrate_fp92.

The SPARCstation 20 TGX model 151 with a 150 MHz SPARC processor with 512 Kbytes of cache, 32 Mbytes of memory, expandable to 512 Mbytes; a 1 gigabyte disk drive, expandable to 353 gigabytes; four SBus expansion slots, accelerated graphics and a 20-inch high-resolution color display sells for $18,995. The dual-processor model 152MP with 64 Mbytes of memory, a 1 gigabyte disk drive, four SBus slots and a 20-inch color monitor sells for $25,495. Comparably equipped systems from Hewlett-Packard list for more than $21,000 for a uniprocessor system or more than $34,000 for a multiprocessor system. A comparable uniprocessor system from SGI lists for more than $23,000.

The SPARCserver 20 model 151 comes standard with 32 Mbytes of memory, one 2.1 gigabyte internal

disk drive and four SBus expansion slots and sells for $17,495. The model 152 with 64 Mbytes of memory and two 2.1 gigabyte drives sells for $28,795.

The 150MHz SPARC MBus modules are fully compatible with current SPARCstation 20 and SPARCstation 10 systems. Users simply replace their existing processor modules for a 30-percent performance increase while maintaining 100-percent binary compatibility with all their applications.

Both the SPARCstation and SPARCserver 20 model 151 systems require the Solaris™ 1.1.2, Solaris 2.4 or later operating environment. The dual-processor model 152MP systems require the Solaris 2.4 operating environment. Price Reductions of 15 Percent In addition to announcing the new workstation models, Sun has also repriced its current SPARCstation and SPARCserver 20 families, as well as system upgrades and x-options by as much as 15 percent. Specifically, the price of the SPARCstation 20 model 71 with a 20-inch monitor has been reduced from $19,795 to $16,995, and the price of the model 712MP with a 20-inch monitor has been lowered from $25,295 to $21,495; the price of the model HS21 with a 20-inch monitor has been reduced from $18,995 to $16,995; and the price of the model HS22MP has been reduced from $24,495 to $21,495. The new SPARCstation 20 model 151 and model 152MP desktop systems, desktop servers, upgrades and options will be available in December, 1995. Sun Microsystems Computer Company is a world leader in the design, manufacture and sale of network computing systems and is a division of Sun Microsystems, Inc. Recognized for quality and innovation, the company's SPARC™ workstations and multiprocessing servers each hold the No. 1 UNIX® marketshare position. These systems are used primarily by businesses, educational institutions and governments worldwide for technical, commercial, industrial and software development applications.

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Sun microsystems Products and Solutions

SPARCstation 20 -- Overview

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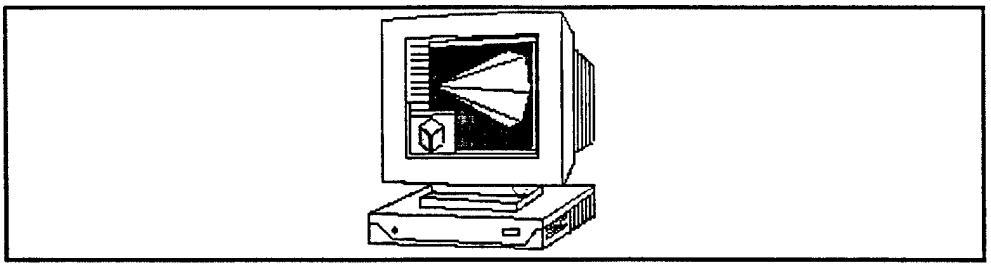
- The SPARCstation 20 System: The Networked UNIX Desktop Performance Leader
- Building on the Industry's Most Successful Desktop

The SPARCstation 20 System: The Networked UNIX Desktop Performance Leader



The Industry's Highest Performance Multiprocessing Network Desktop

The SPARCstation 20 system is the highest performance desktop system in the industry -- offering unmatched architecture and system balance, powerful multiprocessing, and advanced graphics and imaging. The expandability and upgradability, networking, and throughput further enhance the performance of the SPARCstation 20 system.

- The SPARCstation 20 provides unmatched architecture and system balance
  - Choice of powerful processors: 50-MHz SuperSPARC, 60-MHz SuperSPARC, 75-MHz SuperSPARC-II, 100-MHz hyperSPARC(tm), and 125-MHz hyperSPARC
  - MBus: Separate, high-speed CPU memory bus
  - Fast, large memory and disk technologies

- Powerful multiprocessing
  - Two-way MP systems include Models 502MP, 612MP, 712MP and HS22MP
  - Four-way MP systems include Models 514MP and HS14MP. The Model HS14MP offers the highest desktop compute performance available using the SPECrate industry benchmark

- Advanced graphics and imaging technologies
  - SX integrated 24-bit true color graphics and imaging standard on every system -- enabling the world's fastest Adobe Photoshop desktop -- as demonstrated at Siggraph 1994
  - Options for fast 2-D 8-bit graphics acceleration (TurboGX and TurboGXplus(tm) frame buffer) and industry-leading 3-D graphics (ZX and TurboZX frame buffer)

  - Freedom series graphics accelerators for the highest performance 3-D graphics available on the market

- Industry-leading expandability and upgradability
  - Modular processor and multiprocessing design make it easy to upgrade processors. Expanding disk, memory, networking, and graphics is easy through the SPARCstation 20 options
  - Upgrading from the SPARCstation 5 to the SPARCstation 20 is as easy as swapping a board

- Industry's highest performance networking and connectivity
  - Each SPARCstation 20 has integrated twisted-pair and AUI Ethernet, plus other I/O ports, including serial and parallel ports
  - Advanced networking options include 100-Mbps Fast Ethernet, ATM, FDDI, and ISDN

- Industry's fastest throughput
  - The 50-MHz MBus and 25-MHz SBus deliver more than 400-MB/sec. system throughput, providing industry-leading system bandwidth
  - Enables advanced networking and growth to higher performance processors and multiprocessing

SPARCstation 20 System Models

Uniprocessor systems

SPARCstation 20	Entry Level			High Performance	
	Model 50	Model 51	Model 61	Model 71	Model HS
Processor speed	50 MHz	50 MHz	60 MHz	75 MHz	125 MHz
External Cache	None	1 MB	1 MB	1 MB	256 KB
No. of processors	One	One	One	One	One
MBus/SBus speed	50/25 MHz	50/20 MHz	50/25 MHz	50/25 MHz	50/25 MH
SPECint_92	76.9	81.8	98.2	125.8	131.2
SPECfp_92	80.1	89.0	107.2	121.2	153.0
SPECrate_int92	1824	1940	2329	2984	3112
SPECrate_fp92	1900	2111	2543	2875	3629

Multiprocessor systems

SPARCstation 20 Model	502MP	612MP	712MP	HS22MP	514MP	HS14MP
Processor speed (MHz)	50	60	75	125	50	100
External Cache (size/CPU)	None	1 MB	1 MB	256 KB	1 MB	256 KB
No. of processors	Two	Two	Two	Two	Four	Four
MBus/SBus speed (MHz)	50/25	50/25	50/25	50/25	40/20	50/25

SPECint_92	NA	NA	NA	NA	NA	NA
SPECfp_92	NA	NA	NA	NA	NA	NA
SPECrate_int92	3218	4492	5726	5600	7072	8124
SPECrate_fp92	3193	4888	5439	6399	7341	8906

Performance scales differ between the family of SuperSPARC processor-based SPARCstation 20 systems and the new hyperSPARC processor-based SPARCstation 20 systems due to the different processor performance characteristics and different processor cache memory design. The hyperSPARC processor-based models should not be positioned on SPECmark performance or processor speed (MHz) numbers alone.

The performance profile of the hyperSPARC processor-based SPARCstation 20 (e.g. Model HS21, HS22MP, or HS14MP) is ideally suited for compute-intensive applications such as design simulation, modeling and analysis applications that benefit from the strong floating-point performance and fast cache memory design.

The SPARCstation 20 Model 71 with 1-MB SuperCache is Sun's application performance leader for 3-D graphics, MCAD, and general-purpose power markets.

Entry Markets

- The SPARCstation 20 offers advanced desktop performance and features for cost-sensitive markets. No other entry desktop system offers the integration of advanced technologies with the performance and expansion capabilities of the SPARCstation 20
  - Features the compute and graphics performance, multiprocessing, and system expansion potential of advanced desktop technology
  - Complete desktop system is superior to other entry-performance desktop systems and high-end PC systems (integrated networking, advanced graphics and options, high disk and memory capacities)
  - Offers SX 24-bit true color graphics and imaging, and 1280 x 1024 resolution at entry prices

Traditional Markets

- Price/performance leadership for traditional workstation requirements
  - The industry's most popular workstation is now more powerful

Advanced Markets

- Industry-leading graphics, compute, and multiprocessing performance requirements
  - Compute performance requirements: The Power of MP
  - Most cost-effective method to increase system performance
  - Highest performance available on the desktop
  - Performance for advanced graphics requirements

Target Applications for Sun SPARCstation Desktop Systems

	SPARC Xterminal 1	SPARCstation 4	SPARCstation 5	SPARCstation 20 SuperSPARC	SPARCstation 20 hyperSPARC
Application Areas	Software dev. Shop/plant floor CAD viewing/ redlining Document viewing	Software dev. Tech pubs Entry-level drafting Document authoring	Software dev. 2-D mech CAD 3-D wireframe Schematic a capture HDL design Architectural design Medical imaging Graphic design GIS - 2-D mapping Color imaging Document authoring	3-D wireframe 3-D MCAD Mechanical eng. analysis FEA preprocessing Solid modeling styling/ industrial design Animation preview/ scripting Medical imaging Seismic visualization Scientific visualization Photo retouching Color imaging Digital effects Technical illustration	PCB routing EDA - circuit simulation EDA - synthesis simulation Color imaging Seismic analysis Financial modeling

	SPARC Xterminal 1	SPARCstation 4	SPARCstation 5	SPARCstation 20 SuperSPARC	SPARCstation 20 hyperSPARC
Example Applications	Frameview Worldview Acrobat Cyberleaf Cadre Centerline	Interleaf FrameMaker Island Workshop Cadre Centerline Xyvision AutoCAD	AutoCAD Pro/JR Medical Imaging Resellers Adobe Illustrator Cadre Centerline CorelDraw	Marc & Mentat CDRS I-DEAS PV-Wave Pro-Engineer CADDS5 EDS/ Unigraphics Adobe Photoshop Adobe Illustrator Electrogig Landmark NASTRAN	Dracula Checkmate VCS MT SpeedWare Landmark Spice

Building on the Industry's Most Successful Desktop

Positioning

The SPARCstation 20 System at a Glance

Product Specifications	SPARCstation 20 and SPARCserver 20 systems	
Dimensions	417 mm x 409 mm x 77 mm	
Weight	12.7 kg	
CPU		
Architecture	SuperSPARC / SuperSPARC-II	hyperSPARC[1]
Cache on chip	36 KB per CPU	8 KB
External cache	1 MB per CPU (except Models 50 and 502MP)	256 KB
Multiprocessing	Expandable to four	Expandable to four (100 MHz only)
Memory	32 - 512 MB	
Memory type	ECC	
DRAM speed	60 ns	
Bus width	144 bits	
SIMM sizes	16, 32, 64 MB	
Storage	10-MB/sec. SCSI	
Maximum internal	2.1 GB	
Maximum external	138 GB with SPARCstorage Array	
I/O architecture	SBus	
SBus slots	Four 25-MHz slots[2]	
Serial ports	Two	
Parallel port	One	
Networking ports	Twisted-pair Ethernet AUI Ethernet (requires optional AUI adapter cable) Optional ISDN, ATM, FDDI, Fast Ethernet	
Backup and distribution		
Internal	Optional 3.5-inch floppy Optional SunCD 2Plus drive	
External	150-MB .25-inch tape 14-GB 8mm tape 5.0-GB 4mm DAT 20-GB 4mm DAT autoloader SPARCstorage Library Model 8/140	
Operating system	Solaris® 1.1.1 Version B or 1.1.2[3] Solaris 2.3 or 2.4[4]	

Notes

1. Not available as server configuration
2. Models 514MP and HS14MP support two SBus slots
3. Model HS21 requires Solaris 1.1.2 or Solaris 2.4: Hardware 11/94 operating system
4. Model HS22MP and HS14MP requires Solaris 2.4: Hardware 11/94 operating system

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SPARCstation 20 Model HS11

SPARCstation 20 Model HS11 Specifications

Performance

Model	HS21	HS22MP	HS14MP
Processor(s)	1 x 125 MHz hyperSPARC	2 x 125 MHz hyperSPARC	4 x 100 MHz hyperSPARC
SPECint_92	131.2	N/A	N/A
SPECfp_92	153	N/A	N/A
SPECrate_int92	3112	5600	8124
SPECrate_fp92	3629	6399	8906

Processor

Architecture	hyperSPARC
Memory management	SPARC reference MMU with 4096 contexts
Cache	256 KB
CPU interface	Two 64-bit MBus slots for multiprocessing

Main Memory

16-, 32-, and 64-MB SIMM expansion
128 MB maximum (with 16-MB SIMMs)
256 MB maximum (with 32-MB SIMMs)
512 MB maximum (with 64-MB SIMMs)

Standard Interfaces

Ethernet	10-Mb/sec. twisted-pair standard (10-BaseT): AUI available with optional adapter cable
SCSI	10-MB/sec. SCSI-2 (synchronous)
Serial	Two RS-232C/RS423 serial ports
Parallel	Centronics-compatible parallel port (cable required)
Audio	16-bit audio, 8 to 48 kHz; internal speaker and external microphone
SBus	Four expansion slots; 64-bit data bus width

(32-bit compatible)

System Mass Storage

Internal floppy disk	Optional 3.5-in. MS-DOS / IBM compatible (720 KB, 1.2 MB, 1.44 MB formatted)
Internal CD	Optional 644-MB SunCD 2Plus, double-speed, Photo CD compatible
Internal disk	Up to two 3.5-in. disks (535 MB or 1.05 GB formatted)

External Mass Storage

Disk	535 MB, 1.05 GB; 2.1 GB disk pack; 4.2 GB or 8.4 GB multidisk pack; 31.5 GB or 63 GB SPARCstorage Array
Tape	150-MB .25-in. QIC-150; 14 GB 8mm tape; 5 GB 4mm DAT; 20 GB 4mm DAT auto-loader; SPARCstorage Library Model 8/140

Graphics

SPARCstation 20 (SX)	Accelerated 24-bit 2-D/3-D graphics and imaging, high-speed convolution, rotation, panning, zooming, color conversion, 24-bit double buffering, 24-bit Z-buffer, Gouraud shading, up to 1280 x 1024 at 76-Hz
SPARCstation 20 TurboGX	8-bit 2-D/3-D wireframe, up to 1152 x 900 at 76-Hz
SPARCstation 20 TurboGXplus	8-bit 2-D/3-D wireframe, up to 1280 x 1024 at 76-Hz, hardware double buffering
SPARCstation 20ZX	High-performance 3-D graphics, 24-bit double buffering, 24-bit Z-buffer, transparency, Gouraud shading, nonuniform rational b-splines, anti-aliasing, depth cueing, up to 1280 x 1024 at 76-Hz, stereo 960 x 680 at 112-Hz
SPARCstation 20 TurboZX	Same as above, plus up to twice the graphics rendering performance
SPARCstation 20M	Color camera, SunVideo real-time video capture and compression, SX graphics
SPARCstation 20 with Freedom Series	Very high performance 3-D graphics, Gouraud shading, Phong shading, anti-aliasing, depth-cueing, Alpha blending, high-speed hardware

	texture mapping and MIP mapping, dynamic pixel allocation, stereo viewing option, video in/out option, up to 1536 x 1280 resolution

Monitor Options

17-in. color	1152 x 900 res., 76- or 66-Hz refresh rate, 100 dots per inch; 1280 x 1024 res., 76- or 66-Hz refresh rate, 110 dots per inch
20-in. color	1152 x 900 res., 76- or 66-Hz refresh rate, 84 dots per inch; 1280 x 1024 res., 76- or 66-Hz refresh rate, 93 dots per inch; 960 x 680 res., 112-Hz refresh rate, 70 dots per inch

Input Devices

Keyboard	Sun Type 5; AT 101 or UNIX layout available; more than 18 international keyboards available
Mouse	Optical, 3-button
Microphone	SunMicrophone II
Color camera	Optional SunVideo and SunCamera

Software

Operating system	Solaris operating environment
Languages	C, C++, Pascal, FORTRAN, FORTRAN MP
Networking	ONC, NFS, TCP/IP, SunNet OSI, MHS
Windowing System	OpenWindows Version 3
Graphics	SunVision, SunPHIGS, XGL, XIL, Xlib, SunGKS, PostScript

Environment

AC power	100-240 VAC, 47-63 Hz, 0.4 K VA
Operating	0° C to 40° C (32° F to 104° F) 5% to 95% relative humidity, noncondensing
Nonoperating	-40° C to 75° C (-40° F to 167° F) 5% to 95%

	relative humidity, noncondensing
Operating acoustic noise	5.4 bels (at 25° C)
Idle acoustic noise	5.2 bels (at 25° C) Declared noise emissions in accordance with ISO 9296

Regulations

	Meets or exceeds the following requirements:
Safety	UL 1950, CSA 950, TUV EN 60950
RFI/EMI	FCC Class B, DOC Class B, VDE Class B, VCCI Class 2
X-ray	DHHS 21, Subchapter J; PTB German X-ray Decree

Dimensions and Weight

	SPARCstation 20 chassis:	20-in. color monitor:	17-in. color monitor:
Height:	7.7 cm (3.1 in.)	47.1 cm (18.5 in.)	41.4 cm (16.4 in.)
Width:	41.7 cm (16.4 in.)	47.5 cm (18.7 in.)	40.6 cm (16.0 in.)
Depth:	40.9 cm (16.1 in.)	49.5 cm (19.5 in.)	45.0 cm (17.7 in.)
Weight:	12.7 kg (27.0 lb.)	36.5 kg (80.3 lb.)	25.9 kg (57.0 lb.)

Upgrades

Upgrades are available for the

SPARCstation 5, SPARCstation 10,
SPARCstation LX, SPARCstation IPX,
SPARCstation 2, SPARCstation 1+,
SPARCstation 1, and Sun-3 systems.

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Sun microsystems Products and Solutions

SPARCstation Desktop Product Line Overview

Product Specifications	Ultra 1		
	Model 140	Model 170	Model 170E Creator Series
Processor(s)		UltraSPARC-I	
Clock speed	143 MHz	167 MHz	
On-chip Cache size		16-KB I-cache + 16-KB D-cache	
External cache		512 KB	
SPECint92(1)	215	252	252
SPECfp92(1)	303	351	351
SPECbase_int92(1)	180	204	204
SPECbase_fp92(1)	271	313	313
SPECrate_int92(1)	5107	5982	5982
SPECrate_fp92(1)	7175	8323	8323
SPECrate_base_int92(1)	4267	4893	4893
SPECrate_base_fp92(1)	6428	7403	7403
MIPS(1)	291	341	341
MFLOPS(1)	109	126	126
Main memory		32--512 MB	
Disk capacity (SCSI)		1.05 GB--147 GB	
Graphics(2)	TurboGX, TurboGXplus	TurboGX, TurboGXplus	Creator, Creator3D Freedom
Package slots	3 SBus (32/64-bit, 25-MHz) connectors	3 SBus (32/64-bit, 25-MHz) connectors	2 SBus (32/64-bit, 25-MHz) connectors 1 UPA (83-MHz) connector
External Tape backup		2.5-GB QIC, 4- to 8-GB 4-mm, 14-GB 8	
Internal Data interchange/ software distribution/backup		16- to 32- GB 4-mm auto loader, SPARCstorage 4- to 8-GB DDS2 4-mm tap 14 GB 8-mm tape, 3.5-inch floppy, CD-RC	
Audio		16 bit	
Entry configuration	32 MB 17-inch TurboGX color 1.05 GB disk	64 MB 20-inch TurboGX color 2.1 GB disk	64 MB 17-inch Creator graphics 1.05 GB disk
Software licenses(3)			
Solaris		2.5 or later release	

Product Specifications	SPARC Xterminal 1	SPARCstation 4 Model 110	SPARCstation 5 Model 110
Processor	microSPARC	microSPARC-II	microSPARC-II
Clock speed	50 MHz	110 MHz	110 MHz
Cache size	6 KB	24 KB	24 KB
External	None	None	None

SPECint92(1)	N/A	78.6	78.6
SPECfp92(1)	N/A	65.3	65.3
SPECbase_int92(1)	N/A	68.7	68.7
SPECbase_fp92(1)	N/A	63.0	63.0
SPECrate_ int92(1)	N/A	1864	1864
SPECrate_ fp92(2)	N/A	1549	1549
SPECrate_base_int92(1)	N/A	1630	1630
SPECrate_base_fp92(1)	N/A	1494	1494
MIPS (1)	N/A	135.5	135.5
MFLOPS (1)	N/A	21.7	21.7
Main memory	8-128 MB	32-160 MB	32-256 MB
Disk capacity (SCSI)	N/A	1.05 - 56GB	1.05-92GB
Graphics2,5	8-bit accelerated color TurboGX,TurboGX Plus	8-bit pixel-accelerated color	S24,TurboGX, TurboGXplus, SPARCstation 5Z
Package slots	N/A	1 SBus connector	3 SBus (22 MHz) connectors
Tape backup	N/A	2.5GB .25-in., 5-GB 4mm, 14-GB 8mm, 20-GB 4mm auto loader 240-GB SPARCstorage Library	
Data interchange/ software distribution	CD-ROM	3.5-in. floppy CD-ROM	3.5-in floppy CD-ROM Infrared (IR)
Audio	None	16 bit optional	16 bit
Base config.	8 MB 15-in. color	16 MB 15-in. color 535-MB disk	32 MB 17-in. TurboGX color 1.05GB disk
Software licenses 3,4	X-terminal Software Version 2.1, Display Postscript	Solaris 1.1.2 Solaris 2.4 Hardware: 11/94 or later release	

Product	S P A R C s t a t i o n 2 0

Specs	Model 50	Model 51	Model 61	Model 71	Model
Processor(s)	1 SuperSPARC+	1 SuperSPARC+	1 SuperSPARC+	1 SuperSPARC-II	1 hyp
Clock speed	50 MHz	50 MHz	60 MHz	75 MHz	125 M
Cache size	36 KB	36 KB	36 KB	36 KB	8 KB
External cache	N/A	1 MB	1 MB	1 MB	256 KB
SPECint92 (1)	76.9	81.8	98.2	125.8	131.2
SPECfp92 (1)	80.1	89.0	107.2	121.2	153
SPECbase_ int92(1)	71.2	75.3	90.8	116.4	122.4
SPARCbase_ fp92(1)	74.2	81.2	98.1	109.4	142.3
SPECrate_ int92(1)	1824	1940	2329	2984	3112
SPECrate_ fp92(1)	1900	2111	2543	2875	3629
SPARCrate_base_ int92(1)	1689	1786	2154	2761	2903
SPARCrate_base_	1760	1926	2327	2595	3375
MIPS (2)	134.2	133.0	167.4	204.7	243.2
MFLOPS (2)	30.5	30.5	36.6	44.4	51.4
Main memory	32-512 MB				
Disk capacity (SCSI)	1 GB - 353 GB				
Graphics (3)	24-bit color, SX, SPARCstation 20 ZX, TurboGX, TurboGXplus, TurboZX, Freedom Series				
Package slots	4 SBus (25 MHz) connectors	4 SBus (20 MHz) connectors	4 SBus (25 MHz) connectors	4 SBus (25 MHz) connectors	4 SBus (25 MH connec
Tape backup	2.5GB .25-in., 5-GB 4mm 14-GB 8mm, 20-GB 4mm auto loader SPARCstorage Library Model				
Data interchange/ software distribution	3.5-in. floppy CD-ROM				

Audio			16 bit		
Base color config.	32 MB 17-in. SX color 1-GB disk	32 MB 17-in. SX color 1-GB disk	32 MB 17-in. TurboGX color 1-GB disk	32 MB 17-in. TurboGX color 1-GB disk	32 MB TurboG 1-GB d
Software licenses (3)	Solaris 2.3 or later release (Solaris 1.1.1 Version B Optional)				So

Product Specs	SPARCstation 20				
	Model 502MP	712MP	HS22MP	152MP	514
Processors	2 SuperSPARC+	2 SuperSPARC-II	2 hyperSPARC	2 hyperSPARC	4 Sup
Clock speed	50 MHz	75 MHz	125 MHz	150 MHz	50
Cache size	36 KB/CPU	36 KB/CPU	8 KB/CPU	8 KB/CPU	36
External cache	N/A	1 MB/CPU	256 KB/CPU	512 KB/CPU	1 M
SPECrate_int92 (1)	3218	5726	5600	7310	707
SPECrate_fp92 (1)	3193	5439	6399	8758	734
SPARCrate_base_int92 (1)	2984	5332	5347	7004	633
SPARCrate_base_fp92 (1)	2978	4923	6046	7945	670
Main memory	32-512 MB	64-512 MB	64-512 MB	64-512 MB	64-
Disk capacity (SCSI)			1 GB - 353 GB		
Graphics (2)			24-bit color, SX, SPARCstation 20ZX, TurboGX, TurboGXplus, TurboZX, Freedom Series		
Package slots	4 SBus (25 MHz) connectors	4 SBus (25 MHz) connectors	4 SBus (25 MHz) connectors	2 SBus (25 MHz) connectors	4 (2 co
Tape			2.5 GB .25-in. 5-GB 4mm 14-GB 8mm 20-GB 4mm auto loader 140-GB SPARCstorage Library		

Data interchange / software distribution			3.5-in. floppy CD-ROM		
Audio			16 bit		
Base color config.	32 MB 17-in. TurboGX color 1-GB disk	64 MB 20-in. TurboGX color 1-GB disk	64 MB 20-in. TurboGX color 1-GB disk	64 MB 20-in. TurboGX color 1-GB disk	64 Tu co 1-
Software licenses (4),(5)	Solaris 2.3 or later release	Solaris 2.3 or later release	Solaris 2.4 or later release	Solaris 2.4 or later release	So or re

Notes:

(1) SMCC SPEC92, Dhrystone 1.1 MIPS and Linpack 1000 Double Precision results use the Apogee compilers from Apogee Software with a Kuck & Associates preprocessor.

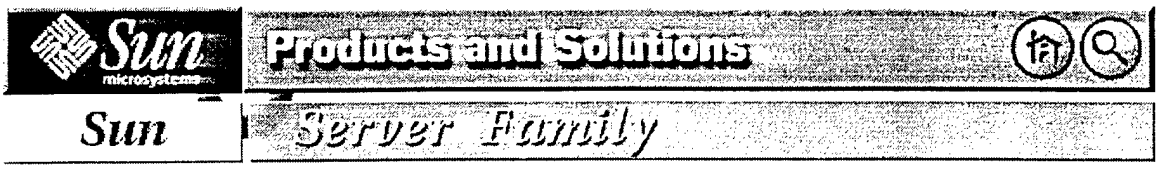
(2) Check price list for system configurations.

(3) Solaris 2.x system license is included.

(4) SPARCstation 5 S24 configurations require Solaris 2.3 H/W: 8/94. Solaris 1.x is not supported on SPARCstation 5ZX or S24 configurations.

(5) XMarks 1.8 - 3.05, and Xstones 81K - 199K.

Questions or comments regarding this service? *webmaster@sun.com*



Product Overview

The SPARCserver™ SPARCserver 5 and SPARCserver 20 give your workgroup outstanding performance in all your critical application areas. You'll have the power to run databases, increase file-sharing throughput, offload printing tasks, and run any of more than 10,000 SPARC(R) solutions, from accounting to electronic design packages. These systems can also open up network resources to all your PC and Macintosh(R) users, whether they are using Novell(R) NetWare(R), Banyan VINES, or AppleTalk(R) software.

Designed for distributed computing, these compact, high-capacity servers run the Solaris(R) operating environment. Robust and feature-rich, Solaris is the leading 32-bit UNIX(R) solution and delivers the highest networking performance in the industry.

Moreover, Solstice™ Enterprise Management Solutions give system administrators a full range of tools to keep the network running at peak efficiency: Solstice JumpStart™ for automatic software distribution. Solstice AdminSuite™ for managing user accounts, host names, printers, and serial ports. Solstice PC Management: SolarNet™ PC-Admin software to automatically add new PC clients and extend consistent security and administrative policies. And OpenBoot™ for plug-and-play support of new system options.

You can also employ comprehensive system and network management software--from Sun and other industry-leading sources--to ensure high data availability and protection. Sun's Solstice DiskSuite™ provides volume management to protect against disk failures, and a journaling file system for fast recovery. Sun servers running Solaris system software are robust and reliable--proven in thousands of production environments.

Cost-effective growth.

As compact as these servers are, they offer you plenty of capacity. Each starts with 32 MB of memory and, depending on which model you choose, can expand to 160, 256, or 512 MB.

What's more, these desktop servers have substantial internal capacity for disk, floppy, and CD-ROM drives. The SPARCserver 5 and SPARCserver 20 can accommodate up to two internal disks for additional storage, and both provide plenty of SBus I/O expansion for additional peripherals or network connections.

We also offer innovative storage solutions such as the SPARCstorage Array series. These disk-array subsystem enhance your server with an unmatched combination of storage capacity, performance, high availability, and manageability--all for a surprisingly low price.

With the SPARCserver 20 system, adding processing power is economical, too. Because its processors reside on separate MBus modules, you can easily add up to two or four processors per system. More CPUs enable your server to handle multiple tasks simultaneously, whether it's separate database queries, multiple file requests, or even a multithreaded compute-intensive application. Another advantage of our modular design: upgrading to next-generation processors is extremely simple and cost-effective.

If this much expandability isn't enough, we offer an easy growth path to our UltraServer family of workgroup servers or to the more powerful departmental or datacenter servers.

Incomparable support

To ensure your SPARCserver systems continue to give the reliable performance you've come to expect, SunService offers a full range of support options from basic telephone support to round-the-clock coverage for mission-critical applications. You pick the level of support that's right for your business, confident that you're backed by the industry's largest base of dedicated UNIX experts.

Questions or comments regarding this service? ***webmaster@sun.com***

Last Modified: 10:06am PST, February 14, 1996

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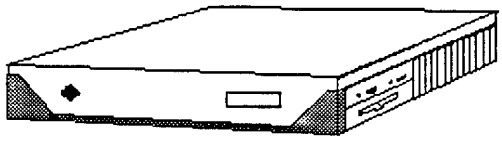
Sun | Server Family

SPARCserver 5 Positioning



Overview

The SPARCserver 5 is a robust, cost-effective, expandable workgroup server, with enough room to grow with a customer's workgroup. The SPARCserver 5 is designed for workgroups of 10 to 40 users with an average of 25 GB of disk storage. It's perfect as a workgroup, file, print, application, or connectivity server to PC LAN or file service environments.

With the right combination of I/O peripherals (disk, tape, and CD-ROM) and software packages such as Solstice™ PC Management, SolarNet™ PC-Admin™, and PC-NFS™; the SPARCserver 5 can become an affordable and powerful gateway to LAN or file service environments.

As a workgroup LAN, the SPARCserver 5 system enables PC and workstation clients to access and share files. It also offers internal LAN communication and administration, and the ability to share other network resources, such as printers.

Key Facts

- The SPARCserver 5 Model 110 is built around the 110-MHz microSPARC-II processor and comes preconfigured with a CD-ROM drive.
- The SPARCserver 5 is designed around a fast 64-bit memory bus and fast microSPARC-II processor CPU (110-MHz).
- The SPARCserver 5 provides greater expandability than the SPARCserver 4, with over 50 percent more memory capacity (256 MB maximum), over three times the total disk storage capacity (107 GB maximum), and three times the network connectivity (three SBus slots).
- Entry configurations of the SPARCserver 5 system start with 32 MB of memory and 2.1-GB disk storage capacity. In addition, the SPARCserver 5 system comes with a host of built-in features:
  - Three SBus slots
  - Two synchronous serial ports
  - One parallel port
  - SCSI and Ethernet (twisted-pair and AUI) ports
  - Support for up to four internal devices (including up to two disks, one floppy drive, and one CD-ROM drive
  - Eight SIMM slots for added memory capacity (8-MB or 32-MB SIMMs)
- Networking connectivity support includes token ring, high-speed serial interface, SBus Prestoserve, SBus Fast SCSI/Buffered Ethernet, SBus SCSI/Buffered Ethernet, serial parallel controller, ISDN, Fast Ethernet, ATM, FDDI, SCSI host adapter, and SBus Quad Ethernet.

- Operating system support includes Solaris 1.1.1 version B or higher, and Solaris 2.3 Edition II or later releases.
- A Solaris 2.x server license comes standard with every SPARCserver 5 system.
- The SPARCserver 5 system can be easily upgraded to the SPARCserver 20 system with a simple board swap.

Questions or comments regarding this service? ***webmaster@sun.com***

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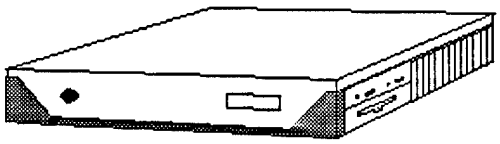
SPARCserver 20 Positioning



Overview

The SPARCserver 20 system is Sun's most affordable multiprocessing server, providing new levels of performance and storage scalability all within a single box.

The SPARCserver 20 is designed for medium sized workgroups of 40 to 70 users with an average of 50 GB of disk storage. The power and scalability of the SPARCserver 20 make it the ideal solution to handle database applications, increase small or mid-size workgroups' file-sharing throughput, off-load printing tasks, and run any of more than 10,000 Solaris(R) solutions, ranging from spreadsheets to CAD packages.

The SPARCserver 20 system is perfect as a high-performance connectivity server, giving PC and Macintosh systems access to applications and resources in other departments, anywhere on the network.

Key Facts

- The SPARCserver 20 delivers high performance from a well-balanced design that includes fast system (50-MHz MBus) and I/O (25-MHz SBus) bus architectures, and highly scalable SuperSPARC-II™ or hyperSPARC processors.
- The SPARCserver 20 provides even greater scalability and investment protection than the SPARCserver 5, with over 100 percent more memory capacity (512 MB maximum), a 144 percent increase in disk storage capacity (339 GB maximum), 33 percent more network connectivity (four SBus slots), and allowance for multiprocessing scalability. In addition, the SPARCserver 20 comes standard with CD-ROM and optional floppy drive capabilities.
- The SPARCserver 20 includes generous room for growth, with storage capacities ranging from 1 to 339 GB, using the latest in storage technology--Sun's SPARCstorage Array.
  - The SPARCstorage Array is built around a 25-MB/sec. full-duplex Fibre Channel interface, providing throughput superior to even fast/wide, half-duplex, 20-MB/sec. SCSI.
- The SPARCserver 20 Models are built around two different processor speeds:
  - 75-MHz SuperSPARC-II: Models 71 and 712MP
  - 150-MHz SuperSPARC: Models 151 and 152MP
- Entry configurations on the SPARCserver 20 system start with
  - Uniprocessor configurations: 32 MB of memory and 2-GB disk
  - Multiprocessor configurations: 64 MB of memory and two 2-GB disks
- Standard features on the SPARCserver 20 system include four SBus slots, two synchronous serial ports, one parallel port, SCSI and Ethernet (twisted-pair and AUI) ports, support for up to four internal devices (including up to two 535-MB, 1.05-GB, or 2.1-GB pluggable disk drives), and

- eight SIMM slots for added ECC memory capacity (16-, 32-, and 64-MB 60-ns SIMMS)
- Networking connectivity support includes Token Ring, high-speed serial interface, SBus and NVRAM Prestoserve™, SBus Fast SCSI/Buffered Ethernet, SBus SCSI/Buffered Ethernet, Serial Parallel Controller, ISDN, Fast Ethernet, ATM, FDDI, SCSI host adapter, and SBus Quad Ethernet.
- Operating system support includes Solaris™ 1.1.1 Version B or higher and Solaris 2.3 Hardware: 5/94 or later release.
- With a simple SuperSPARC-II module swap, users can easily upgrade to faster and higher performing processors within the SPARCserver 20 product family.
- A Solaris 2.x server license comes standard with every SPARCserver 20 system. Every server license comes bundled with Solaris 2.x System Administrator AnswerBook, Solstice AdminSuite, Solstice™ Backup™, and Solstice™ DiskSuite™ products, which are included as part of the Solaris 2.x product.

Questions or comments regarding this service? *webmaster@sun.com*

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Sun microsystems Products and Solutions

Sun Server Family

Specifications

Processor	Architecture	SPARCserver 20: Superscalar SPARC Version 8 and 75-MHz SuperSPARC or 150MhZ hyperSPARC™ SPARCserver 5: SPARC Version 8, 110-MHz microSPARC-II
	Memory management	SPARC reference MMU SPARCserver 20: 65,536 contexts SPARCserver 5: 256 contexts
	Cache	SPARCserver 20: 16-KB data and 20-KB instruction on chip; 512KB, 1MB external cache SPARCserver 5: 8-KB data and 16-KB instruction on chip
Main Memory	8-MB SIMM Expansion	SPARCserver 5: 8 SIMM slots, 64 MB max
	16-MB SIMM Expansion	SPARCserver 20: 8 SIMM slots, 128 MB max.
	32-MB SIMM Expansion	SPARCserver 20: 8 SIMM slots, 256 MB max. SPARCserver 5: 8 SIMM slots, 256 MB max.
	64-MB SIMM Expansion	SPARCserver 20: 8 SIMM slots, 512 MB maximum
Standard Interfaces	Ethernet	10-Mb/sec twisted-pair standard (10-BaseT); AUI (adapter cable required)
	SCSI	10-MB/sec SCSI-2 (synchronous)
	Serial	SPARCserver 5 and SPARCserver 20: Two RS-232C/RS-423 synchronous serial ports
	Parallel	Centronics-compatible parallel port (cable required)
	Audio	16-bit audio; 48 kHz; internal speaker and external microphone

	SBus	SPARCserver 20: four expansion slots, 32/64-bit data bus width SPARCserver 5: three expansion slots, 32-bit data bus width
Mass Storage	Internal floppy disk	Optional 3.5-in. MS-DOS"/IBM" compatible (720 KB, 1.2 MB, 1.44 MB formatted)
	Internal disk	SPARCserver 20 and SPARCserver 5: Two 3.5-in. x 1-in. disks
	External storage options	Disk: 3.5-in 1.05 GB or 2.1 GB using Desktop Disk Pack; 4.2 GB or 8.4 GB using Multidisk Pack Tape: 150-MB .25-in QIC-150; 14-GB 8mm,5-GB 4mm DAT, 20-GB 4mm DAT auto-loader Disk array: SPARCstorage Array (SPARCserver 5 and SPARCserver 20)
	Maximum disk capacity	SPARCserver 20: 339 GB max. SPARCserver 5: 107 GB max.
Network SBus options		Token Ring, HSI, FDDI, fast SCSI/buffered Ethernet, serial/parallel controller, SCSI host adapter, ISDN, SBus Quad Ethernet, 100-Mb/sec Ethernet, ATM, Differential SCSI/buffered Ethernet, SBus Prestoserve™, and NVRAM Prestoserve (SPARCserver 20 only)
Server option packs	Printer	SPARCprinter™ II, NeWSprinter™ 20, or NeWSprinter CL+™
	Storage	Server desktop packs: 2.1 GB disk, 5 GB 4mm tape, SunCD 2Plus, 2.1 GB disk, 14 GB 8mm tape, SunCD 2Plus
Software	Operating system	Solaris operating environment, SPARCserver 20 and SPARCserver 5: Solaris 2.3, Hardware: 8/94 or later release, or Solaris 1.1.1 version B or later release
	Languages	C, C++, Pascal, FORTRAN, Cobol; Java
	Networking	ONC™, NFS(R), TCP/IP, IPX/SPX SunLink OSI, MHS, DNI, SNA, X.25, PPP, DCE
	Windowing system	OpenWindows™ Version 3, CDE
	System Management	Solstice and SolarNet products

	System Management	Solstice and SolarNet products
Environment	AC power	SPARCserver 20: 100-240 VAC; 47-63 Hz, 0.4 K VA SPARCserver 5: 100-240 VAC; 50-60 Hz
	Operating	0 C to 40 C (32 F to 104 F) 5% to 95% relative humidity, noncondensing
	Nonoperating	SPARCserver 20: -40 C to 70 C (-40 F to 158 F) 5% to 95% relative humidity, noncondensing SPARCserver 5: -40 C to 75 C (-40 F to 167 F) 5% to 95% relative humidity, noncondensing
	Operating acoustic noise	SPARCserver 20: 5.4 bels (at 28 C) SPARCserver 5: 5.4 bels (at 28 C)
	Idling acoustic noise	5.2 bels (at 28c C) Declared noise emissions in accordance with ISO 9296
Regulations	Safety	Meets or exceeds the following requirements:
	RFI/EMI	FCC Class B, DOC Class B, VDE Class B, VCCI Class 2
	X-ray	DHHS 21, Subchapter J; PTB German X-ray Decree
Dimensions and Weight	Height	7.7 cm (3.1 in.)
	Width	41.7 cm (164 in.)
	Depth	40.9 cm (16.1 in.)
	Shipping weight	12.7 kg (27.0 lb.)

Questions or comments regarding this service? ***webmaster@sun.com***