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TEST, CONTROL AND MONITOR SYSTEM (TCMS)

OPERATIONS PLAN

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ACRONYMS

ALRUTS	Automated Line Replaceable Unit Tracking System
AP	Application Processor
BIOP	Buffer Input/Output Processor
BIT	Built-In Test
BLD	Test Build
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CCATS	Configuration and Calibration And Test Set
CCB	Configuration Control Board
CCBD	Configuration Control Board Directive
CCMS-II	Checkout, Control and Monitor System - II
CCP	CDBFR Communications Processor
CDBFR	Common Data Buffer
CDE	Commercial Development Environment
CDS	Central Data Subsystem
CEC	Core Electronics Contractor
CI	Configuration Item
CITE	Cargo Integration Test Equipment
CM	Configuration Management
CMP	Command Processing
CMS	Configuration Management Services
CO	Contract Change Order
COTS	Commercial-Off-The-Shelf
CPU	Central Processing Unit
CSCI	Computer Software Configuration Item
CSF/CAF	Central Software Facility / Central Avionics Facility
CSR	Customer Service Request
CTS	Configure Tests
DAC	Data Acquisition and Control
DBS	Database Subsystem
DMI	Direct Manipulation Interface
DMON	Display Monitor
DMS	Data Management System
DNS	Display Network Subsystem
DP	Display Processor
DRP	Disaster Recovery Plan
DRRS	Digital Record and Retrieval Subsystem
DSM	Data Storage Management

EMON	Exception Monitor
FD	Function Designator
FDD	Function Designator Directory
FEDP	Facility Equipment Design Plan
FEP	Front End Processor
FERD	Facility Equipment Requirements Document
FIT	Functional Interface Tool
GCE	Ground Operations Aerospace Language/Control Logic/Test Control Supervisor Development Environment
GOF	Global Operations Facility
GSE	Ground Support Equipment
HCI	Human Computer Interface
HIM	Hardware Interface Module
HOF	Hazardous Operations Facility
HOSF	Hazardous Operations Support Facility
HRT	HCI Real Time Services
HSE	HCI Support Environment
HSSC	Harris Space Systems Corporation
HTD	HCI Test Development Services
HVAC	Heating, Ventilation and Air Conditioning
HWCI	Hardware Configuration Item
I/O	Input / Output
IBM	International Business Machines
IGW	International Gateway
IPR	Interim Problem Report
IRGW	Intermediate Rate Gateway
IV&V	Independent Verification and Validation
JSC	Johnson Space Center
KSC	Kennedy Space Center
LCWS	Local Control Workstations
LDM	Link Configuration Database Manager
LRU	Line Replaceable Unit
MCOE	Master Console Operations Engineer
MDD	Monitor Data for Distribution

MDM	Multiplexer/Demultiplexer
MDSS	McDonnell Douglas Space Systems
MIOP	Monitor Input/Output Processor
MODB	Master Object Database
MOU	Memorandum of Understanding
MPAC	Multi-Purpose Application Console
MRC	Material Review Center
MSU	Mass Storage Unit
NASA	National Aeronautics and Space Administration
NMG	Network Manager
NMS	Network Monitor Subunit
NSS	Network Simulator Subunit
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OIS-D	Operational Intercom System - Digital
OLDB	Online Data Bank
OMI	Operations and Maintenance Instruction
ORT	Operational Readiness Test
OS	Operating System
OSA	Off-line Support Area
PAM	Permanent Archive Media
PDMS	Payload Data Management System
PDR	Processed Data Recorder
PGOC	Payload Ground Operations Contractor
PON	Payload Operations Network
POW	Payload Office Workstation
PRACA	Problem Reporting and Corrective Action
PSCNI	Program Support Communications Network Internet
PSTF-R	Payload Spin Test Facility - Replacement
PTS	Production Tracking System
RC	Ring Concentrator
RCD	Record Test Data
RDBMS	Relational Database Management System
RFD	Retrieve and Format Test Data
RMG	Resource Manager
RTIF	Real Time Interface
RTN	Real Time Network
SDDS	System Developmental & Diagnostic Subunit

SDP	Standard Data Processor
SIB	Simulation Interface Buffer
SMG	System Management
SN	Service Net
SPF	Software Production Facility
SPM	SPF Manager
SR&QA	Safety, Reliability and Quality Assurance
SSFP	Space Station Freedom Program
SSPF	Space Station Processing Facility
SSPSE	Space Station Payload Software Engineering
SSS	System Software Services
SST	Set Support Team
SYM	System Operational Readiness Testing
TAE	Test Application Execution
TAM	Temporary Archive Media
TAS	Test Application Software
TBI	TCMS Bulk Input
TCMS	Test, Control and Monitor System
TDM	Test End Item Data Bank Manager
TEI	Test End Item
TGS	Time Generation Subunit
TRS	Test Resource Set
TS	Technical Support
TSM	Test End Item Software Manager
TUG	TCMS Utilization Group
UPS	Uninterruptible Power Supply
VME	Versa Module Eurocard

SECTION I

INTRODUCTION

1.1 PURPOSE

This document was prepared by McDonnell Douglas Space Systems (MDSS) under Contract NAS10-11400 to National Aeronautics and Space Administration - Kennedy Space Center (NASA-KSC). The purpose of this document is to provide a clear understanding of the Test, Control and Monitor System (TCMS) operating environment and to describe the method of operations for TCMS. TCMS is a complex and sophisticated checkout system focused on support of the Space Station Freedom Program (SSFP) and related activities.

This document provides an understanding of the TCMS operating environment and defines operational responsibilities. NASA and the Payload Ground Operations Contractor (PGOC) will use it as a guide to manage the operation of the TCMS computer systems and associated networks and workstations.

1.2 SCOPE

This document examines all TCMS operational functions. Other plans and detailed operating procedures relating to an individual operational function are referenced within this plan. This plan augments existing Technical Support Management Directives (TSMDs), Standard Practices, and other management documentation which will be followed where applicable.

For the purpose of this document, "User" is defined as a member of the KSC test engineering, applications, or simulation software development organizations. Users are responsible for developing test software, simulation software and conducting a coordinated test of flight hardware and Ground Support Equipment (GSE). "Operations Engineer" or "Master Console Operations Engineer" is defined as a member of the TCMS Operations and Maintenance organization and is responsible for the Operations of TCMS set equipment.

Also, for the purpose of this document, "Operations" is defined as all Operations and Maintenance activities that are required to ensure the continuous functioning of TCMS. These functions include:

- Master console operations;
- Computer operating system software and network operations;
- System maintenance;

- Database administration and file management;
- Hardware and set resource configuration control;
- Performance assessment and improvement;
- System and network security;
- Software Production Facility (SPF) and Global Operations Facility (GOF) operations.

Also included within the definition of "Operations" are the following support services:

- Anomaly verification and testing of TCMS hardware and software;
- Train support personnel;
- User support (TCMS Client Support Area);
- Preparation of procedures and policies;
- Security and disaster recovery plans;
- Tracking of the work necessary to ensure that TCMS Customer Service Requests (CSRs), Interim Problem Reports (IPRs), and Problem Reports (PRs) are correctly dispositioned.

The following terms, when used in this document, refer to groups consisting of the appropriate NASA and PGOC TCMS personnel:

- Operations and Maintenance (O&M);
- Logistics;
- Space Station Payload Software Engineering (SSPSE);
- Safety, Reliability and Quality Assurance (SR&QA);
- Software Product Assurance (SPA);
- Sustaining Engineering (SE).

1.3 CEC SET SUPPORT TEAM

While the Core Electronics Contractor (CEC) contract is still in effect, the CEC will provide a Set Support Team (SST). This team will help NASA and PGOC operate and maintain TCMS. SST will provide assistance to O&M as well as other organizations. It is assumed throughout this document the SST is an integral part of TCMS O&M

1.4 DOCUMENT ORGANIZATION

This document is organized into the following nine sections:

Section 1 - Introduction

Section one introduces the TCMS Operations plan by including the purpose, scope, and organization of the document. It also lists reference documents where more detailed information on specific topics can be found.

Section 2 - System Support

Section two states the goals of TCMS O&M and how they will be measured. This section also discusses the organization and responsibilities of the TCMS Utilization Group (TUG).

Section 3 - Operations

Section three discusses the different operational elements of TCMS. It gives a brief summary of the elements along with their operational components and how they will be operated. The TCMS Master Console functionality, Client Support Area, work tracking and control, shift operations, and system configuration are described.

Section 4 - Resource Management

Section four discusses resource management of TCMS.

Section 5 - Performance Management

Section five discusses the TCMS O&M performance goals and objectives and states how O&M will ensure they are satisfied.

Section 6 - Anomaly Verification and Testing

Section six discusses the maintenance responsibility of O&M and how operations personnel will work with maintenance personnel to correct hardware and software anomalies. It includes part of the paper trail associated with the maintenance work as well as who is responsible for maintenance on which subsystems. General scenarios are given to show the TCMS maintenance flow. Specific maintenance information is not discussed here but in the TCMS Maintenance Plan, TS-TCMS-92003.

Section 7 - Training

Section seven states the TCMS training objectives and who is responsible for training O&M personnel.

Section 8 - System Administration

Section eight states the roles and responsibilities of system administration. It includes a list of tasks the system administrator will carry out on an as needed, daily, weekly, monthly and occasional basis. System administration also includes security, database and resource scheduling.

Section 9 - Risk Assessment

Section nine discusses how TCMS O&M will develop and carry out a disaster recovery plan. The section states risks TCMS will be susceptible to as well as emergency preparedness.

1.5 REFERENCE DOCUMENTS

a. K-CTE-50.1 Rev B.	TCMS Operations Concept Document
b. TS-TCMS-92001	TCMS Operations and Maintenance Philosophy
c. TS-TCMS-93xxx	TCMS Security Plan
d. TS-TCMS-92003	TCMS Maintenance Plan
e. TS-TCMS-92004	TCMS Communication and Patching Plan
f. TS-TCMS-93xxx	TCMS Database Management/System Administration Plan
g. KSCM-DL-0112	TCMS ACT/VAL Management Plan
h. TBD	TCMS Sustaining Engineering Plan
i. TBD	TCMS Disaster Recovery Plan
j. TBD	System Operations and Maintenance Manual for the Cargo Integration Test Equipment
k. K-CTE-63.2	TCMS Production Control Plan
l. SP10.001-A91	Nonconformance/Problem Reporting and Corrective Action (PRACA) System
m. KHB-1040.1D	Emergency Preparedness Plan
n. KMI 1620.5A	Bombs and Bomb Threats
o. KMI 8838.1B	Fire Protection, Fire Prevention and Rescue
p. KHB 1040.2F	KSC Hurricane Handbook
q. KSC-STA-61.07	Facility Equipment Requirements Document/Design Plan

SECTION II

SYSTEM SUPPORT

2.1 STATEMENT OF GOALS

The goal of TCMS O&M is to provide reliable, uninterrupted system support for TCMS in order to facilitate the test and checkout of SSFP test articles and subsystems. This primary goal will be attained through the following sub-goals.

- TCMS Set Availability;
- Reconfiguration Time;
- Network Availability;
- Service Request Cycle Time;
- Service Request Volume;
- Anomaly Metrics.

*Note: Goals are **TBD** pending analysis of final TCMS system design. Separate Service Level Agreements will be drafted and agreed upon before first set installation at KSC.*

2.2 GOAL MEASUREMENT

TCMS Set Availability is measured per end item test. Availability for each subsystem of the TCMS set is averaged to provide an overall set availability. The subsystem availability is computed as the 'up time' for the duration of the test period.

Reconfiguration Time is the time it takes to configure the TCMS set for an end item test. The aggregate times for hardware allocation, patching, software loads, and validation are included in reconfiguration time as well as the size of the set being reconfigured.

Network Availability is the continuously measured 'up time' of each TCMS network. Each area supported by the network is tracked separately. From these separate measurements an overall availability is computed. A set availability and overall TCMS availability will be computed.

Service Request Cycle Time includes IPR, and CSR response cycle time. The amount of time that is required to close and document an IPR, CSR or nonconformance is tracked to allow performance to be measured and improved.

Service Request Volume is a measure of the number of IPRs and CSRs that are opened, and how many were closed in a given period.

Anomaly Metrics is a percentage-based list of anomalies encountered during TCMS operation to the total number of defects encountered.

A descriptive comparison between reconfiguration and availability will be developed to show how each affects the others resources.

2.3 SYSTEM AVAILABILITY

The implementation of system availability reporting is required for the measurement and comparison of data relative to the overall availability of TCMS systems. System availability is the first step in an ongoing process that will provide comprehensive reporting and statistical data analysis required for continuous improvement.

System availability time is defined as the time that the system is available for productive use. Productive use includes the time for normal testing as well as the time to accomplish scheduled overhead events required to support production, during which the users do not have access to the system. These activities generally occur on a daily, weekly, or monthly schedule and in some instances, may occur on an as-required basis. These activities are normally scheduled on third shift or between tests so not to inhibit user activities.

The system availability (SA) percentage is derived by the formula:

$$SA\% = (1 - (U/(BT-S))) * 100$$

Where U equals unscheduled outage time, BT equals base time, and S equals scheduled outage time.

The following definitions apply:

Unscheduled outage time (U) is the unplanned or unforeseen events that remove the system from productive use.

Base Time (BT) equals the time that the systems should be functional. In the case of TCMS, that functionality is defined as 24 hours a day, seven days a week.

Scheduled outage time (S) is the planned events that remove the system from productive use and for which the user community has been given adequate notice. Every attempt is made to schedule this category of outage during off-shift hours. It must be recognized, however, that due to third party contractual agreements or constraints this may not always be possible.

The formula decrements the base time by scheduled outage time. In doing so the formula recognizes that SA% should not be reduced unrealistically by efficient scheduling of required activity. Therefore, the O&M organization should pay careful attention to scheduling requirements and coordination of those events with the user community.

Long standing industry and government standards recognize that unscheduled outage time of an efficient data processing organizations' base time typically equals 3.0% or less. This leaves a service level objective of 97.0% for system availability. However, the TCMS requirement is slightly lower with the system availability objective being 96%.

The following sample calculation illustrates the method for calculating the system availability percentage:

Base Time (BT) = 168 hours
Scheduled outage time (S) = 25 hours
Unscheduled outage time (U) = 3.58 hours

SA% = (1 - (U / (BT - S))) * 100
SA% = (1 - (3.58hrs / (168hrs - 25hrs))) * 100
SA = 97.5%

System availability should not be confused with prime shift availability or the ratio of overhead (administrative) processing to overall availability. The reporting of those statistics is intended to be an outgrowth of this reporting system and will require additional developmental effort.

Log entry -- The person in charge of the system during the event, whether Operations Engineer, system manager, or vendor representative is responsible for insuring the proper entries are made in the TCMS Availability Log.

Administrative -- A designated person shall be responsible for daily monitoring and follow-up of the logs to insure that entries are complete and correct. The same person shall ensure that a supply of forms is available at each Master Console. When the log is complete for the period, the designated person will perform the data entry function and produce the appropriate reports.

Management -- Management should review the logs and shall have final responsibility for determining how a questionable event should be logged.

2.4 TCMS UTILIZATION GROUP

The TUG is composed of personnel from operations, maintenance, administration, sustaining engineering, logistics, software development, quality assurance, software product assurance, and the user community to discuss and resolve TCMS operational issues. The overall desired effect is rapport and mutual assistance throughout TCMS.

The TUG will identify, study, and recommend solutions to issues related to TCMS O&M performance. TUG activities will be coordinated with appropriate directors and departments throughout NASA and PGOC and will consist of:

- Resolving TCMS hardware and system software processing problems and inefficiencies;
- A forum for resolving O&M scheduling difficulties;
- Coordinating support of user activities;
- Planning for peak resource demands or TCMS resource modifications.

2.4.1 RESOLVING TCMS PROCESSING PROBLEMS AND INEFFICIENCIES.

Considerable time and effort can be wasted during test and checkout because of application-system problems and wasteful use of TCMS resources. The problems may include frequent restarts and difficulty in verifying proper completion of jobs. Inefficiencies include poor test design, material shortages, scheduling, overtasking of resources, etc.

With rapport established in the TCMS community, various alternatives to improve the existing processing method can be considered. For example, the users can provide input to their department, thus addressing solutions to problems where the most-informed persons for the appropriate applications are located.

The TUG meetings will be held monthly, or more frequently if required. The TUG O&M chairperson is responsible for distributing meeting notices with adequate lead time to encourage meeting attendance. Minutes will be taken at all meetings to retain a history of the activity performed and the actions taken. The TUG chairperson or designee is responsible for preparation and distribution of meeting minutes.

2.4.2 RESOLVING SCHEDULING DIFFICULTIES.

TUG members will help plan how to meet schedules, identify and resolve conflicts, and prioritize the TCMS work load. They will provide PDMS-based automated scheduling systems with the rules, dependencies, and logic, to resolve TCMS scheduling problems. The 72 hour, 11 day schedule will be used for TCMS processing and utilization.

2.4.3 COORDINATING USER ACTIVITIES. TUG members will resolve any user problems that arise. The TUG will then assign a task team made up of personnel from each division to analyze the problem by establishing and documenting procedures used for resolution.

2.4.4 PLANNING FOR PEAK RESOURCE DEMANDS OR TCMS RESOURCE MODIFICATION. Many times, managers of large computer systems similar to TCMS have been surprised by the unexpected demands on the systems resources and problems with hardware and software because of a lack of planning and communication. By increasing communication, the TUG will minimize unplanned situations that would interfere with the test and checkout of test articles.

SECTION III

OPERATIONS

TCMS O&M has the primary responsibility to support operations of TCMS. The goal of this group is to provide reliable, uninterrupted system support to all TCMS customers. TCMS Operations are categorized as:

- Master Console operations (paragraph 3.1);
- Computer room operations (paragraph 3.2);
- Operational services (paragraph 3.3);
- Work tracking and control (paragraph 3.4);
- Operations at Core Electronics Contractor site (paragraph 3.5);
- Central Software Facility/Central Avionics Facility Operations at Johnson Space Center (paragraph 3.6).

Along with the above topics, operations personnel are responsible for the following:

- Resource Management (section 4);
- Scheduled and corrective maintenance activity support (section 6);
- Error detection and problem resolution (paragraph 6.1)
- System Administration for TCMS sets and hosts(section 8);
- Host and Network Security (paragraph 8.2)
- Database Administration (paragraph 8.3).

3.1 TCMS MASTER CONSOLE

The TCMS Master Console Area, located in the TCMS Control Room, is the nerve center for TCMS. All O&M activity stems from this area. The master console is made up of workstation housings, workstation tables, Operational Intercom System - Digital (OIS-D), Display Processors, Payload Office Workstations, and laser printers. The workstation housings are joined to form a circular area where all Master Console operations are performed.

The Master Console Operations Engineers (MCOEs) are responsible for the following TCMS functions:

- Configuration of TCMS hardware and software;
- Monitoring all system messages;
- Monitoring TCMS health and status;
- TCMS Hardware and software error detection;
- Execution and support of scheduled and unscheduled events;

- Generating, logging and tracking TCMS problem reports;
- Satisfying all system requests including printing and mounting requests.

The Master Console Area also includes the Client Support Area functionality. The Client Support Area is located in the center of the Master Console Area. The Client Support Area serves as the link between the users and the O&M personnel. For further information on the Client Support Area, see paragraph 3.3.

Figure 3-1 below shows the Master Console Area and its components.

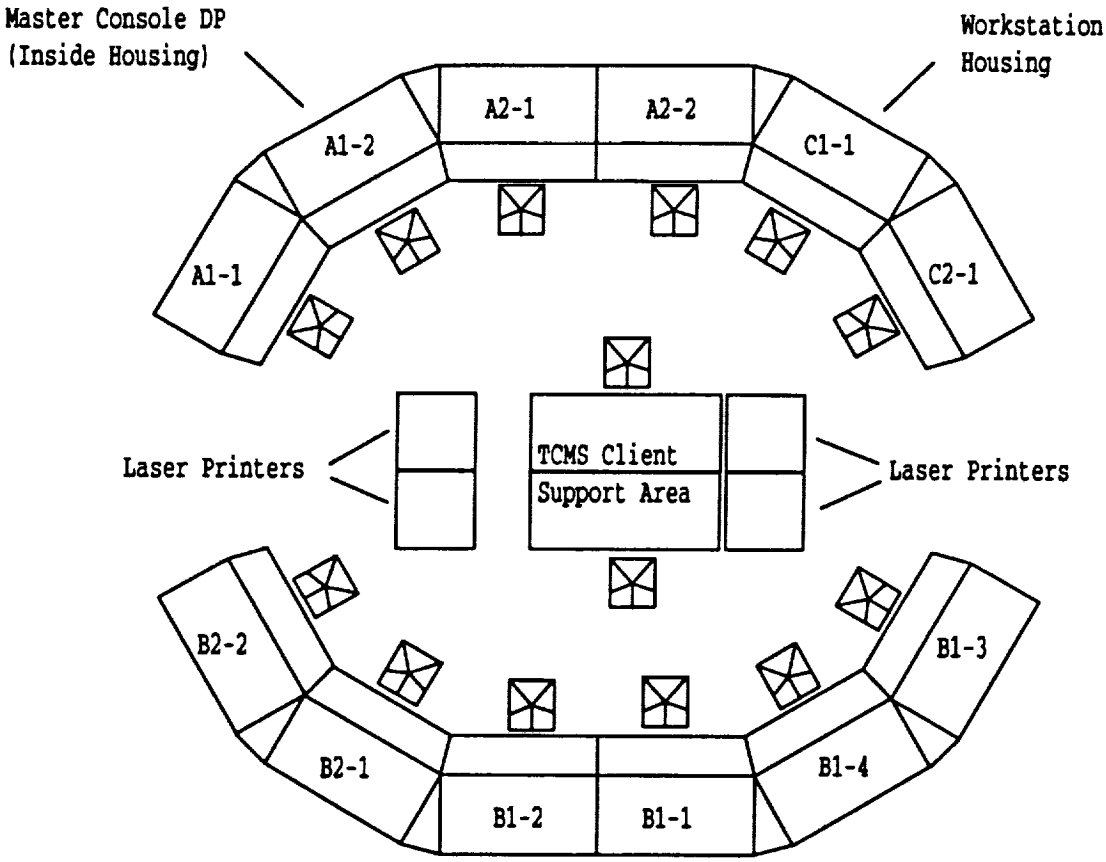


Fig 3-1
TCMS Master Console Area

The Master Console Area contains fourteen DPs. O&M assumes the Master Console Operations Engineer (MCOE) can actively view four windows per Display Processor (DP). The set master, Test Resource Set (TRS) master, Network Manager (NMG), and an individual TRS each require one window. The Master Console DPs are distributed in the following manner:

Note: Currently, DPs can only view one TRS at a time. This section assumes that this will change and multiple TRSs will be available to one Master Console DP.

HALF SET	# OF DPs	HALF SET	# OF DPs
A1	2	C2	1
A2	2	GOF	1
B1	4	SPF	1
B2	2	PSTF-R	*1
C1	1	CAF	*3

* - DPs not included in the fourteen Master Console DPs.

B1 - Four DPs have been allocated to the B1 half set. These DPs are required to support the number of TRSs possible during software development. Baseline configuration allows the B1 set to have at most nine concurrent TRSs including combinations of the following:

- Three Simulation test pairs (6 TRSs - 6 windows)
- Three "Buffer Stuffers" (3 TRSs - 3 windows)
- Set Master (1 window per set)
- TRS Master (1 window per TRS)
- Network Manager (1 window per set)

Assuming an MCOE can actively view four windows from one DP, four DPs will cover the required number of windows needed.

A1, A2, B2 - Two DPs have been allocated to each of the A1, A2, and B2 half sets. These half sets will be the main sets used for hardware testing. Normally, no more than three TRS's will be concurrently active on any of the three half sets. Active display windows include combinations of the following:

- Three TRSs (3 TRSs - 3 windows)
- Set Master (1 window per set)
- TRS Master (1 window per TRS)
- Network Manager (1 window per set)

Assuming an MCOE can actively view four windows from one DP, two DPs would cover a minimum configuration in any of the half sets A1, A2, B2.

C1, C2 - One DP has been allocated to each half set in set C. This set does not include equipment that will allow more than one TRS to be active per half set. The DP will be used to display the following windows:

- One TRS (1 window)
- Set Master (1 window per set)
- TRS Master (1 window per TRS)
- Network Manager (1 window per set)

Assuming an MCOE can actively view four windows from one DP, one DP per half set will cover the configuration of set C.

GOF, SPF - The GOF and SPF will need a minimum of one DP each to run the Network Manager software. Also delivered with each Database Subsystem (DBS), Processed Data Recorder (PDR), and Host are terminal class machines connected directly to the console port of the box. These consoles are used for retrieval status as well as operations and maintenance functions.

PSTF-R - PSTF-R will require a minimum of one DP to run Network Manager and view the active TRS.

CAF - As of the PDR for the CAF, three DP's are allocated to the CAF Master Console.

There are currently no DPs available as spares or as maintenance and troubleshooting aids. When an anomaly occurs within a set, the sets MCOE will have to troubleshoot the anomaly as well as monitor the remainder of the set from the same DP. Otherwise an operator will have to 'take over' one or more of the windows from a DP to allow for troubleshooting or maintenance. This could impact the repair time if the operator is heavily involved in troubleshooting of the particular anomaly.

3.2 COMPUTER ROOM OPERATIONS

TCMS O&M has the primary responsibility to support operations of the TCMS computer facility. The goal of this group is to provide reliable, uninterrupted computer support to all TCMS personnel. The specific functions and how each is performed will depend upon the final configuration provided by the CEC.

TCMS O&M operates the TCMS computer systems and associated peripherals, performs system backups, schedules preventive maintenance with the original equipment manufacturer (OEM) or internal maintenance personnel, monitors system activity, verifies job execution, responds to user inquiries, performs set configuration/reconfiguration, and

performs software downloads. Most operations are executed from the TCMS Master Console Area. See paragraph 3.1 for information on the TCMS master console.

Computer room operations are further divided into the following paragraphs:

- Active Sets (paragraph 3.2.1);
- Payload Spin Test Facility - Replacement (PSTF-R) (paragraph 3.2.2);
- Software Production Facility (SPF) (paragraph 3.2.3);
- Global Operations Facility/Processed Data Recorder (GOF/PDR)(paragraph 3.2.4);
- Data Management System (DMS) Kits (paragraph 3.2.5);
- Communications and Patching (paragraph 3.2.6);
- User Rooms (paragraph 3.2.7);
- Cargo Integration Test Equipment (paragraph 3.2.8).

Each section describes the operational functions for its respective set or group of sets.

3.2.1 ACTIVE SETS. Active Sets include half sets A1, A2, B1, B2, C1, C2, and the hazardous set (PSTF-R). An "active set" is one of the half sets currently supporting or being configured to support software development, training, or testing of a flight hardware article. A half set is composed of the group of hardware and software needed to test a flight article or GSE including:

- Core provided hardware, software, and patch fields;
- DMS Kit provided hardware, software, and patch fields;
- Intermediate bay hardware and patch fields;
- Highbay hardware and patch fields;
- Facility provided hardware.

Operational activities are executed by the set MCOE on the set Master Console DP located in the TCMS control room.

3.2.1.1 Active Set Operational Components. Each active set is composed of one or more of the following baseline hardware component's and its associated software:

- AP
- DP
- Master Console DP
- PDR
- FEP's
- HIM's
- RTN

- CDBFR
- Bridges
- Routers
- DMS Kits
- Patch fields
- Facility hardware

For detailed information on any of the active set components, see the specific Core Configuration Item (CI) documentation.

3.2.1.2 Active Set Operations. The set's MCOE will be responsible for operations of all the set components including operator level preventive maintenance, set initialization, software downloading, system software loading, monitoring system activity, responding to user inquiries, error detection, event initiation, set configuration, set configuration updates, and supporting active tests. In addition, operations and communications personnel will maintain bridge and router configurations.

3.2.2 HAZARDOUS OPERATIONS FACILITY. The Hazardous Operations Facility (HOF) includes the TCMS active set designed for hazardous operations. It is composed of the PSTF-R and the Hazardous Operations Support Facility (HOSF). The user control room and user DPs for the HOF will be located in the HOSF. HIMs and distance sensitive FEPs will be located in the PSTF-R. All other set equipment and the master console DP will be integrated in the Space Station Processing Facility (SSPF) with the other Core equipment. Operational activities will be executed by the set MCOE on the set Master Console DP located in the TCMS control room.

3.2.2.1 Hazardous Operations Facility Operational Components. HOF operational components are identical to the active set operational components. See paragraph 3.2.1.1 above. Additionally, the HOF is equipped with safety equipment to shutdown hazardous operations should the need arise.

3.2.2.2 Hazardous Operations Facility Operations. TCMS O&M will operate the HOF consistent with Active Set Operations, paragraph 3.2.1.2 above.

3.2.3 SOFTWARE PRODUCTION FACILITY. The SPF includes the set of hardware used for development and configuration management of applications and simulation software. SPF allows software developers to perform final compiles on the target subsystems. It serves as a local repository for downloaded Master Object Database

(MODB) data, build data, and test configuration functions. Several databases are also located on the SPF. For information on the databases see paragraph 8.3 of this document.

3.2.3.1 Software Production Facility Operational Components. The SPF is composed of the following baseline equipment:

- Host Computer Systems
- Cluster Controller-to-Disk Drive Interface
- Disk Drive Storage Unit
- Tape Drives
- Target AP
- Target PDR
- Target DBS
- Line Printers
- Master Console DP
- SPF Host Console (attached to host console port)

For a detailed description of the SPF equipment see the Core Hardware Design and Maintenance documentation for the Software Production Facility, 83K03802.

3.2.3.2 Software Production Facility Operations. The anticipated SPF workload consists primarily of databases functions, software development and build activities, reports concerning these activities, and maintenance of the delivered Core developed software. The SPF will be available for users 16 hours per day, 5 days per week. Preventive maintenance and backups will be performed during third shift.

For detailed information on specifications, installation, operations, and maintenance of the SPF and its components, see the Core Hardware Design and Maintenance documentation, 83K03820.

3.2.3.2.1 Host Operations. Startup of the Host systems is automatic. Once the disk drives and Central Processing Unit(s) are powered on, the system will autoboot. All configured devices will come up along with all installed layered software products. If a hardware or software problem should develop, a message indicating the problem and the severity level is sent to the host console. If the system can continue to run it will due so; however, if the operating system determines that the error will compromise the integrity of the system, the system will crash. If a crash occurs the system will record all necessary debug information in a dump file before it halts. The system will then re-boot itself. It is the responsibility of O&M and the computer vendor to troubleshoot a system crash. If there is a power spike or fluctuation, the system will re-boot itself. However, the SPF is

powered by facility Uninterruptible Power Supply (UPS) making power fluctuations minimal.

Once the system is up and running, operator intervention is minimal and the system will be operated according to vendor documentation. The System Administrator will be responsible for the creation and deletion of users as well as system tuning through the use of tools to monitor and adjust its performance (i.e., SYSGEN, a subsystem of the operating system).

3.2.3.2.2 Host Backups. Backups are planned to be performed using the VAX/VMS BACKUP command. This command will provide for an on-line backup, thereby negating the need for system downtime while backups are being performed. System performance is only minimally degraded by this operation. This backup methodology copies all files that are not being accessed, to tape. If the file is open for access, the operating system makes a "best guess" attempt to copy the file to tape. A warning message is issued indicating that this has occurred. The operator will be prompted to mount tapes as needed to complete the backup.

Incremental backups will be performed on a daily basis with full system backups occurring on a monthly basis. Backups are performed as part of third shift operations and will not preempt flight testing or other scheduled events. A subset of the media library will exist off-site where the storage of first generation backups will be maintained. The third shift Operations Engineer is responsible for performing the backups and maintaining the off-site media library.

Note: The location of the off-site storage area is TBD.

3.2.3.2.3 Cluster Controller-to-Disk Drive Interface Operations. The cluster controller-to-disk drive interface, once configured, will require no operator intervention. Any maintenance will be provided by the vendor.

3.2.3.2.4 Disk Drive Storage Unit Operations. The disk drives supplied with the SPF will require no operator intervention. Once the drives are powered up and have been placed on-line by the front panel button they require no attention.

A second type of backup operation will need to be performed to defragment the disks. This operation will be performed as needed, based on the amount of disk fragmentation. To defragment a disk the system must be completely shutdown and re-booted using the standalone Backup kit. This boot configuration brings the system up in a minimal, single-user state. Once the system has been booted in this configuration the disk to be

defragmented is copied to tape using the /IMAGE qualifier of the BACKUP command. This command copies all files to tape contiguously. Another backup is then performed in which the files are copied from tape to disk. At this point the disk has been defragmented and the system should be shutdown and re-booted in its normal configuration.

3.2.3.2.5 Other SPF Device Operations. All other SPF host devices will be operated consistent with their respective vendor documentation. The target devices will be operated consistent with their vendor and Core documentation.

3.2.4 GLOBAL OPERATIONS FACILITY / PROCESSED DATA RECORDERS. The GOF consists of two DBS connected by the GOF Global Display Bus to the TCMS Global Bus. Sets A, B, C, and PSTF-R access the GOF through the TCMS Global Display Bus. The GOF also contains routers and gateways to manage TCMS external network communications and the connection of the DBSs and SPF to Payload Operations Network (PON) users and external networks. Users working from POWs are granted access to TCMS data through the GOF routers and gateways.

Note: The security ESR that allows PON access to TCMS data is not yet approved. Should the ESR fail to be approved, PON access will be deleted due to security risks.

Each DBS within the GOF supports the following functions:

- Manage retrieval requests.
- Maintain knowledge of the location of all recorded data in the hosting system for both near-real-time and archived data.
- Manage all incoming PON traffic through bridges, routers, and gateways.

The Processed Data Recorders (PDRs) are not part of the GOF but their operational activities are similar to the DBSs'. PDRs are used to perform the following functions:

- Support recording of processed and unprocessed data simultaneously to Temporary Archive Media (TAM) and Permanent Archive Media (PAM);
- Support retrievals from TAM;
  - From within a TRS
  - From authorized TRS external requesters - DBS, DP, or Payload Office Workstation (POW).
- Support recording redundancy when configured as a Primary Recorder/Primary Retriever pair;
- Support configuration and load for the TRS;
- Provide high speed print capability.

The following assumptions apply to the operations of the PDRs and the GOF DBSs:

- The PDRs and DBSs will be co-located in the same room to help minimize operations man power.
- Data retrievals from a PDR are made from the TAM drives only. No PDR retrievals will be done from the PDR PAM drives.
- PDR PAM disks will be moved and logged into the DBS catalog before the TAM overwrites the data. TCMS operations makes the assumption that if the data is not on TAM, then it must be on the DBS and retrieval requests are routed accordingly by TCMS System Software.
- The GOF operators will pre-initialize disks with a volume ID before a test.

TCMS O&M operators are responsible for operating both the DBSs and the PDRs.

3.2.4.1 Global Operations Facility / Processed Data Recorders Operational Components. The GOF consists of a number of components that will require operator intervention. Listed below are those components:

- DBS
  - PAM storage system with at least 2 optical drives or optical jukebox(s)
  - 4 gigabyte magnetic hard disk
  - One SPF-compatible Software Distribution Peripheral (removable media)
  - Two 9-track tape drives
  - High speed laser printer(s)
- Master Console DP
- PON Router
- PSCNI/CAD/CAE gateway
- PDMS/POW gateway

Each PDR consists of the following operational components:

- 500 Megabyte hard disk
- TAM hard disk storage
- PAM storage system with at least 3 optical drives or optical jukebox(s)
- One SPF-compatible Software Distribution Peripheral (removable media)
- Magnetic tape drive
- High speed line printer (shareable between PDRs)

Consumables for GOF/PDR devices may include PAM cartridges, magnetic tapes, printer paper, and SPF-compatible distribution media. The KSC Supply System will provide all consumables required for GOF/PDR operations. A five day supply of consumables will be located in proximity to the GOF/PDR.

3.2.4.2 Global Operations Facility / Processed Data Recorders Operations. The GOF operators will be responsible for operations of the GOF DBSs, PDRs, gateways and printers, including replacing consumables, operator-level preventive maintenance, distributing printouts to the appropriate distribution box, and maintaining gateway configuration. Additionally, operators and communications personnel will maintain bridge, router, and gateway configurations.

The GOF DBSs and PDRs will require the operators to maintain a media library and service user requests. A subset of the media library will be located in the GOF/PDR area containing a number of PAM media components. The main media library will be located in a room next to the GOF/PDR area in a controlled environment. Access to this room will be limited to O&M and SR&QA personnel. The GOF operator must maintain these libraries so specific media can be found and mounted quickly. Each DBS will require media to be mounted and dismounted per user requests.

In the current baseline, DBSs do not load share. Each user or group is assigned to one of the DBSs. This makes managing the requests more difficult and man power intensive since requests would have to be manually moved to the other DBS if necessary. PDRs will require new media to be mounted as current media is filled. It is the GOF operators responsibility to perform these functions.

The DBS/PDRs will be co-located in the GOF area. This drives the need to display all PDR and DBS messages so that a few operators can monitor the messages and maintain knowledge of the status of all operations. The current baseline design is that messages are displayed at a terminal that is associated with each PDR or DBS and that the terminal monitors only the TRS in which it is configured.

The baseline GOF configuration includes a single DP. The functions of this DP are as follows:

- Provide a platform for network management for the GOF set equipment;
- Provide a platform to receive retrieval related messages such as volume mount requests;
- Provide a platform for manual entry into the DBS catalogs for logging disks into and out of the GOF.

Each DBS and PDR has a dumb terminal attached to its console port. The use of this terminal is restricted to O&M functions only, including: maintenance, operating system message acknowledgment, and tape load requests.

Current baseline dictates that PAM disks (rewritable opticals) are recorded such that each side is considered a separate volume. The recording software is forced to record to

separate disks since the drives cannot record to both sides of the disk without the disk being flipped over. The TCMS baseline provides 3 disk drives per PDR that can be used in a round robin mode using all three drives (i.e., drive 1 -> 2 -> 3 -> 1...) or used in ping pong mode using only two drives (i.e., drive 1 -> 2 -> 1 -> 2...) to record.

Note: ESR 99708 is outstanding to add jukeboxes to the PDRs and DBSs. If this ESR is approved, the PDRs will have two jukeboxes with one drive each. The recording will be in a ping pong mode between the drives. Flipping the disk over will not be necessary since the jukebox will do it as needed.

Baseline provides that the Operations Engineer manually enters a volume id before each volume is initialized for recording. Automatic volume id generation is currently being investigated by the recording CSCI. This volume id must also be manually affixed to the outside of the PAM for easy reading and cataloging.

Preventive maintenance for the GOF/PDR is the responsibility of the TCMS O&M group and will be performed between tests and during third shift operations. Each DBS and PDR hard disk is required to be defragmented on a regular basis. Both the PAM and tape drives will be cleaned as part of preventive maintenance. The GOF Operations Engineer will perform these functions as well as maintain and monitor audit trail files of all GOF/PDR operations performed.

3.2.5 DATA MANAGEMENT SYSTEM KITS. A DMS kit is an integrated set of electronic units and an interface device to connect these components to a host computer. DMS Kits will be provided in multi-phased stages as the development of the DMS hardware and software progress.

DMS Kits are used for code verification and test support in place of the flight hardware. The DMS Kit requires a host computer that provides the simulation environment, control, and data recording and processing.

3.2.5.1 Data Management System Kit Operational Components. The configuration for individual DMS Kits will vary depending on the requirements and phase of testing or training. The configuration of DMS Kits for training and operational facilities will also vary depending on facility requirements and mission-specific configurations. The kit operational components are:

- Simulation Interface Buffer (SIB)
  - Local Control Workstations (LCWS)
  - System Developmental and Diagnostic Subunit (SDDS)
  - Network Monitor Subunit (NMS)

- Network Simulator Subunit (NSS)
- Functional Equivalent Units (FEUs)
  - Intermediate Rate Gateway (IRGW)
  - International Gateway (IGW)
  - Multiplexer Demultiplexer (MDM)
  - Ring Concentrator (RC)
  - Standard Data Processor (SDP)
  - Mass Storage Unit (MSU)
  - Multi-Purpose Application Console (MPAC)
  - Time Generation Subunit (TGS)

3.2.5.2 Data Management System Kit Operations. TCMS O&M personnel are not currently responsible for the operation of the DMS Kits, their related components, or associated software. Responsibility for the operations of these items is currently under negotiation.

O&M is responsible for the configuring, reconfiguring, preventive maintenance, and maintenance troubleshooting of DMS Kits. Maintenance is limited to troubleshooting and calling Work Package 2 for further assistance.

3.2.6 COMMUNICATIONS AND PATCHING Communications and patching of TCMS hardware is covered in the TCMS Communications and Patching Plan, TS-TCMS-92004. For information on operations involved in the patching rooms, communications rooms, and other patching field areas, see the Communications and Patching Plan.

3.2.7 USER ROOMS. The user's method of interfacing with an active set is primarily through a DP in one of the nine user control rooms. During testing, the Test Conductor is responsible for directing the test, test personnel, and monitoring all activity in the user room. Users who encounter any hardware or software problems will report them directly to the Test Conductor and/or Test Integration. With inputs from the test team, the Test Conductor will determine the severity of the problem. If a Problem Reporting and Corrective Action (PRACA) condition exists, the user will document the problem. The Test Conductor then forwards the users documentation to Quality so a PRACA report can be opened. The Test Conductor or Test Integration will then notify the sets MCOE . If a Test Conductor does not exist, users will notify the Client Support Area directly.

User rooms are configured for individual tests by O&M personnel before test initiation according to Section 1 of the test's Operations and Maintenance Instruction (OMI). O&M

may remove user room wall partitions before test configuration is complete to form larger rooms. See Figure 3-2 and Figure 3-3 for the default user room configurations.

Because a DP does not lend itself to unconstrained mobility, O&M policy is that DPs will not be moved. Moving wall partitions adjoining two rooms will effectively add DPs to a user area, thus satisfying user requirements for additional DPs in a TRS.

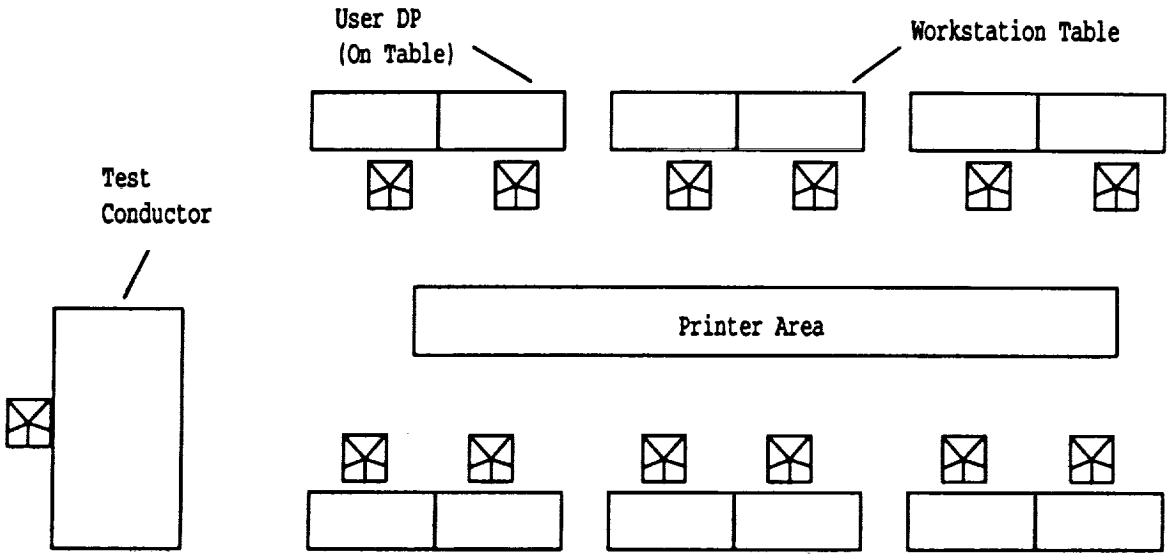


Fig 3-2
Typical TCMS User Room - Style A

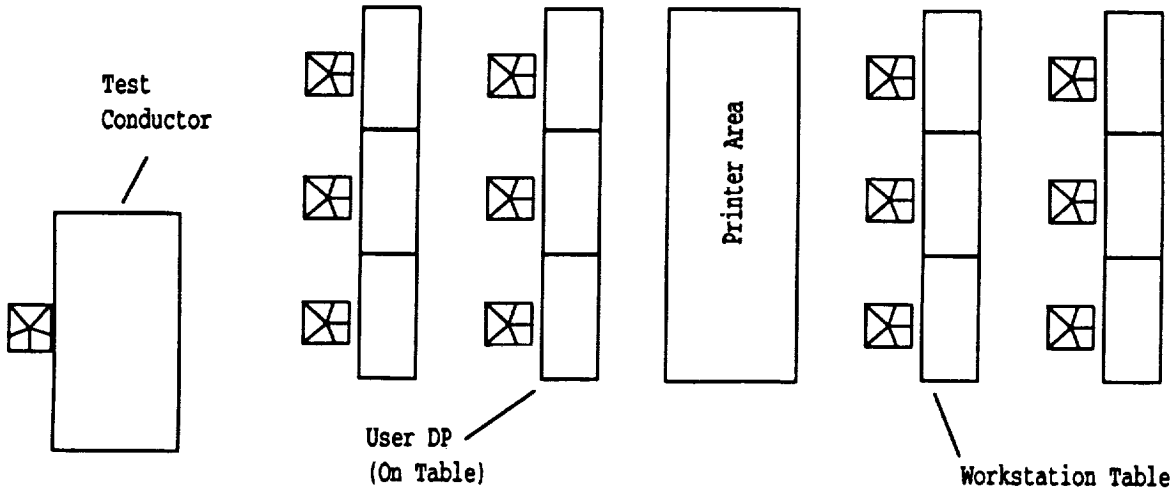


Fig 3-3
Typical TCMS User Room - Style B

Hardware located in user rooms will be loaded with software and validated by TCMS O&M prior to test initiation. O&M will resolve any hardware or software anomalies that occur prior to test initiation. See Section 6, Anomaly Verification and Testing.

3.2.7.1 User Room Operational Components. The user rooms consist of the following baseline operational components:

- DP's
- Laser Printers
- Bridges
- Repeaters
- Communications Servers (three of the nine user rooms)

3.2.7.2 User Room Operations. User rooms contain at least one laser printer that will require paper and toner cartridges. Paper will be kept in proximity to the printers. It is the users responsibility to keep the local user room printers loaded with paper as needed. Toner will be replaced as needed, but a verbal request must be submitted to the Client Support Area for additional toner or paper. O&M personnel will check paper supply and toner availability during user room configuration to assure adequate supply is available.

Preventive and corrective maintenance for user room equipment is the responsibility of the TCMS O&M group. Preventive maintenance will be scheduled between tests and

completed as a part of third shift operations. Corrective maintenance will be completed as needed. See Section 6, Anomaly Verification and Testing for more information.

During tests, there may be vendor equipment located in the user rooms. This equipment is under the control of the vendor and will be maintained by that vendor in coordination with the TCMS MCOE. Section 1 of the tests OMI must account for the space necessary for the vendor equipment. All required cabling of vendor equipment to KSC interfaces is the responsibility of the Payload Communications group.

3.2.8 CARGO INTEGRATION TEST EQUIPMENT. Cargo Integration Test Equipment (CITE), if placed in the SSPF, will be operated and maintained as stated in the System Operations and Maintenance Manual for the Cargo Integration Test Equipment.

3.3 OPERATIONAL SERVICES

Operational Services are those tasks that are beneficial to the users including:

- TCMS Client Support Area (paragraph 3.3.1);
- Payload Office Workstation Service Requests (paragraph 3.3.2);
- Communications Requests (paragraph 3.3.3);
- Set Peripheral Devices (paragraph 3.3.5).

This section will describe those activities dealing with the TCMS Client Support Area and peripheral devices attached to TCMS equipment. See Figure 3-1 for location of the TCMS Client Support Area.

3.3.1 TCMS CLIENT SUPPORT AREA. The TCMS Client Support Area, which serves as the link between the users and O&M personnel, will be located in the Master Console Area of the TCMS Control Room. By collocating the Master Console and Client Support Area, response time will be minimal and will help provide synergy throughout TCMS.

The Client Support Area is a subset of the Master Console and is positioned in the center of the master console horseshoes (see Figure 3-1). It consists of two POW class computers used for viewing anomaly information from the PRACA database. The Client Support Area is manned by TCMS MCOEs. Communications to and from the Client Support Area are through OIS-D. In cases where OIS-D is unavailable (such as off-site problems) telephone support is available.

The Client Support Area is strictly for reporting TCMS hardware and software breakdowns and requests. It does not include software operation questions. Users with application software operation questions will contact SSPSE. Problems with POWs are directed to the Network Services Help Desk.

When a call is made to the Client Support Area, the sets MCOE will log the problem, and if possible, correct the it. If an immediate solution can not be applied, the MCOE will contact the proper O&M personnel to correct the problem. For more information see the maintenance scenarios shown in Section 6, Anomaly Verification and Testing.

The TCMS Client Support Area and the Network Services Help Desk will be working together to close IPRs, PRs and Trouble Tickets that affect POW hardware, software, and related components. The TCMS MCOE is responsible for tracking any anomaly that occurs on TCMS set equipment. This includes active set equipment, DMS Kits, DPs, TCMS bridges and routers, patch fields, and network cabling. Payload Office Workstations accessing TCMS data, their network equipment, and network cabling are the responsibility of the Network Services Help Desk.

3.3.1.1 TCMS System Hardware / Software Anomaly Reporting. The TCMS Client Support Area will be the focal point for reporting, tracking, and managing the resolution of TCMS hardware/software anomalies. All calls will be logged and the appropriate organization(s) notified. Client Support Area personnel will ensure the end user has been contacted to verify satisfactory resolution of the anomaly before writing the closure statement on the IPR or PR.

Typically, only users on TCMS hardware (i.e., a display processor) will notify the TCMS Client Support Area. Users on POWs will contact the Network Services Help Desk with any problems that arise. Network Services will then turn the trouble ticket over to O&M if it's determined to be a TCMS problem.

See Section 6, Anomaly Verification and Testing, for detailed information.

3.3.1.2 Network Services Help Desk. Network Services is currently responsible for hardware and software problems that arise on existing PC's. Since they currently have the expertise in this area, they will continue to function as the point of contact for TCMS POW anomalies.

The Network Services Help Desk will be responsible for logging all calls that come from users working from a Payload Office Workstation. Users will call trouble tickets into the Network Services Help Desk. Network Services will then disposition the trouble ticket. If it is determined to be a TCMS anomaly, it will be turned over to the TCMS Client Support Area. Otherwise, Network Services will correct the anomaly.

Note: A Memorandum of Understanding is being developed between Network Services and TCMS that clearly defines the roles, responsibilities, and level of service.

3.3.2 PAYLOAD OFFICE WORKSTATION SERVICE REQUESTS. The CSR will be used by TCMS users to obtain payload office workstation services. After the user fills out the CSR and submits it to the Network Services Help Desk, network services personnel will plan, implement and test the requested services. Once the work requested on the CSR is completed, network services documentation and configuration data will be updated by the appropriate department. Network Services will then request data access from the TCMS System Administrator for the user submitting the CSR. Data access allows the user access to the TCMS GOF from a POW.

3.3.3 COMMUNICATIONS REQUESTS. The CSR will be used by TCMS users to request communications-related services including printers, or POWs. All other TCMS communications are part of the tests OMI. An ESR must be written to include additional communication related requests in the OMI. The CSR will evoke the proper organizations to plan, coordinate, and develop a work package for the requested services. They will then be tasked to implement the work package. After the task is complete, documentation and configuration data will be updated to reflect the latest configuration.

3.3.4 SET PERIPHERAL DEVICES. Set peripheral devices are operated by TCMS Operations personnel. These devices include printers, tape drives, disk drives, optical drives, and other such devices (DP floppy disk drives and printers are not included as they are operated by the user). The operator will be responsible for changing tapes, disks, cartridges, ribbons, toner, and keeping paper in the printers (excluding paper for printers located in the user rooms in which users will be responsible for keeping paper loaded) as well as distributing printouts to the appropriate distribution box located in the TCMS printer area.

Media and paper will be supplied through the KSC Supply System and will be stored in proximity to the peripheral device. Used media will be stored in the media library in the SSPF. The media library is a separate, secured, climate-controlled storage area next to the TCMS Control Room, managed by TCMS O&M personnel.

3.4 WORK TRACKING AND CONTROL

Work Tracking and Control will be accomplished using applicable Technical Support Management Directives (TSMDs) and Standard Practices as well as the information found

in this document. These documents address such topics as CSRs, IPRs, PRs, applications development, and network outage coordination.

3.4.1 EVENTS. An event is a job or task that a user, operator, or group wishes to execute on a TCMS set. Events may be scheduled or unscheduled with many falling in both categories. The following list includes many of the scheduled and unscheduled TCMS events:

- Flight hardware testing;
- Test Configuration;
- File restoration;
- Daily, weekly and monthly backups;
- Line Replaceable Unit (LRU) replacement and off-line maintenance;
- Simulation and Application development;
- On-line and off-line maintenance;
- Software load verification and validation;
- Preventive and on-line maintenance;
- Disaster recovery.

O&M specific events will be scheduled through the TCMS System Administrator (see Section 8, System Administration). O&M specific unscheduled events will be handled on a priority basis. O&M event priority will be determined by the System Administrator in conjunction with TUG, users, and other O&M personnel. Upon event completion, any available results will be given to the event initiator(s) for review.

The planning for these events will include support for OMI reviews, scheduling, pre/post test meetings. O&M personnel will support these activities as needed.

3.4.2 SCHEDULED EVENTS. Scheduled events are those events that have been scheduled through the TCMS System Administrator prior to event execution. O&M events include: preventive maintenance, backups, scheduled LRU replacement. All events, with exception of those described in paragraph 3.4.3 of this document, will be scheduled. A priority may be attached to an O&M event by the System Administrator, TUG or other O&M personnel to prioritize event execution. Higher priority events may preempt lower priority events as system resources permit. However, an initiated event will typically execute until completed before system resources are returned for use by pending events.

The TCMS shift manager is responsible for ensuring all O&M events are scheduled and prioritized.. Once the O&M schedule is agreed upon, the shift manager will deliver the proposed schedule to the appropriate group for addition in the 11 day, 72 hour schedule.

3.4.3 UNSCHEDULED EVENTS. Unscheduled events are those events that have not been previously scheduled and are deemed critical to TCMS operations. By nature, these events, consisting of emergency operations, have a higher priority and may preempt a scheduled event.

Unscheduled events include such events as file restoration, disaster recovery, LRU replacement and verification, subsystem or test article trouble shooting, and resolving network cabling problems. Unscheduled events do not include preventive maintenance, subsystem validation or related events that should be scheduled.

3.4.4 SHIFT OPERATIONS. The TCMS O&M work day is divided into two or three shifts with one or two additional shifts overlapping the two or three standard shifts.

First shift operations will be 07:00 - 15:30, Second shift operations will be 15:00 - 23:30, and third shift operations will be 23:00 - 07:30. In addition there may be an overlapping shift which will start after the normal start of the first shift and continue after the start of second shift. See Figure 3-4 below.

All times listed in the figure below are preliminary and may change after TCMS activation.

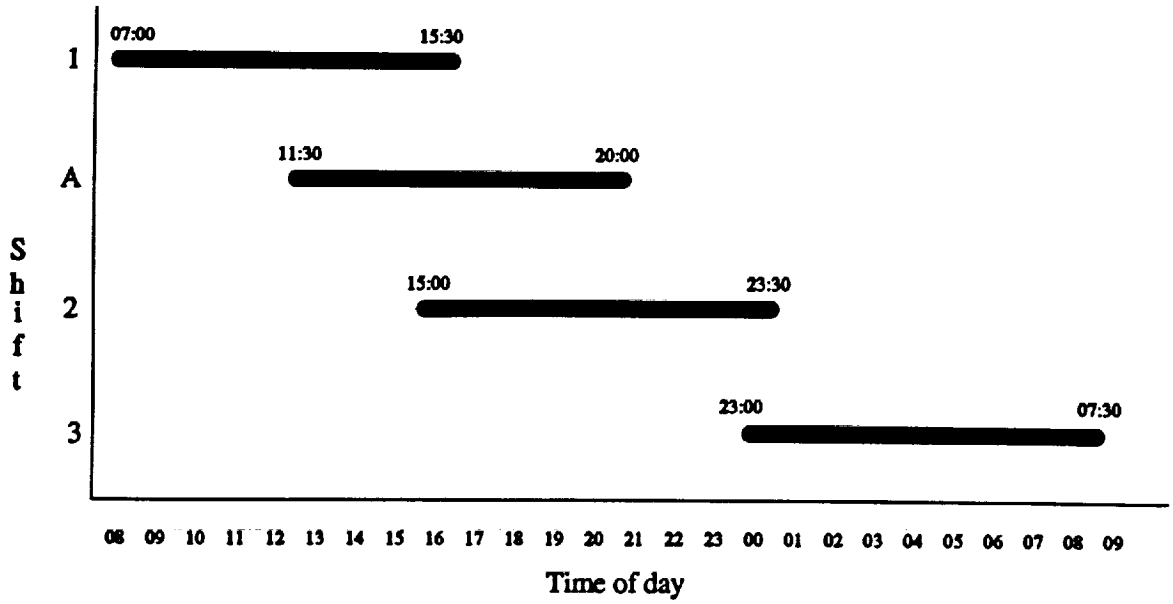


Fig 3-4
Shift Operation Schedule

3.4.4.1 First and Second Shift. First and second shift operational activities include:

- Monitoring system activity on all half sets
- Monitoring health and status of all half sets
- Responding to user inquires
- Error detection
- Support of active tests
- Support of simulation and test application software verification
- Set configuration
- Printout distribution
- Corrective maintenance

The major function of the first and second shifts will be to support active tests and configure available set resources for scheduled use.

3.4.4.2 Third Shift. Third shift operations include:

- First and second shift operations should testing be scheduled
- Corrective maintenance
- Backup of system resources
- Verifying integrity seals
- System tuning
- Upgrade installation
- General subsystem file maintenance
- Preventive maintenance including:
  - Diagnostics
  - Cleaning
  - Changing filters
  - Implementing planned LRU replacement (scheduled maintenance)
  - Network signal flow validation
  - Software load verification

The major function of the third shift is to perform those events that bring the sets integrity level to the highest possible level. Third shift operations include those supporting events that are required to provide reliable operation of TCMS.

Third shift operations may also include all the activities associated with first and second shift operations. At times there may be flight hardware tests and set configuration scheduled for third shift.

Backup of system resources will take place during third shift. A subset of the media library exists off-site where the storage of disaster recovery backups will be maintained. The third shift Operations Engineer is responsible for performing the backups and maintaining the off-site media library.

3.5 OPERATIONS AT CORE ELECTRONICS CONTRACTOR SITE

If operations at the Core Electronics Contractor site are required, they will be similar to operations at KSC. See Section 3 for additional information.

3.6 CENTRAL SOFTWARE FACILITY / CENTRAL AVIONICS FACILITY OPERATIONS AT JOHNSON SPACE CENTER

Operations for the Central Software Facility/Central Avionics Facility (CSF/CAF) at Johnson Space Center (JSC) will be similar to operations at KSC.

SECTION IV

RESOURCE MANAGEMENT

4.1 HARDWARE RESOURCES

This section includes a listing of all the Hardware Configuration Items (HWCI) in TCMS followed by a brief description of each item. Also included are descriptions of the more important specialized pieces of test equipment unique to the TCMS system.

4.1.1 DISPLAY PROCESSOR. The DP is the system interface to the user within the Core distributed architecture. In simple terms, it is where the user does the testing. The DP has a 32-bit CPU, a keyboard, a pointing device, a primary display, up to three (3) slave monitors, a removable media device, and an MS DOS compatible floppy drive. The DPs directly interface with the Display Network Subsystems (DNS) for accessing the Applications Processor (AP), data storage and retrieval subsystem, DBS, service network, SPF, and external systems such as PDMS.

4.1.2 APPLICATION PROCESSOR. The AP is a UNIX-based processing node within the Core distributed architecture. It is a computation-intensive subsystem that primarily executes real-time system services and test application programs. It consists of two 32-bit CPUs, a hard drive, and a removable media device. It interfaces directly with the DNS for access to the DPs and through a Buffer Input/Output Processor (BIOP) to the Real Time Network (RTN). It also interfaces directly with the Service Net (SN).

4.1.3 FRONT END PROCESSOR. The Front End Processor (FEP) is a universal hardware element that performs the protocol and data processing necessary to support a wide variety of synchronous and asynchronous test article control and data acquisition at the front end interfaces. It consists of several CPUs and interface modules housed in a Versa Module Eurocard (VME) bus chassis. The specific interfaces required govern the configuration of this chassis. The FEP can process all known space station, payload and ground support equipment data types by configuration of interface cards, custom software and customized high performance filter modules. The FEP communicates to the other subsystems by way of the RTN through a BIOP. It also interfaces directly with the SN (release 2 functionality).

4.1.4 REAL TIME NETWORK. The Real Time Network (RTN) provides message and data communication capability for attached processors. The RTN utilizes star topology with hosts connected to the central node through dedicated, high speed, point-

to-point links. Through access control of shared data storage area and message routing tables, the hosts attached to the RTN can be configured into multiple Test Resource Sets (TRSs) to support parallel operations. The RTN consists of the Common Data Buffer (CDBFR), host resident BIOPs, and host resident Monitor Input/Output Processors (MIOPs). The BIOP supports the exchange of single, multiboard and homogenous data sets as well as messages. Error detection and correction and/or error reporting mechanisms ensure the integrity of the information. The MIOP is a unidirectional link that routes data passing through the RTN to a PDR. It also interfaces directly with the SN.

4.1.5 HARDWARE INTERFACE MODULE. The Hardware Interface Module (HIM) acts as the front-end element of TCMS and is connected to the GSE data bus for communications with the FEP. A FEP may control up to eight HIMs through a ground data bus. The modular design of the HIM accommodates several types of interfaces depending upon the particular configuration required. There are two basic types of HIMs; the slave HIM and the standalone HIM. The slave HIM is always connected to a FEP and its' function is to either transfer measurement data from a GSE device to the FEP, or to pass a command from the FEP to the specific GSE device. Thus, there is no algorithmic processing of measurements or command generation in the slave HIM. The standalone HIM interfaces to GSE equipment as in a slave HIM, but gathers measurements and issues GSE commands without requiring a FEP.

4.1.6 PROCESSED DATA RECORDER. The PDR records data from the RTN to support near real-time retrievals and post-test retrievals. The data consists predominantly of preprocessed test article data from a FEP. The PDR records on two different media simultaneously. TAM supports the near real-time retrievals and PAM supports a historical record. The PDR interfaces with the RTN for data recording and the DBS for the retrieval functions. It also interfaces directly with the SN.

4.1.7 DATABASE SUBSYSTEM. The DBS provides the data management and data handling functions to support the data display and analysis performed during and after tests. The DBS supports data retrieval and analysis. During a test the DBS supports data retrieval and analysis of the PDR recorded data.

4.1.8 DATA MANAGEMENT SYSTEM. The DMS kit typically contains a SIB and a set of Functional Equivalent Units (FEUs, which can be described as non-flight versions of various space station components). The SIB is the interface device within the DMS kit that provides the interface bridge to the Space Station Freedom environment, including the local buses and networks. Each SIB is composed of a local control workstation and a number of subunits that may or may not include all the following; a

Local Bus Input/Output Subunit (LIOS) for SN/0 only, a Multiplexer/Demultiplexer Interface Subunit (MIS), an SDDS, an NSS, and an NMS. The space station DMS buses and networks include MIL-1553B local buses, ANSI X3T9.5/83-15FDDI networks, and an EIA RS-422A time distribution bus.

4.1.9 SOFTWARE PRODUCTION FACILITY. The SPF is the hardware set used for development and configuration management of applications and simulation software. SPF allows software developers to perform final compiles on the target subsystems. It serves as a local repository for downloaded MODB data, build data, and test configuration functions. Several databases are also located on the SPF.

4.1.10 SPECIALIZED TEST EQUIPMENT.

4.1.10.1 Functional Interface Test Tool. The Functional Interface Tool (FIT) is a portable device that is designed to perform card level testing of the custom Input/Output (I/O) cards in the HIM. The FIT's FEP Simulator function is able to simulate, record, and verify the HIM's responses to roll calls, FEP commands/queries, and I/O card transactions. The FIT consists of a keyboard, monitor, CPU, and floppy drive, all contained in a hand-carried housing.

4.1.10.2 HP3070 Board Tester. This is a highly computerized device that is capable of checking both the functionality and operational readiness of custom designed circuit boards. The board tester is able to verify functionality and operational readiness with board-unique templates that this device can fabricate for each custom circuit board.

4.1.10.3 RTN Analyzer. The RTN analyzer is a tool for monitoring the activity through the RTN. It consists mostly of custom LRUs such as the Input/Output Processors that are identical to those used in the RTN. One custom card, the Link Tester, is unique to the RTN analyzer.

4.1.10.4 Configuration, Calibration, and Test Set. The Configuration, Calibration, and Test Set (CCATS) provides the capability to verify data transmission throughout the Core system. When integrated with the Core system, CCATS can be used in the configuration, calibration, and testing of a TRS or elements within a TRS. CCATS can also be used in a stand-alone mode to verify the electrical characteristics of Core subsystem interfaces.

4.2 SOFTWARE RESOURCES

This section includes a listing of all the Software Configuration Items (CSCI) in TCMS followed by a brief description of each item.

4.2.1 SYSTEM SOFTWARE. System Software is a collection of custom designed software programs called Computer Software Configuration Items(CSCIs) that are being developed by the CEC. These CSCIs work in conjunction to provide the software functionality required for TCMS. A detailed description of each CSCI is given below:

4.2.1.1 Test Build. Test Build (BLD) provides the capability to create and edit a Test Configuration for test of a Test End Item. BLD provides the initial identification of the Test Configuration; creation of the Function Designator Directory (FDD), creation of FEP Tables; creation of Remote Interface Tables for HOSC, Real Time Interface (RTIF), and CCP; creation of Central Data Subsystem (CDS) Build Products; and creation of Test Configuration Partitions. An Online Data Bank (OLDB) is created when a request is received from the Configure Tests (CTS) CSCI for transfer of a Test Configuration. Some operations may be executed concurrently. Creation of the Test Configuration is initiated by a client through the Human Computer Interface (HCI) Test Development Services (HTD) CSCI.

4.2.1.2 Commercial Development Environment. Commercial Development Environment (CDE) provides the development environment for Test Application Software in the commercial High Order Languages. This environment includes a Commercial-off-the-shelf (COTS) syntax-directed editor, compiler, linker, and static analyzer. A custom precompiler is provided to perform Function Designator (FD) reference checks. It also provides the environment for expert system development.

4.2.1.3 Command Processing. Command Processing (CMP) is responsible for the validation and issuance of client entered and test application software generated commands. Command validation includes command parsing along with checks for syntax, client permissions, command applicability, prerequisite sequence, and two-step command processing. Command issuance includes monitoring Test End Item commands for completion status from front end processors and routing validated commands to applications within the TRS. This CSCI is also responsible for the initiation of all transient routines requested by the client or test application software.

4.2.1.4 Configuration Management Services. Configuration Management Services (CMS) performs four basic Configuration Management (CM) Service functions: configuration control, revision tracking, transaction logging, and status accounting, which are distributed through the Develop Tests CSCIs and accessed by the HTD CSCI.

4.2.1.5 Configure Test. CTS provides the capabilities to establish a TRS by defining the software loads, interfacing with System Management (SMG) to provide CDBFR-II configuration data, receiving the System and Test Configuration software loads from the SPF or transferring from the GOF to the Test Resource Set local storage, and distributing the software to the Hardware Resources within the TRS.

4.2.1.6 Data Acquisition and Control. Data Acquisition and Control (DAC) is responsible for the acquisition, processing, and exception checking of data from the Test End Item. This CSCI provides a command interface between Core and the Test End Item.

4.2.1.7 Data Storage Management. Data Storage Management (DSM) stores data on various types of physical storage media, in many different data formats. The data is under the control of several different database or file management systems. The DSM CSCI provides higher-level Core CSCIs with access to this stored data, independent of the location or the characteristics of the physical storage media.

This service provides low-level data administration functions for the Core stored data. It includes services necessary to manage, administer, monitor, protect, modify, and maintain integrity of the stored information. Custom software solutions are only implemented when COTS products do not fulfill the Core requirements. This service also maintains the integrity and consistency of data replicated across platform boundaries.

4.2.1.8 Ground Operations Aerospace Language/Control Logic/Test Control Supervisor Development Environment. Ground Operations Aerospace Language/Control Logic/Test Control Supervisor Development Environment (GCE) provides the development environment of Test Application Software using GOAL, CL, and TCS. This environment includes a syntax directed editor, syntax checker, compiler, and static analyzer. The capabilities supporting GOAL and CL development are generic capabilities provided for both CCMS-II and TCMS. The capabilities supporting TCS development is specific to CCMS-II.

4.2.1.9 Human Computer Interface Real Time Services. Human Computer Interface Real Time Services (HRT) provides interactive displays that allow clients to perform, monitor, and control activities, perform test support functions, and specify data retrieval report requests. This CSCI allows clients to control and monitor Test End Items, safing capabilities, and data retrieval and analysis capabilities.

Additionally, HRT provides client interaction displays that allow clients to transfer the build configuration, configure resources, load and initialize the TRS, interface with the timer services, control recording of test data, interface with health and status, and maintenance functions.

4.2.1.10 Human Computer Interface Support Environment. Human Computer Interface Support Environment (HSE) provides the basic input/output facilities between the HCI Real Time Services CSCI, HCI Test Development Services CSCI, the Workstation HCI and the Display Processor. The HSE CSCI is composed mainly of COTS software products with a minimal amount of custom software where required to provide the necessary access to functions and transparency layer. It provides windowing and window management functions with a Direct Manipulation Interface (DMI) environment. It also provides facilities for executing Core system defined displays, editing and executing Display Graphics, accessing Programmable Function Panels (CCMS-II only), formatting and providing analysis requests to a COTS graphing product for retrieved archived data reports, and special functionality as required for interacting with external interface displays.

4.2.1.11 Human Computer Interface Test Development Services. HTD allows clients to manage test article and link definition data, develop Test Application Software, define and manage test configurations, manage Core resources, manage client account information, and customize and manage client interfaces to suit individual or group needs.

The HTD CSCI also provides access to COTS products (Syntax Directed Editors, Graphical Editors, compilers, linkers, debuggers, DBMSs). Once a session is established with any of these COTS products, the client interface is provided to the initiated COTS product. Additionally, the HTD CSCI provides the actual client interfaces for those areas where the use of COTS may not be suitable and where the functionality will be provided by Core-developed software.

Lastly, the HTD CSCI uses report data generated by other support CSCIs and routes this report data to the appropriate client selected output destination (display, soft copy, or printer). This CSCI provides access to Test Development functions residing in the SPF Hosts. The Test Development functions are accessible from a DP or POW compatible workstations.

4.2.1.12 Link Configuration Database Manager. Link Configuration Database Manager (LDM) provides the capability to incorporate, edit, administer, and report Link Configuration Data contained in the Link Configuration Database. A client is allowed to interactively examine the Link Configuration.

4.2.1.13 Monitor Data for Distribution. Monitor Data for Distribution (MDD) provides the distribution of real time data to external systems and is responsible for Exception Monitor (EMON) processing, Display Monitoring (DMON), Predictive Trending processing, Dynamic Display processing, and for TCMS, POW processing of FD data. For CCMS-II, the MDD function is responsible for the gathering, formatting, and transmission of real time data to the KSC CDS through the RTIF IF and for responding to commands to plot on the SCRS real time and recorded data.

4.2.1.14 Network Manager. NMG performs three basic functions: configuration, where devices are controlled; monitoring, where management information is retrieved and stored; and reporting, where abnormal events concerning network devices are reported. The NMG is primarily COTS.

4.2.1.15 Record Test Data. Record Test Data (RCD) performs real time recording of Test End Item Data and Test Resource Set Data. This recorded data is used by the Retrieve and Format Test Data (RFD) CSCI for the purpose of retrievals during or after test execution. On the PDR, unprocessed data consists of Test End Item (TEI) data that has been extracted from the data stream and identified by the FEPs but has not been linearized or converted to engineering units. Processed data consists of TEI data that has been fully processed by the FEPs and placed into the CDBFR. On the Digital Record and Retrieval Subsystem (DRRS), raw data is recorded directly from the buses before it is decommutated by the FEPs.

4.2.1.16 Retrieve and Format Test Data. RFD performs retrievals of raw TEI data (CCMS-II), processed TEI data and Core internal data. The retrieved data is formatted for retrieval reports and CDS backfills. Management of retrieval control requests is also provided so that a client with proper permissions or test application software may cancel, suspend, or resume retrieval requests. A client with proper permissions may activate/inhibit near-real-time and post test retrievals. The client or test application software may also request a status of all retrievals.

4.2.1.17 Resource Manager. Resource Manager (RMG) provides the capability to define hardware resources, allocate hardware resources to TRSs, and maintain an accounting of their use. This CSCI is responsible for maintaining the Hardware Resource Database through client interaction. It also assists the client in allocating resources to a particular test, and subsequently modifying that allocation in response to a hardware or software problem.

4.2.1.18 System Management. SMG is responsible for controlling and monitoring resources within a set, which includes shared resources, resources allocated to an operational TRS configured to support a test, and resources allocated to a default TRS. This CSCI is also responsible for the current configuration and status of all resources within the set.

4.2.1.19 SPF Manager. SPF Manager (SPM) provides tools for project management, requirements and design analysis, SR&QA and Independent Verification and Validation (IV&V).

4.2.1.20 System Software Services. System Software Services (SSS) is divided into four distinct groups. These groups are operating system environment, operating system transparency, distributed environment transparency and general software services.

The SSS CSCI provides services such as: interprocess communication, file/library management, process control, resource management, system wide messaging capability, engineering units conversions, and time conversions.

4.2.1.21 System Operational Readiness Testing. System Operational Readiness Testing (SYM) provides the client with the capabilities of supporting fault detection, fault isolation and trouble shooting initiated from the TRS level. System Operational Readiness Test (ORT) invokes TRS ORT, which tests the communication paths of the configured hardware resources. Each physical data link, hardware unit and peripheral will be tested to verify that the TRS is capable of supporting a test configuration.

4.2.1.22 Test Application Execution. Test Application Execution (TAE) is responsible for the execution of Test Application Software that is composed of Core Custom Language Programs and Commercial High Order Language Programs. The TAE CSCI provides the interpreter for GOAL and Control Logic language programs. The TAE CSCI, through the use of the Command Processing CSCI, issues and executes commands contained in Test Application Software (TAS) Programs to the Test End Item and the

Test Resource Set. TAE provides application generated data to the HCI real Time Services CSCI for display to the client.

4.2.1.23 Test, Control and Monitor System Bulk Input. TCMS Bulk Input (TBI) provides the capability to receive and process Test End Item and Link Configuration data transmitted from the responsible design agency at JSC.

4.2.1.24 Test End Item Data Bank Manager. Test End Item Data Bank Manager (TDM) provides the capability to create and update commands used to modify Test End Item and System Validation data in the Data Bank. The update commands can originate from either CBI or TBI or a workstation. In addition, the TDM CSCI provides the capability to generate a copy of the Data Bank and to produce numerous pre-defined reports of the data contained in the Data Bank.

4.2.1.25 Test End Item Software Manager. Test End Item Software Manager (TSM) provides services to manage data from Shuttle on-board processing received from JSC. This includes on-board load, dump, and compare.

4.2.1.26 Configuration and Calibration And Test Set. CCATS provides the capability to verify data and command transmission paths from a DP to a FEP in the Core System. It captures and analyzes interface data to isolate a problem to a subsystem or group of subsystems with a TRS.

4.2.2 COMMERCIAL-OFF-THE-SHELF SOFTWARE. COTS software is software that has not been specially designed for TCMS. This software is commercially available and therefore saves resources.

4.2.2.1 Operating Systems. An operating system (OS) coordinates the multitude of activities going on within a computer. At all times, an operating system must ensure that characters are correctly displayed on the screen, that data is saved and retrieved without error, that instructions are processed in an orderly way, and that you are informed if an error occurs. An operating system is a coordinator whose function is to keep all parts of the system functioning smoothly and in harmony.

The OS for the VAX computer system located in the SPF is VMS from Digital Equipment Corporation. The APs will use CX/UX OS from Harris Corporation and the DPs will use ULTRIX OS from Digital Equipment Corporation. The FEPs will run on VADSworks

OS from Verdix corporation as will the Standalone HIMs. The Slave HIMs will run on a VX-Works OS kernel from Wind River Systems, Inc.

4.2.2.2 Compilers. Compilers are tools that allow easier programming for the software developer. They allow the developer to write code in a High Order Language (HOL) that is more readable by a human, and convert this 'code' to a machine language executable file that the computer will understand. Compilers help to bridge the gap between what the computer understands and what the developers/programmers understand.

For TCMS, the following HOL compilers will be made available:

- C
- Ada
- GOAL

4.2.2.3 Support Software. Support Software is software that supports the OS. Some examples would be VAX 6000 diagnostic set, VAX Cluster Software, DECNET Software, VMS Volume Shadowing, Artemis 7000, etc.

4.3 HARDWARE AND SOFTWARE RESOURCE MANAGEMENT

4.3.1 CENTRAL AVIONICS FACILITY. While the methods of conducting testing in the Central Avionics Facility at the Johnson Space Center in Houston, Texas are currently at the Preliminary Design Review stage and therefore somewhat vague, it is anticipated that the hardware scheduling and allocation will be accomplished in a manner similar to that described in the following paragraphs.

4.3.2 HARDWARE SCHEDULING/ALLOCATION. The scheduling and allocation of the TCMS hardware is accomplished through the eleven day/seventy-two hour schedule. The user community provides the initial requirements for hardware into this schedule. The user community then develops OMIs from the eleven day/seventy-two hour schedule. The O&M group refers to Section 1 of a given OMI for the specific equipment required for a particular test. The O&M group then matches individual resources with individual requirements and provides functional resources at the required time for the duration of the test. Additional planning will be required if the Section 1 identified equipment exceeds the equipment allocated to that set.

4.3.2.1 Operational Sets. To be assured of timely TCMS O&M support of formal Space Station testing, appropriate time periods will be need to allow reconfiguration and patching of the TCMS set of interest, as well as an understood method of identifying the equipment required and/or modifying the equipment required for the TCMS set of interest.

As for the time periods required, the users shall be able to provide a detailed listing of the TCMS equipment required to support a given test in the form of Section 1 of an OMI at least five days before the start of a formal test.

In the event of modifications to the original OMI equipment listing by the users immediately before the start of a test or during an actual test, the TCMS O&M group will give immediate attention to the modification, and the users can expect an additional delay due to reconfiguring/repatching of no more than twenty-four hours.

It has been agreed that the user community will have the responsibility to avoid potential TCMS equipment conflicts and to resolve them when they occur. Should an equipment conflict go undetected by the users, the TCMS O&M group will, upon discovery, immediately notify the appropriate users of the conflict and participate in the resolution of the conflict as required.

4.3.2.2 Development Set. To facilitate speedy development of Space Station test software, the users and the O&M group have a much closer and less formal working relationship when working with TCMS equipment designated as development set equipment.

Before the start of each shift where equipment change/reconfigure/repatch is required, an authorized user will provide the O&M group with a listing of the equipment required, along with an estimate of how long the equipment will be required for development purposes. The TCMS O&M group will then provide the authorized user with an estimate of the time required to make the appropriate changes. With the understanding that support of a formal test is the primary TCMS O&M responsibility, the O&M group will immediately begin the requested changes.

4.3.3 HARDWARE MANAGEMENT. The configuration management system will be used for: tracking the current configuration of, providing for the assured integrity of, and introducing approved changes to, the TCMS hardware, not including test equipment.

The configuration management system identifies the hardware items to be placed under configuration control and describe their baseline configuration. The Payload Level III/IV CCB addresses proposed changes to the configuration baseline. Verification of changes is accomplished by reviews to assure that hardware design satisfies approved requirements

and that modifications have been incorporated per the modification instructions. Configuration accounting is accomplished by an automated configuration management tracking system that provides visibility of all changes to the current baseline.

4.3.3.1 Configuration Identification for TCMS Hardware. Configuration identification is the process of selecting hardware items to be under configuration control, describing their baseline configuration in terms of technical documentation and hardware identifiers, and the system for preparing, maintaining, and releasing configuration documentation. The functions of configuration identification are described in the following paragraphs.

4.3.3.1.1 Identification of TCMS Hardware Under Configuration Control. TCMS hardware items to be under configuration control are established by NASA and accepted by the PGOC during transition. The PGOC authorization to add or delete TCMS hardware items to/from the accepted baseline is by Configuration Control Board Directive (CCBD) and/or Contract Change Order (CO). The PGOC Program Control - Configuration Management department will maintain a current listing of items under formal program/project configuration control.

4.3.3.1.2 Baseline Identification for TCMS Ground Hardware. The configuration baseline is the current defined and approved configuration used as a reference point for program/project planning purposes and as a point of departure for control of changes. The baseline identification and all approved changes thereto are maintained by the PGOC Configuration Management Organization.

4.3.3.1.3 Engineering Documentation Preparation, Maintenance, Records, and Release System. The PGOC will use or adapt existing methods and systems for the preparation, maintenance, record keeping and release of engineering documentation. Existing systems will be used except when system changes will require NASA approval before implementation, e.g., if changes affect non-PGOC.

4.3.4 SOFTWARE MANAGEMENT. The details of how TCMS system and application software will be managed and controlled can be found in the TCMS Production Control Plan, K-CTE-63.2. The TCMS system and applications software of interest includes both COTS and custom designed software. Items such as how the current system software configuration will be tracked, how the integrity of the system software is guaranteed, how approved changes are introduced, and where correct copies of system software are stored will be found in the TCMS Production Control Plan.

4.4 DOCUMENTATION MANAGEMENT

Procedures, separate from this document, will be written by O&M to detail documentation management.

SECTION V

PERFORMANCE MANAGEMENT

Overall TCMS performance will be managed by TCMS O&M. This organization is responsible for ensuring that TCMS performance goals and objectives are satisfied. A working group will address the following disciplines: communications, systems, and software. The working group consisting of O&M, Payload Comm, SSPSE, SPA, and SR&QA will develop measurements and standards based on justifiable user requirements, analyze the results of performance measurements, industry trends, and evaluate proposed modifications to meet performance objectives.

5.1 SYSTEM PERFORMANCE

A major function of TCMS O&M will be to fine tune the systems performance and reliability. This will be accomplished by:

- Design and fine-tuning a system configuration that best meets the demand for computer resources;
- Monitoring system resources (memory, CPU, disk I/O, network I/O, etc.) using TCMS-provided tools;
- Using historical and statistical methods to plan future growth;
- Providing/receiving technical assistance and guidance to/from the database and applications developers to ensure system resources are used effectively;
- Working with the database designers and applications developers to ensure performance and resource considerations are understood and followed;
- Planning, installing, configuring, and verifying system hardware and software to maintain system integrity;
- TUG will meet to finalize initial system design and delivery. TUG will continue to meet regularly to analyze the configuration's impact on overall performance, recommend changes, and plan future upgrades.

5.2 NETWORK PERFORMANCE

Network management tools provide the ability to monitor traffic and status. Network performance measurement will be implemented using procedures developed jointly by TCMS O&M and PGOC Communications groups. These procedures address network-related performance measurements and those required for network maintenance.

5.3 SOFTWARE APPLICATION & DATABASE PERFORMANCE

Application and database performance will be measured and tuned in a cooperative manner between users and O&M to maximize the performance of scarce TCMS resources. Hardware and software development tools will be used to optimize performance features.

5.4 PAYLOAD OFFICE WORKSTATION PERFORMANCE

The impact of TCMS design and software on workstation performance will be assessed by the Network Services Department.

SECTION VI

ANOMALY VERIFICATION AND TESTING

TCMS hardware and system software will be tested through CEC acceptance testing. Joint DL/CS activation/validation testing will also be executed on each TCMS set as it is delivered and on major hardware deliveries. These formal tests are conducted to assure that all TCMS equipment meets the specified system requirements defined in the TCMS Facility Equipment Requirements Document/Design Plan (FERD/FEDP), KSC-STA-61.07. These tests include performance demonstrations and environmental exposures that have been completed before O&M assumes responsibility for the hardware or software. Specific information on the integrated activation/validation process can be found in the TCMS Activation/Validation Management Plan, KSCM-DL-0112.

Once the system is accepted by NASA, the TCMS O&M group will ensure its operational integrity through health & status, system & subsystem ORT and diagnostics. This includes the preventive and corrective maintenance of all TCMS-related hardware, system software, and the LRU removal & replacement as described in TCMS Maintenance Plan, TS-TCMS-92003.

6.1 ERROR DETECTION AND PROBLEM RESOLUTION

Error detection and problem resolution involve three O&M groups: operators, hardware maintenance, and software maintenance personnel. Hardware and software maintenance personnel will be involved with problem resolution of only those anomalies that involve their specific areas. The user community will be involved in supporting problem resolution. Throughout the resolution process current configuration control procedures will be followed to insure system configuration.

When an anomaly occurs, and the sets MCOE is notified through the Master Console health and status function or by user notification through OIS-D, if necessary, the MCOE will try to determine the type of anomaly (i.e., hardware or software) and, if possible, on which platform the anomaly is occurring. The MCOE will gather as much information as possible on the anomaly characteristics. After determining the type and gathering the characteristic data, the MCOE will document the problem, contact quality to open an IPR and contact the appropriate maintenance personnel to correct the anomaly and present them with the collected data.

The PRACA system will be used to insure all problem resolution actions are tracked before returning the set to its on-line state. The appropriate maintenance engineer together with the quality representative will escalate the IPR to a PR for toubleshooting and maintenance. Once the problem is corrected, the appropriate maintenance engineer,

NASA counterpart, and quality representative will close the PRACA report. For information on PRACA, see Nonconformance/Problem Reporting and Corrective (PRACA) System, SP10.001.

6.1.1 ASSUMPTIONS. The following paragraphs include assumptions for the typical TCMS maintenance process. Assumptions are dependent on the location of the user. Each paragraph shows the set of assumptions for that location. The four figures following the assumptions apply for all locations and depict the maintenance process once TCMS has been determined to house the anomaly. Figure 6-2 shows the overall TCMS organizational maintenance flow. Figure 6-3 shows the flow for system hardware maintenance, Figure 6-4 shows the LRU repair flow, and Figure 6-5 shows the software maintenance flow.

The box in figure 6-4 marked "Special Hardware Dispositioning" represents the actions taken as the result of recurring failures. Each time an LRU is processed through the Off-line Support Area (OSA), failure data will be entered into the Production Tracking System (PTS). When the OSA cannot find a problem with an LRU sent to the OSA, the PTS will be used to determine if the problem is recurring. It is anticipated that the quantity of this type of failure will be limited and each will be handled on a case-by-case basis. For recurring problems, TCMS O&M personnel have several options depending on the circumstances.

1. If the problem is not an isolated case (i.e., it appears to be a design problem), TCMS O&M will work with the CEC or TCMS Sustaining Engineering to ensure that the problem is properly resolved.
2. TCMS O&M may elect to return the LRU, through TCMS Logistics, to the appropriate repair facility and work with that repair facility to ensure the problem is corrected.
3. TCMS O&M may elect to perform in depth troubleshooting in the OSA to duplicate and isolate the problem.
4. TCMS O&M may elect to have the LRU scrapped through the Material Review Center (MRC).

Figure 6-5 contains a box marked "Special Software Dispositioning" that represents the actions taken when a software problem cannot be duplicated. In such cases, TCMS O&M Software Engineering will work with the CEC, TCMS Sustaining Engineering, SSPSE, or the COTS software vendor as appropriate to isolate and resolve the difficulty.

For specific information on maintenance, see the TCMS Maintenance Plan, TS-TCMS-92003.

6.1.1.1 Payload Office Workstation Assumptions. The following assumptions apply if the user calling in the Trouble Ticket is working from a POW. A POW is defined as either an IBM compatible computer or an Apollo workstation connected to TCMS through the PON.

- Users working on POWs will call Trouble Tickets into the Network Services Help Desk. POW users will not contact the TCMS Client Support Area.

- If it's determined to be a TCMS anomaly, Network Services will close out the Trouble Ticket and immediately transfer the information on the anomaly to the TCMS Client Support Area where an IPR will be opened for further troubleshooting. Troubleshooting may include contacting the user for help in expediting the problem resolution.

- If it's determined not to be a TCMS issue, Network Services will correct the anomaly.

6.1.1.2 Display Processor Assumptions. The following assumptions apply if the user calling in the IPR is working from a DP.

- Active Test DPs
  - Users working on DPs will notify the Test Conductor and/or Test Integration who will notify the TCMS MCOE through an OIS-D headset. If OIS-D is unavailable, a telephone is available for contacting the Master Console.

- All other DP activity
  - Users working on DPs will notify the TCMS MCOE through an OIS-D headset. The MCOE will request from quality that an IPR be opened. If OIS-D is unavailable, a telephone is available for contacting the Master Console.

6.1.1.3 Health and Status Assumptions. The following assumptions apply if the anomaly was reported by the health and status function to a TCMS MCOE.

Note: Network Manager, the health and status CI, currently does not gather health and status of the FEPs or HIMs. This functionality will be included in release two of the CI.

- TCMS system health and status may be reported to the set MCOE through the network manager software, a system message, OIS-D, a phone call, or by visually checking subsystems.

- Only TCMS set anomalies are reported through the Network Manager. No health and status is available for POW's connected via the PON.

- An IPR is opened by quality and dispositioned by the MCOE.

6.1.2 PROBLEM OWNERSHIP. Determining which organization(s) are responsible for problem resolution is not always easy. The Test Conductor takes the lead in determining the owner of the problem and O&M will support the Test Conductor, Test Integration, and System Engineer during problem identification. The following scenario describes the process used to determine ownership of a problem.

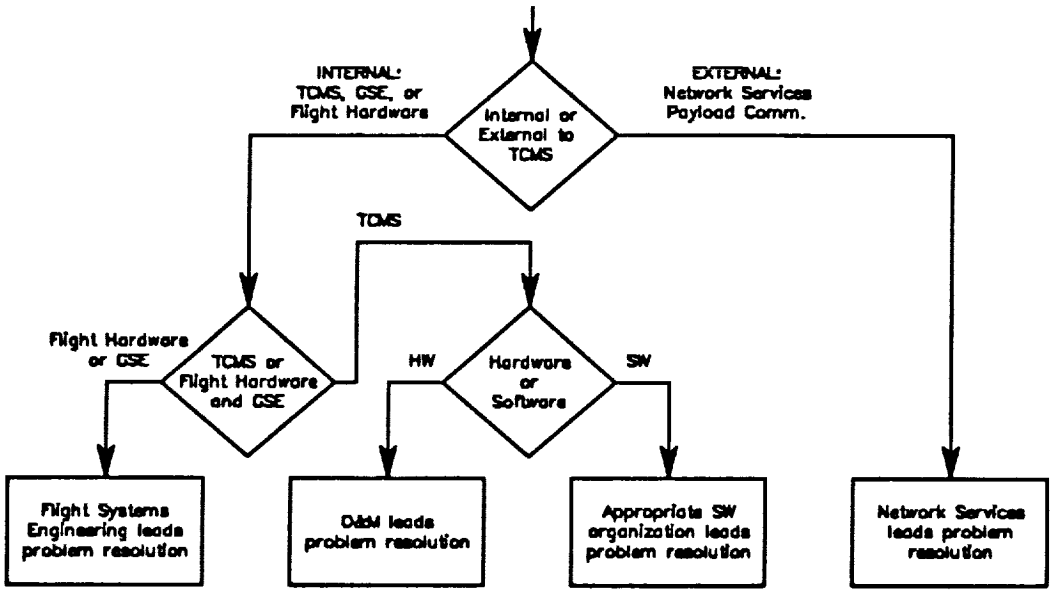


Fig 6-1
Problem Ownership Flow

During End Item Testing, the Test Conductor and/or Test Integration will resolve disputes relative to problem ownership and high level trouble shooting activities. Detailed trouble shooting of TCMS hardware is always a TCMS O&M responsibility and any disputes will be handled by O&M.

6.1.3 JOINT PROBLEM RESOLUTION. Cases will arise where it is unclear who is responsible for anomaly correction. In these cases, a joint effort between two or more groups will be initiated by the test team. Depending on the type of anomaly, two or more of the following groups may be involved:

- O&M,
- Flight Systems Engineers,
- SSPSE (Application software developers),
- Sustaining Engineering,
- Users,
- Production Control
- Software Product Assurance,
- Network Services.

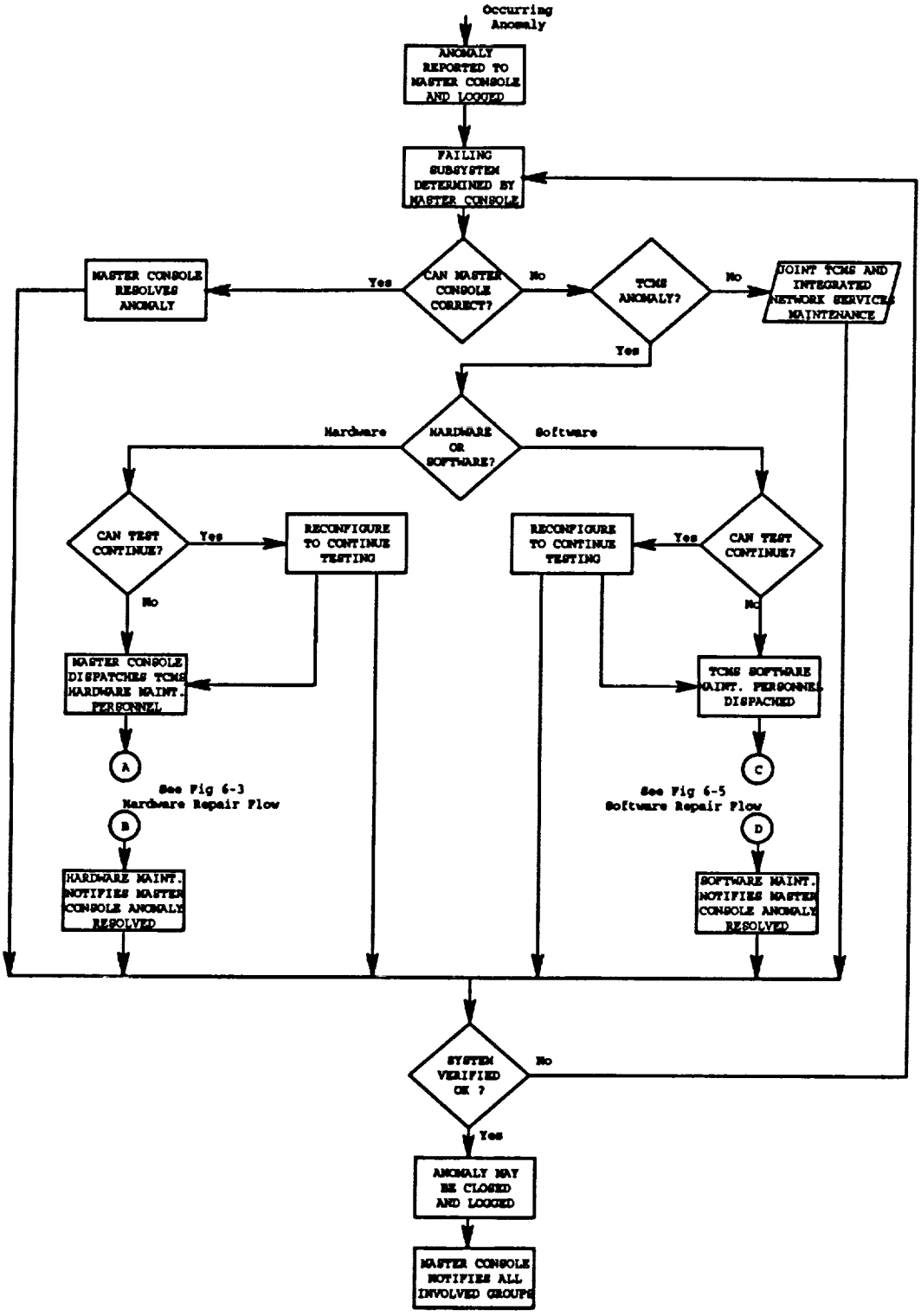


Fig 6-2
Anomaly Resolution Flow

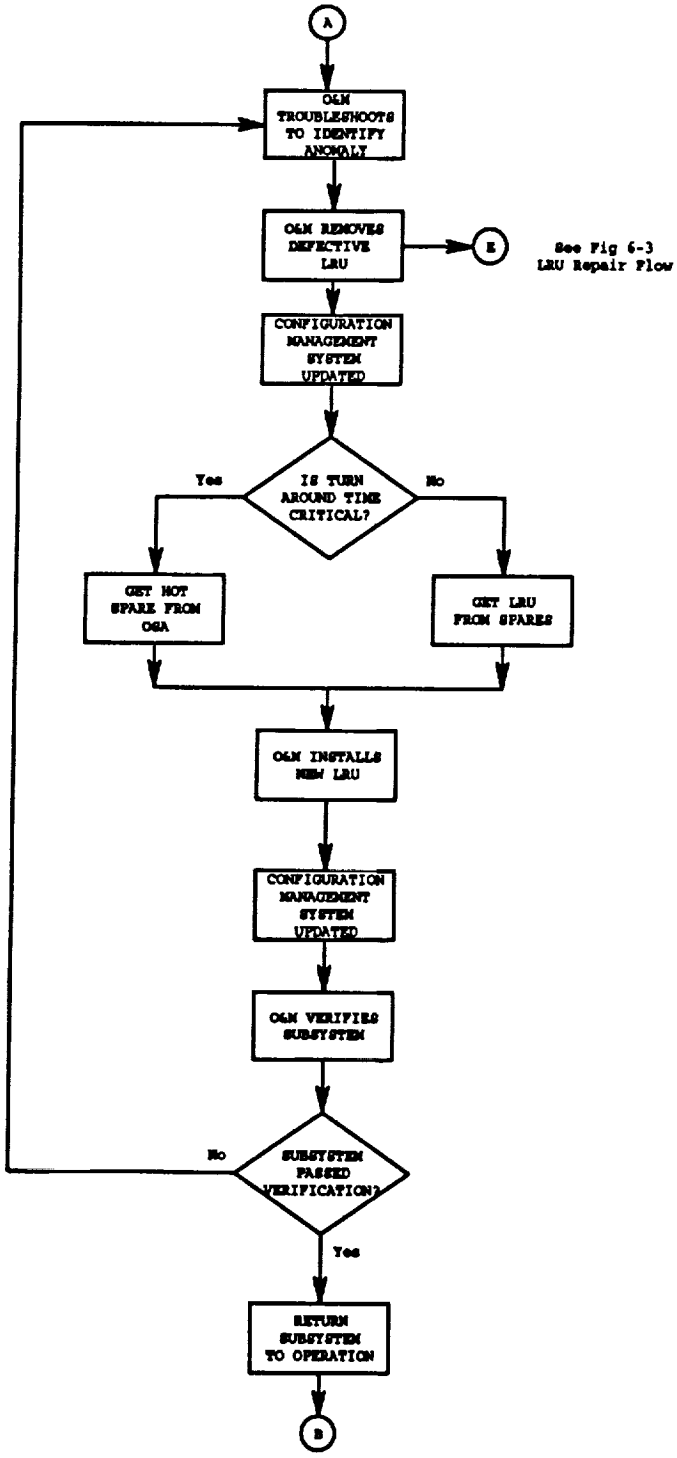


Fig 6-3
Hardware Repair Flow

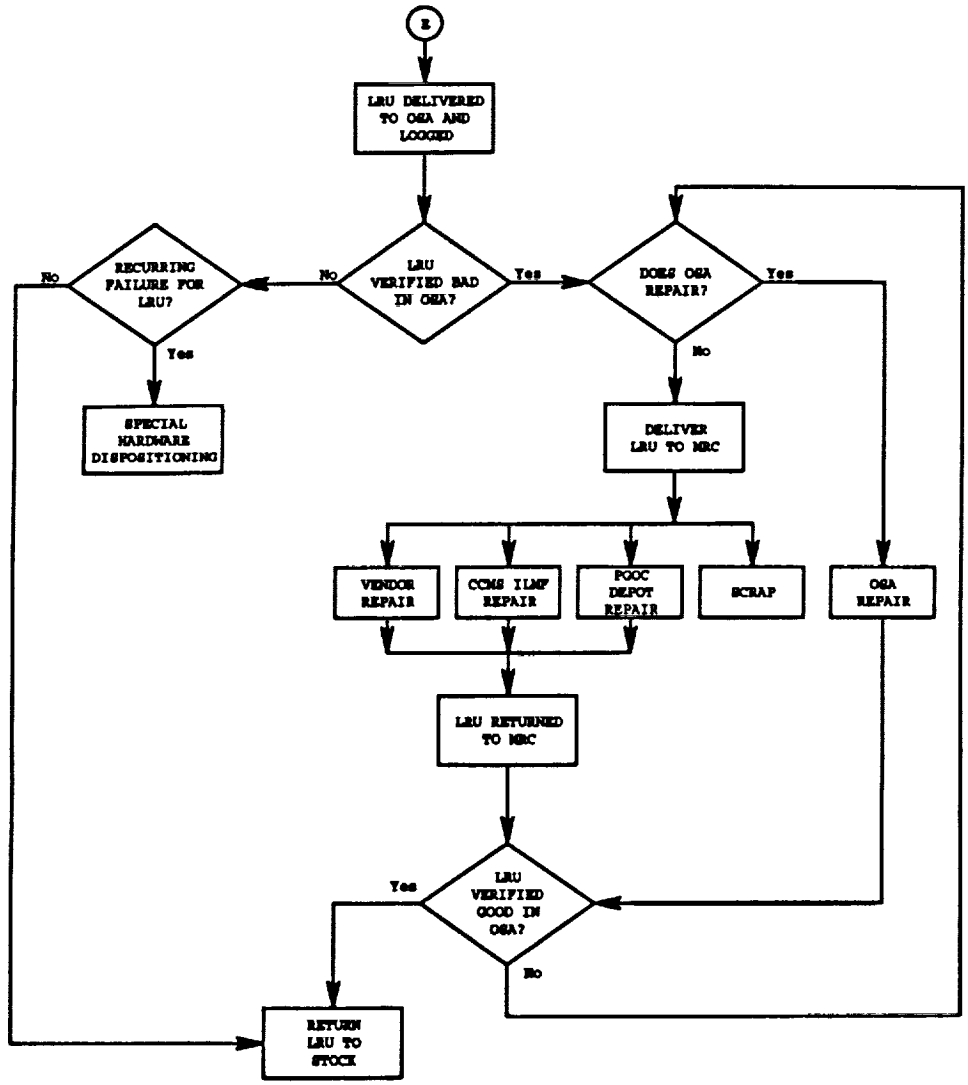


Fig 6-4
LRU Repair Flow

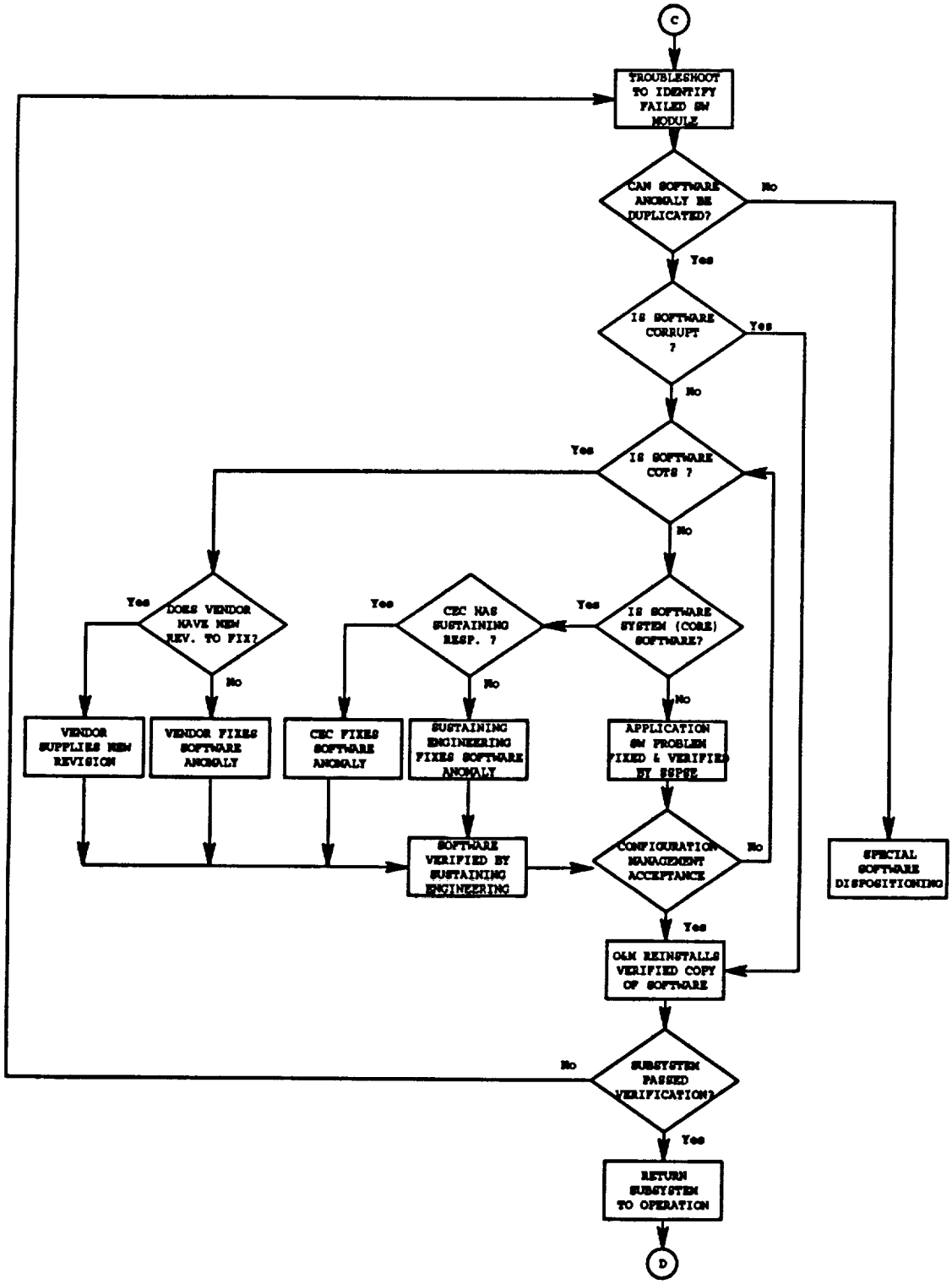


Fig 6-5
Software Repair Flow

6.2 HARDWARE ANOMALY RESOLUTION

The TCMS reliability will be kept at an optimum level through the replacement of faulty hardware with previously verified LRUs. The verification of hardware spares will be performed in the OSA. The OSA is the set of TCMS hardware dedicated to the TCMS off-line functions. The primary purpose of the OSA is to minimize downtime of operational sets.

TCMS Maintenance Engineering staff and Quality ensure the proper repair and verification of spare LRUs and subsystems. The spares are installed in the on-line test set by maintenance personnel. Failed LRUs will be handled in accordance withthe TCMS Maintenance Plan, TS-TCMS-92003. Once the hardware is installed and restored to an operational state, the Maintenance Engineer will run diagnostics to ensure that the LRU is functional. The PRACA paperwork is then signed off by the diagnostic team and closed by quality.

A Core maintenance design goal is to integrate the various levels of maintenance for improved fault isolation. Operational failures detected by System Integrity provides the failure symptoms and parameters for direct testing at the next level.

Specific information about anomaly resolution can be found in the TCMS Maintenance Plan, TS-TCMS-92003.

6.2.1 ON-LINE RESOLUTION. System Integrity is the on-line, non-intrusive testing of the TRS operational status. It provides for continuous health monitoring and status of peripherals, software, and network interfaces. It also controls and monitors redundant resources, monitors stored resources, and provides fault detection and isolation to a subsystem.

Organizational level repair action will be to remove and replace, from verified spares, the LRU determined faulty by the various levels of troubleshooting and diagnostic maintenance. The subsystem will be re-tested with subsystem ORT and diagnostics and returned to operational status. System ORT and diagnostics are then run and the system is returned to operational status.

If System Integrity detects an anomaly during a test, TCMS O&M personnel, along with the Test Conductor and Test Integration, will make a decision as to the criticality of the problem. If the problem is deemed minor by the involved organizations, an IPR will be opened, and the test may continue without immediate problem resolution. The problem will be resolved following the test. If the problem is not minor and the test has not started, fault isolation will commence. If the problem is not minor and the test has started,

the Test Conductor will be notified and TCMS O&M will recommend a course of action to Test Integration.

6.2.2 OFF-LINE RESOLUTION. System Maintenance is the off-line intrusive test of the sets operational status. It is composed of two integrated functions: set ORT and set diagnostics. It is active after the set has been configured and subsystems allocated but not operational. It provides a functional checkout of redundant and stored resources. System Maintenance, with System Integrity, provides the pre-operational fault detection and isolation to the subsystem.

Subsystem Maintenance is the off-line intrusive test of a subsystem's operational status. It is composed of two integrated functions; subsystem ORT and subsystem diagnostics. It is typically active when a subsystem is not configured or allocated to a TRS. However, it can be activated on subsystems that are configured or allocated to a TRS. Subsystem Maintenance provides fault detection and isolation to an LRU within the subsystem.

For COTS hardware, diagnostics rely extensively on BIT or routines supplied by the OEM. The Core design approach is to integrate COTS BIT into the ORT as much as possible. ORT provides the executive routines and additional testing not provided by BIT.

6.3 SOFTWARE ANOMALY RESOLUTION

Software maintenance of TCMS operating systems and system software will be performed by the TCMS Sustaining Engineering organization. Test application software maintenance will be performed by the SSPSE Organization. There are three categories of TCMS software that are discussed in this section:

- COTS Software — Vendor purchased products.
- Test Application Software — SSPSE developed software.
- System Software — Core developed and vendor purchased operating system software.

For problems determined to be software related, the hardware platform(s) containing the defective software is investigated by the appropriate software group and loaded with a verified copy of the software module by O&M personnel. Once the platform is installed, O&M and Test Integration will ensure the software will operate as required.

Additional information about the following paragraphs can be found in the TCMS Production Control Plan, K-CTE-63.2.

6.3.1 COMMERCIAL-OFF-THE-SHELF SOFTWARE. If an anomaly has occurred within a COTS product, it must be determined if: an actual "bug" exists; the software is corrupt; or the COTS package is unable to perform the needed function.

In the case of software corruption, the solution is to re-install the COTS package from a CM verified copy.

If it is determined a "bug" exists, the vendor will be contacted and a request will be issued to supply a patch to correct the error. Upon receipt of the patch or corrected software, it will be given to TCMS Sustaining Engineering for verification and then re-installed by O&M from the new CM verified copy.

If an immediate update is unavailable, a test may be suspended until the update is received. If the software engineer, with Sustaining Engineering group concurrence, determine a previous version of the software will be able to accommodate continued test execution, the previous version will be used.

If the software is unable to perform the needed task, the issue is turned over to TUG or the test team to determine the criticality and a solution.

6.3.2 TEST APPLICATION SOFTWARE. If an anomaly has occurred within application software and has been determined not to be software corruption, the anomaly will be deferred to the Space Station Payload Software Engineering group. In the case of software corruption, the application will be re-installed by O&M from a CM verified copy

6.3.3 SYSTEM SOFTWARE. System Software is divided into one of two categories depending on the status of the CEC contract. While the CEC contract is still in effect, the CEC is responsible for maintenance of the software package. Otherwise, TCMS Sustaining Engineering maintains all system software. The responsible group will correct any occurring anomalies.

6.3.3.1 Core Electronics Contractor Responsibility. If an anomaly has occurred within a system software package and has been determined not to be software corruption, the system software package will be deferred to be corrected by the CEC if the CEC is still under contract for maintenance. If the software is corrupt, upon anomaly resolution the package will be reinstalled from a CM verified copy.

6.3.3.2 TCMS Sustaining Engineering Responsibility. At the end of the CEC contract, responsibility of system software will be that of the TCMS Sustaining Engineering department. If an anomaly has occurred within a system software package at this point, the system software package is deferred to TCMS Sustaining Engineering for correction. If the software is corrupt, upon anomaly resolution the package will be reinstalled from a CM verified copy.

SECTION VII

TRAINING

Planning for the TCMS training of both end-users and support personnel is the responsibility of the Product Support - Logistics department. This department will develop and implement a program that ensures the space and workstation requirements of this project. Practical administrative training functions and activities will be integrated by the Training department. The CEC is responsible for initial training of O&M personnel on all Core hardware and software components six months before transition of O&M responsibilities. Continuing training is the responsibility of the Product Support - Logistics department. The OSA set will be utilized as a training set for the continuing training of users and support personnel as required.

7.1 OPERATIONS & MAINTENANCE TRAINING

Technical training to support the use, management, and monitoring of Core supplied software and hardware is the responsibility of the CEC. Initially, training in the use of hardware and software, supplied as part of the CEC contract, will be provided by the CEC. On-going training will be conducted by the Logistics department.

7.2 USER TRAINING

The CEC will train key user personnel in the use of all CEC-supplied software applications and hardware including DP training. These key personnel will support the training of additional employees. Initial user training on the use of TCMS software applications will be conducted by the SSPSE department after the applications are released into production. After user groups are trained, they will be responsible for on going training of additional employees. SSPSE personnel will support future training as needed.

SECTION VIII

SYSTEM ADMINISTRATION

8.1 SYSTEM ADMINISTRATION ROLES AND RESPONSIBILITIES

Each shift will have at least one person in charge of operating system administration and maintenance. The responsibility of the System Administrators is to ensure the efficient operation of TCMS and to perform a wide variety of tasks that require special privileges. The system administrator will perform various maintenance tasks to prevent adverse effects on system performance.

For additional information on System Administration see the TCMS Database Management/System Administration Plan, TS-TCMS-93xxx.

8.1.1 EVENT LOGGING. System Administration will keep a log of all system modifications and system events. Each event, message, backup, or modification should be logged with the date, time, name of the person logging, and the circumstances surrounding the event. An accurate log helps in diagnosing system problems and charting the growth and use of the system.

8.1.2 ROLES AND RESPONSIBILITIES. System Administration has several duties to perform and the following lists a high level overview of these administrative duties.

- Ensure the integrity of TCMS is not compromised through use of security mechanisms.
- Ensure that adequate backups (regular copies of files) are made and stored for future use.
- Handle problems related to use of limited computer resources (i.e., disk space, number of processes, etc.).
- Alleviate system communication stoppages due to failed connections.
- Apply operating system updates and maintenance fixes.

8.1.2.1 Roles and Responsibilities Summary. Tasks can be broken down into groups by how often they are carried out. The following list of tasks ranges from those that must be performed more often to those that need to be performed less often.

As Needed Tasks:

- Record all system modifications and events in a log.
- Be on-call for emergency situations, crashes, power spikes, etc.
- Maintain security of hardware, software, and data file access.
- Coordinate system software downloads from the SPF.
- Create and modify user configuration files.
- Adjust system tuning parameters to maximize efficiency and performance.

Daily Tasks:

- Support backups.
- Monitor usage levels.
- Monitor for runaway processes.
- Monitor disk space.
- Monitor printer status.
- Monitor audit trail output.
- Monitor communications links.
- Monitor for unattended login sessions.
- Perform security checks.

Weekly Tasks:

- Check file system integrity on all subsystems.

- Monitor printer spooler status reports.
- Clear, trim, or truncate log files.
- Use system performance tools to evaluate system efficiency.
- Generate report of disk utilization.
- Remove unnecessary temporary files.

Monthly Tasks:

- Support full system backup.
- Archive critical files if changed.
- Change administration passwords.

Occasional Tasks:

- Support upgrade of operating system, application software, and system software.
- Locate large files and verify their purpose.
- Find "orphan" files (no real user).
- Locate sparse directories and compress if necessary.
- Verify user/file permissions.

8.2 SECURITY

See the TCMS Security Plan, TS-TCMS-93XXX, for information on TCMS security including such topics as: physical security, network security, system access, and security recovery.

8.3 DATABASE ADMINISTRATION.

See the TCMS Database Management Plan, TS-TCMS-93XXX, for information on TCMS database management. Included in this document in Appendix A is a copy of the TCMS Database: Roles and Responsibilities Memorandum Of Understanding (MOU). The purpose of the MOU is to document the roles and responsibilities associated with the operation, administration, and maintenance tasks concerning various TCMS Databases. It describes the different TCMS databases, along with the tasks required to properly manage them. An attached matrix assigns responsibilities to the associated tasks and databases. The roles and responsibilities contained in the matrix represent post CEC involvement.

SECTION IX

RISK ASSESSMENT

The Disaster Recovery Plan (DRP) will be published using "RiskWatch" software as an aid in determining risks.

Note: "RiskWatch" is a COTS program that will generate portions of the TCMS Security Plan and Disaster Recovery Plan. It was developed with the ability to generate charts and tables with NASA specific risks included.

The "RiskWatch" software requires that all system assets be defined such as the cost of:

- COTS equipment
- System hardware
- Facilities
- DPI
- Operating System
- UPS
- HVAC
- Alarms
- Software to be developed
- Safeguards

After defining the cost and types of risks, vulnerability, severity, and predictability must be assessed. The types of risks that may occur to NASA are included in the "RiskWatch" software. The major risks involved include: natural disasters, fire, bomb threats, and accidents. Virus and "hacker" threats will also be included although not specifically part of the "Risk Watch" software.

Vulnerability is the probability of a risk occurring to a particular asset. If there is a very small probability of a risk occurring, the asset is nearly, but not absolutely, invulnerable. Severity refers to how disastrous the results will be if a risk occurs to a particular asset. If only a small financial loss or a short processing delay results, the risk has an extremely low severity.

All this information is then entered into "RiskWatch," that then generates a questionnaire that is used to gather more relevant data for the system. After the answers to the first questionnaire are entered into "RiskWatch" a second questionnaire is generated. This final questionnaire then gathers the remaining data need for the software to be able to generate the risk analysis. As part of the risk analysis, several tables and charts are generated which show the cost involved in implementing each section of the TCMS Disaster Recovery Plan, TS-TCMS-93XXX.

The completion of the TCMS DRP will be delayed until the "RiskWatch" software has been delivered. Upon arrival of the "RiskWatch" software, a comprehensive DRP will be generated addressing the issues outlined in this section.

9.1 RISK ANALYSIS

This paragraph will be updated to contain the actual risk analysis generated from "RiskWatch" when it becomes available.

9.2 RISKS

9.2.1 NATURAL DISASTERS. Natural disasters associated with adverse weather and hurricanes are anticipated in the emergency preparedness planning, outlined in KSC Hurricane Handbook, KHB 1040.2f. During the period of June 1 through November 30, the KSC area is subject to high winds and heavy rains. Precautions required are implemented in coordination with government, affected contractor organizations, and the KSC Emergency Preparedness Officer.

KSC guidelines will be followed for lightning protection. TCMS equipment will be protected by lightning prevention equipment within the facility.

9.2.2 FIRE. Appropriate physical safeguards are also being planned to protect TCMS, including a fire detection and suppression system. The KSC fire department will be wired into the fire detection system. Fire prevention and protection responsibilities are outlined in KMI 8838.1B, "Fire Protection, Fire Prevention and Rescue." In the implementation of the procedure, safety of personnel will be given primary consideration.

All fires will be properly reported according to established procedures and all persons not engaged in fire fighting or other emergency duties, will be evacuated to safe areas. Periodic inspections are conducted by the KSC Fire Department to identify deficiencies in housekeeping, safety, and fire control equipment. All personnel receive periodic training in the use and function of fire safety equipment by the KSC Fire Department.

9.2.3 BOMB THREATS. Any person receiving a bomb threat at KSC has instructions readily available for handling and responding to the call per KMI 1620.5A, Bombs and Bomb Threats. Immediate instructions are on the back of all KSC phone books. Procedures for evacuating and securing the station include emergency shutdown and identification of responsibilities for securing the area.

9.3 EMERGENCY PREPAREDNESS

Detailed plans and procedures for dealing with fires natural disasters, environmental factors and other contingencies have been developed for use at KSC to cope with any emergency or disaster that may occur. The Emergency Preparedness Plan, KHB 1040.1D, includes the necessary preparatory actions and procedures to be taken for the protection of personnel, property, and material resources at KSC in the event of one or more of the following contingencies.

- Hurricanes
- Civil Disturbance
- Fire and Explosion
- Loss of Utilities
- Defense Readiness
- Peacetime Radiological Incidents
- Inadvertent Space Vehicle/Missile Impact
- Emergency Medical Operations
- Adverse Weather/Tornadoes

9.3.1 CONTINGENCY PLANNING. Contingency plans will be developed by O&M for TCMS contingencies. These plans will inform the O&M personnel the course of action to take when any contingencies occur. Examples of such situations would be:

- SPF host unavailable;
- Global bus, local bus, etc. unavailable;
- Data loss or damage;
- Power outage;
- PON access unavailable;
- Fire and other natural disasters;
- Set master AP unavailable.

This list is not meant to be exhaustive and does not include many of the possible contingencies. The following paragraph demonstrates an example of a contingency plan when the SPF host(s) is unavailable.

9.3.1.1 SPF Host Unavailable Contingency Plan. *SPF Host Unavailable definition:* The SPF host is unavailable when communication to other TCMS subsystems is not possible.

One SPF Host Unavailable: If one of the two SPF hosts is unavailable, O&M will notify as many users as possible by system message, phone, or OIS-D, and redirect them to the second SPF for their operations. Activities that are only possible using the unavailable SPF will be postponed until it's brought back on-line. O&M will reconfigure as needed to redirect all activity to the second SPF host then troubleshoot and repair the unavailable host. This situation will not hinder active tests but may postpone scheduled tests or events. SPF peripherals such as disk arrays, 9-track tape drives, and laser printers will be available. However, the hosts line printer will be unavailable. Users working from POWs or DPs may have communications halted momentarily but will be able to continue work through the second SPF host.

Two SPF Hosts Unavailable: If both SPF hosts are unavailable, O&M will attempt to notify as many users as possible by telephone or OIS-D. All SPF activities will be postponed until one or both of the hosts are brought back on-line. This situation will not hinder active tests but will alter further scheduled events. O&M will begin troubleshooting and repairing the hosts to bring them back on-line as quickly as possible. All SPF peripherals will be unavailable. All users will have communications halted until one of the hosts is repaired.

9.3.2 CONTINGENCY OPERATIONS. In case of fire or other environmental danger or damage, KSC fire department and/or other appropriate disaster-trained personnel will assume control of the situation, ensuring that all personnel have been safely evacuated. Upon emergency services approval for computer personnel to re-enter the area, TCMS Hardware/Maintenance/Engineering personnel will begin immediate assessment of damage and proceed to bring sufficient equipment on-line to resume operations as soon as practical.

Concurrently, clean-up operations will be initiated to bring remaining equipment on-line for auxiliary support.

If software is lost (i.e., the system disk is destroyed), software backups will be utilized to restore the system provided the appropriate hardware is available. Secure and protected storage of media for all backup system and application software and data files reside in an undetermined off site storage location.

APPENDIX A

TCMS DATABASES: ROLES AND RESPONSIBILITIES MOU

MEMORANDUM OF UNDERSTANDING

TCMS DATABASES: ROLES AND RESPONSIBILITIES

MEMORANDUM OF UNDERSTANDING

TCMS Databases: Roles and Responsibilities

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MEMORANDUM OF UNDERSTANDING

TCMS Databases: Roles and Responsibilities

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Subject: TCMS Databases: Roles and Responsibilities

Purpose

The purpose of this MOU is to document the roles and responsibilities associated with the operation, administration, and maintenance tasks concerning various TCMS Databases. This memorandum describes the different TCMS databases, along with the tasks required to properly manage them. The attached matrix assigns responsibilities to the associated tasks and databases. The roles and responsibilities contained in the attached matrix represent post HSSC involvement. The roles and responsibilities of HSSC and their transition to CM/PGOC must still be negotiated.

TCMS Databases

The databases described below will either be a part of the TCMS or will support TCMS activities.

Databases residing on the SPF:

1. Test End Item Data Bank - Contains all the measurement and stimulus specifications that define the interface between a Test End Item (TEI) and the TCMS Core system. Measurement and stimulus specifications are collectively referred to as Function Designators (FDs) and are identified by a Function Designator Name. A Function Designator may be composed of Compiler Data, Calibration Data, Hardware Data, and FD Addressing data. In addition, the Data Bank contains System Validation Criteria which identifies valid Data Bank clients and their authorization level, and defines the data subgroups used to validate entry. The TEI data bank also contains Data Bank Revision Data, which is composed of transaction auditing data, creation date, date of last update, update user, and an incremental revision level.

   Note: Data cached from the MODB may be stored in an Oracle RDBMS by the TCMS BULK INPUT (TBI) CSCI prior to incorporation in the TEI Data Bank and Link Configuration Database. This implementation detail is currently TBD.

2. Link Configuration Database - The Link Configuration Database is the repository for all the information required by the Core systems to acquire and process Link Configuration data. Link Configuration data describes the configuration of the data links that provide the front-end communications path between the TCMS Core systems and a Test End Item.

3. Function Designator Directory (FDD) - Contains the Compiler, the selected Hardware, and FD Addressing data for each Function Designator selected for a Test Configuration extracted from the Data Bank. Only one set of Hardware and FD addressing data for each Function Designator is contained in the FDD. Each FD is assigned a System Software Reference Number (SSRN) used to access the FD in the Test Configuration. This FD information provides the data to construct the On-line Data Bank (OLDB) and the FEP tables which direct the processing of FDs.

4. Application Software Libraries - Contains both development and configuration managed software. These include: Test Application Software, Simulation Software, Dynamic Displays, and Test End Item Software. These libraries and their associated supporting software will be provided by the Software Support Environment (SSE) for TCMS.

5. Hardware Resource Database - Hardware Resource Data is used to identify Hardware Resources and to allocate them to a Test Resource Set. These data are both functional and physical in nature and may include a reference designator, function description, physical port id/address, class, type, location, and serial number.

6. System Software Library - Contains TCMS system software which is under CM control.

7. Master Client Profile Database - Contains data describing each valid user of the TCMS. This data includes associated permission levels, groups, SYSCONs, TCIDs, Partitions, and Support Roles for which the individual user is authorized.

8. Real Time Client Profile Database - A subset of the Master Client Profile Database, this database is automatically created by the system and downloaded to the Set during the Configure process in support of specific test activities.

9. Support Role Database - Used by a system administrator to view, define, modify and delete support roles which specify which HTD/HRT functions are available to a given "role" or "class" of user.

10. Client Support Area Database - Used to track and maintain all requests and problem reports relating to TCMS Hardware and Software anomalies. The location and tool used for this database is TBD.

11. Resource Utilization Scheduling Database Used to schedule the availability of TCMS hardware resources. The location and tool used for this database is TBD.

12. Hardware CM Database Contains information concerning the TCMS hardware configuration. These data include serial number, description, revision number, and location. The location and tool used for this database is TBD. This database may be hosted on the existing ALRUTS or Production Tracking System (PTS).

13. Preventive Maintenance Database - Used to keep track of and schedule the preventive maintenance activities for the TCMS Set (and SPF Set) hardware. The location and tool used for this database is TBD.

Databases residing on the PDR and DBS:

1. Archive Location Catalog - Contains the data retrieval locations (PDR, DBS, etc.) for both processed and raw recorded data. Each entry (which also maps to a media volume) is identified by a volume ID, Mission ID, Test Configuration Identifier (TCID), TRS ID, start and stop time, etc. Also included is a time association table for converting Greenwich Mean Time (GMT) to Coordinated Universal Time (UTC) for a TRS. This database is populated as volumes are filled during recording in a TRS. The database may then be accessed to retrieve the location of the recorded data and to convert times.

2. Other Databases - TBD.

Roles and Responsibilities

The following tasks relate to the responsibilities of managing the above mentioned databases.

- Data Administration - Ensuring that the data placed in the database meets the specific rules and conventions of consistency, validity, accuracy, and format.

- Data Maintenance - Making the entries, deletions, and changes to the data in the database.

- Data Source - Indicates the organization responsible for supplying the Data/Files contained in the Database/Library.

- User/System Support - Servicing user requests including individual backup/restore operations, increasing file space allocations, facilitating special group access to specific files, etc.

- Security - *This list is a subset of the overall TCMS security function.* Determine which data items need special security protection, which users or classes of users are authorized to see, create, update, or delete what data in the database. Maintain security access tables, Client Profiles, and Support Role definitions. Create procedures to implement security measures.

- Configuration Management - Establish and implement a formal system of control to assure that no unauthorized changes are made to the baseline software and data contained within the databases. Revision history as well as build/class information must be maintained in accordance with the TCMS Production Control Plan, K-CTE-63.2. Procedures must be developed to facilitate the end user's compliance with this plan and to prevent accidental or intentional corruption. SSE provided CM Tools will be used to perform portions of the CM function.

- Initial Loading - Populate the database with its initial data values and resolve any inconsistencies that arise during this process.

- Disk Management - Periodic backup of database files to archive media. Both full and incremental backups must be scheduled and performed. Disk defragmentation will be performed periodically to increase contiguous free space to maintain system performance.

- Housekeeping - Determine and execute the policies for retention and deletion of data and/or data migration.

- Space Allocation - Maximize usage efficiency by periodic measurement of file utilization to determine appropriate restructuring.

- Performance Monitoring / System Tuning - Analysis of key performance criteria to assess relative performance levels. Adjusting physical database parameters to improve performance.

- Expansion - Creation, implementation, and testing of additional physical or logical volumes.

- Database Modification - Addition of new fields or keys, changing the size of existing fields, reorganization of databases or indices.

- Error Detection and Problem Resolution - Data corruption problems are flagged and resolved. Source of problems are tracked down and corrected.

- Software Upgrades - Installation and testing of new releases of COTS database software.

- Data Conversions - Execution of conversion procedures to insure data compatibility with new Database SW/HW.

- Regression Testing - Testing of all database functionality when new releases of software or hardware which interact with TCMS Databases are introduced.

- Disaster Recovery - Procedures for restart and recovery following system outages. Restoration of database contents from backups in the event of loss of records or of catastrophic destruction of entire files.

Organizational Definitions

The following abbreviations are used in the attached matrix to describe the responsible organizations:

- User - This refers to the TCMS Applications Software Development group and the Production Control group. This is not intended to be construed as the "user of the data in the database" but rather, the "user community", in contrast to the other listed organizations.

- Sust. Eng. - This refers to the TCMS Sustaining Engineering organization. (due to size limitations this may be abbreviated as "SE")

- O&M - This refers to the TCMS Operations & Maintenance group.

TCMS DATABASE ROLES & RESPONSIBILITIES

9-Oct-92

	Test End Item Database	Link Configuration Database	Function Designator Directory	Application Software Libraries	System Software Library	Archive Location Catalog	Hardware Resource Database	Master Client Profile Database	Real Time Client Profile Database	Support Role Database	Client Support Area Database	Resource Utilization Scheduling Database	Hardware CM Database	Preventive Maintenance Database
Data Administration	User	User	User	User	User	O&M	O&M	User/O&M	User/O&M	User/O&M	O&M	O&M	O&M	O&M
Data Maintenance	User	User	User	User	User	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Data Source	User	User	User	User	Sust. Eng.	O&M	O&M	User/O&M	User/O&M	User/O&M	O&M	User/O&M	O&M	O&M
User Support	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Security	User/O&M	User/O&M	User/O&M	User/O&M	User/O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Configuration Management	User	User	User	User	User	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Initial Loading	User	User	User	User	User	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Disk Management	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Housekeeping	User	User	User	User	User/SE.	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Space Allocation	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Performance Monitoring / Tuning	User/O&M	User/O&M	User/O&M	User/O&M	User/O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Expansion	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Database Modification	User/S.E.	User/S.E.	User/S.E.	User/S.E.	User/S.E.	Sust. Eng.	Sust. Eng.	Sust. Eng.	Sust. Eng.	Sust. Eng.	O&M	O&M	O&M	O&M
Error Detection and Problem Resolution	User/O&M	User/O&M	User/O&M	User/O&M	User/O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Software Upgrades	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/S.E.	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M	O&M	O&M	O&M
Data Conversions	User	User	User	User	Sust. Eng.	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M	O&M
Regression Testing	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/SE	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M/S.E./U	O&M	O&M	O&M	O&M
Disaster Recovery	User/O&M	User/O&M	User/O&M	User/O&M	O&M/SE/Use	O&M	O&M	User/O&M	User/O&M	O&M	O&M	O&M	O&M	O&M

APPENDIX B

TCMS SYSTEM DESCRIPTION

Appendix B
TCMS SYSTEM DESCRIPTION

B.1 GENERAL

TCMS is a major KSC/Core Electronics Contractor (CEC) developed system supporting the Space Station Freedom Program (SSFP) at KSC and Johnson Space Center (JSC). The equipment consists of Commercial-Off-The-Shelf (COTS) and custom hardware, software, and firmware. It is configured into various subsystems and sets to meet the automation requirements of the space station checkout activities. This section describes the major hardware components of TCMS. Figure B-1 shows a high level view of the TCMS architecture. Figure B-2 shows a typical TCMS operational set configuration

B.2 TCMS SETS

TCMS is configured into sets and subsets of end-item equipment at various locations. The CEC will deliver three sets (configured as six half sets) for support of the SSPF test stand area, one set to the OSA, one set to the hazardous facility, one set to the CAF/CSF at JSC, and SN0. TCMS sets are configured from the following assemblies:

B.2.1 DISPLAY PROCESSOR. The Display Processor (DP) is the system interface to the user within the Core distributed architecture. It includes a 32 Bit Central Processing Unit (CPU) running UNIX based ULTRIX, a keyboard, a pointing device, a primary display, up to three slave monitors, a removable media device, and an MS DOS compatible floppy disk drive. The DPs directly interface with the Display Network Subsystem (DNS) for accessing the Application Processor (AP), Processed Data Recorder (PDR), Data Base Subsystem (DBS), Service Network (SN), Software Production Facility (SPF), and external systems such as Payload Data Management System (PDMS).

B.2.2 APPLICATION PROCESSOR. The Application Processor (AP) is the UNIX based data processing node within the Core distributed architecture. It is a computation intensive subsystem that primarily executes real time system services and test application programs. It consists of two 32 bit CPUs, a 500 megabyte hard disk drive (upgradeable to 2 gigabytes), and a removable media device. It interfaces directly with the DNS for access to the DPs and through a Buffer Input/Output Processor (BIOP) to the Real Time Network (RTN).

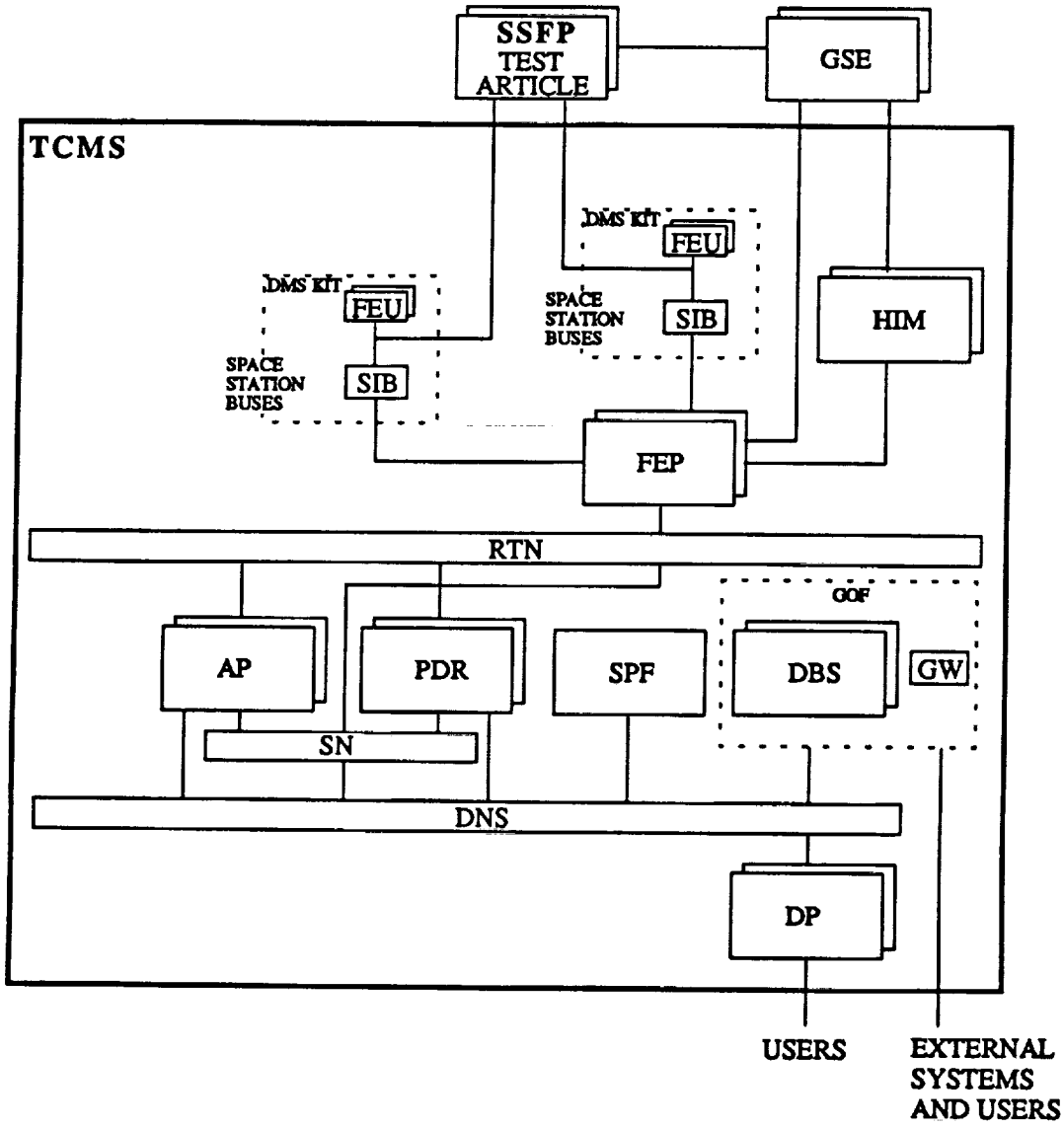


FIG B-1
TCMS ARCHITECTURE

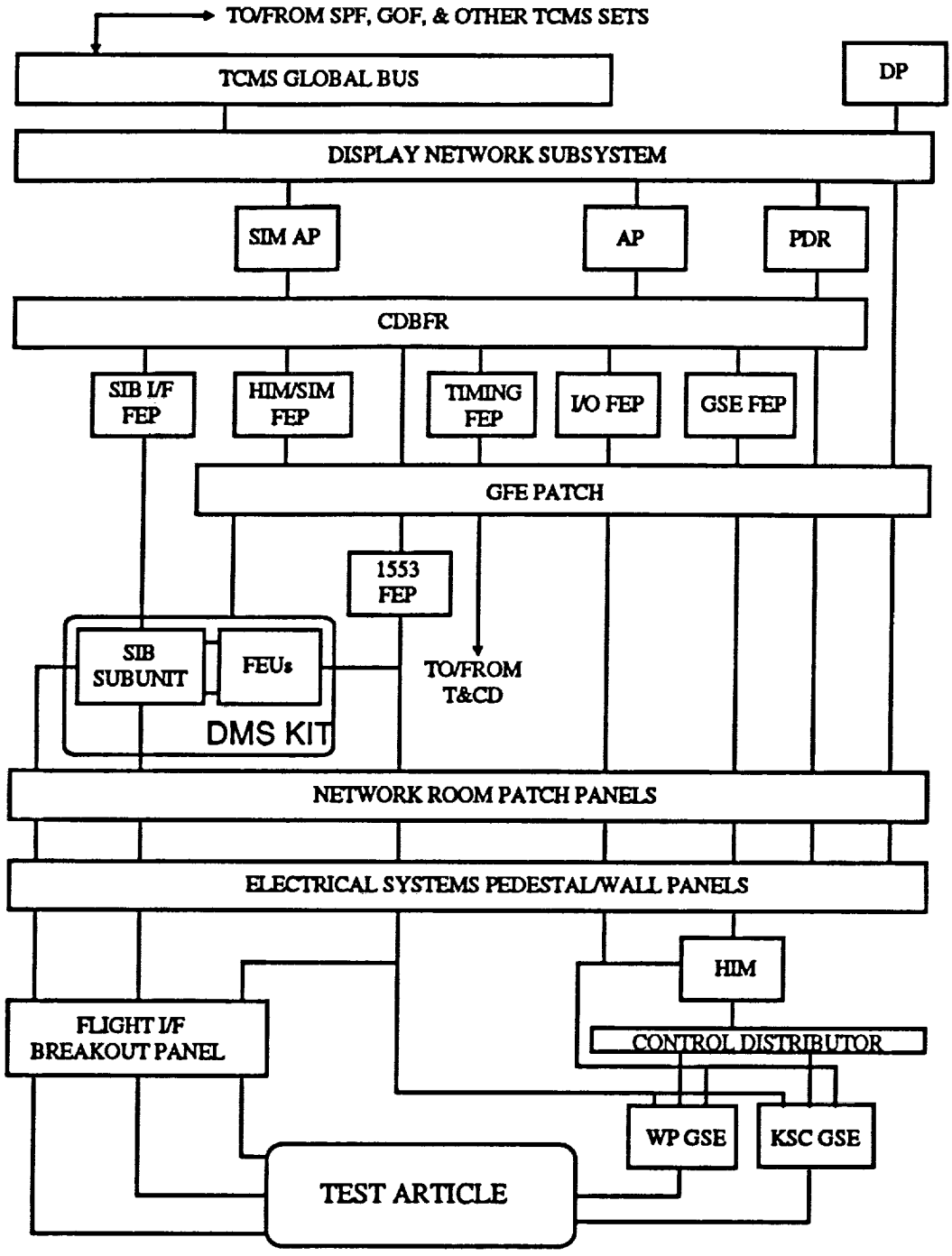


FIG B-2
TYPICAL TCMS OPERATIONAL SET CONFIGURATION

B.2.3 FRONT END PROCESSOR. The Front End Processor (FEP) is a universal hardware element that performs the data processing necessary to support a wide variety of synchronous and asynchronous test article control and data acquisition at the front end interfaces. It consists of several CPU and interface modules housed in a Versa Module European (VME) bus chassis. The specific interfaces required govern the configuration of this subsystem. The FEP has the capability to process all known Space Station, Payload, and Ground Support Equipment (GSE) data types by configuration of interface cards, custom software, and customized high performance filter modules. The FEP communicates to the other subsystems by way of the RTN through a BIOP.

B.2.4 REAL TIME NETWORK. The Real Time Network (RTN) provides message and data communication capability for attached processors. The RTN utilizes star topology with hosts connected to the central node through dedicated, high speed, point-to-point links. Through access control of shared data storage area and message routing tables, the hosts attached to the RTN can be configured into multiple Test Resource Sets (TRSs) to support parallel operations.

The RTN consists of the Common Data Buffer (CDBFR), host resident BIOPs, and host resident Monitor Input/Output Processors (MIOPs). The BIOP supports the exchange of single, multiboard, and homogeneous data sets as well as messages. Error detection and correction and/or error reporting mechanisms ensure the integrity of the information. The MIOP is a unidirectional link that routes data passing through the RTN to a Processed Data Recorder (PDR).

B.2.5 DISPLAY NETWORK SUBSYSTEM. The Display Network Subsystem (DNS) provides a communication path for system operations. The DNS provides the capability to isolate the DPs and APs into Local Display Buses (LDPBs) with filtered interfaces to the Global Display Bus (GDPB). The LDPB allows all local traffic to be generated without interfering with data traffic on the GDPB.

B.2.6 SERVICE NET. The Service Net (SN) provides a communication path for maintenance operations. The SN provides capability for remote and local access to operation and maintenance services for applicable TCMS hardware.

B.2.7 HARDWARE INTERFACE MODULE. The Hardware Interface Module (HIM) acts as the front-end element of TCMS and is connected to the GSE Data Bus for communications with the FEP. A FEP may control up to sixteen HIMs via a ground data bus. The modular design of the HIM accommodates several types of interfaces depending upon the particular configuration required.

There are two basic types of HIMs, slave and standalone (also known as a smart or Local Processor Control (LPC) HIM). The slave HIM is always connected to a FEP and its sole function is to transfer measurement data from a GSE device to the FEP, or to pass a

command from the FEP to the specific GSE device. Thus, there is no algorithmic processing of measurements or command generation in the slave HIM. The standalone HIM interfaces to GSE equipment as in a slave HIM, but it gathers measurements and issues GSE commands without requiring a FEP.

B.2.8 PROCESSED DATA RECORDER. The Processed Data Recorder (PDR) records data from the RTN to support near real time retrievals and post-test retrievals. The data consists predominantly of preprocessed test article data from a FEP. The PDR records on two different media simultaneously. One media, Temporary Archive Media (TAM), supports the near real time retrievals and the other, Permanent Archive Media (PAM), supports a historical record. The PDR interfaces with the RTN for data recording.

B.2.9 DATA BASE SUBSYSTEM. The Data Base Subsystem (DBS) provides the data management and data handling functions to support the data display and analysis performed during and after tests. The DBS supports real time data storage and retrieval as well as media library data base management. During a test the DBS supports data retrieval and analysis of the PDR recorded data.

B.2.10 DATA MANAGEMENT SYSTEM. A Data Management System (DMS) kit is an integrated set of electronic units and an interface device to connect these components to a host computer. DMS kits are used for code verification and test support in place of the flight hardware.

The DMS kit typically contains a TCMS Simulation Interface Buffer (SIB) and a set of DMS Functional Equivalent Units (FEUs). The SIB is the interface device within the DMS kit that provides the interface bridge to the Space Station Freedom environment, including the local buses and networks. The FEUs are non-flight versions of various space station flight components.

The DMS kit configuration will vary depending on mission specific requirements and phase of testing. The kit operational components are:

- Simulation Interface Buffer
  - Local Control Workstations (LCWS)
  - System Development and Diagnostic Subunit (SDDS)
  - Network Monitor Subunit (NMS)
  - Network Simulator Subunit (NSS)
- Functional Equivalent Units
  - Intermediate Rate Gateway (IRGW)
  - Intermediate Gateway (IGW)
  - Multiplexer/Demultiplexer (MDM)
  - Ring Concentrator (RC)

C-2

- Standard Data Processor (SDP)
- Mass Storage Unit (MSU)
- Multipurpose Applications Console (MPAC)
- Time Generation Subunit (TGS)

The space station DMS buses and networks include MIL-STD 1553B local buses, ANSI X3T9.5/83-15FDDI networks, and an EIA RS-422A time distribution bus.

B.2.11 PATCH PANELS. The TCMS Patch Panels provide for the interconnection of TCMS subsystems and the connection with systems external to TCMS. SSPF patching is accomplished in the Central Communications Room (Rm. 1025), the Networks Room (Rm. 1026), the Communications & Tracking Room (Rm. 1062), the Test & Simulation Room (Rm. 2021), the Control Support Room (Rm. 2023), High Bays, Intermediate Bays, and Off-line labs (Rms. 1077, 1083 & 1098). Payload Spin Test Facility - Replacement (PSTF-R) patching is accomplished in the Flight Data Communications Room (Rm. 117). Patching for the Hazardous Operations Support Facility (HOSF) is accomplished in the HOSF Control/User Room (Rm. S109).

Currently there are 97 DMS Kit patch racks, the majority of them being in SSPF Rm. 2021. Because of the complexity involved in patching this quantity of racks, default patching configurations will be used as much as possible as long as modifications can still be made as required.

Figure B-3 is a diagram of the patching scheme used on TCMS. This diagram is preliminary and has areas of uncertainty shown with question marks. TCMS O&M will revise this drawing when the interfaces in question are firmed up. For more detailed information on TCMS patching, and a description of all the interfaces needed to support testing in each of the three facilities (SSPF, PSTF-R, and the HOSF), reference the TCMS Communications and Patching Plan (TS-TCMS-92004).

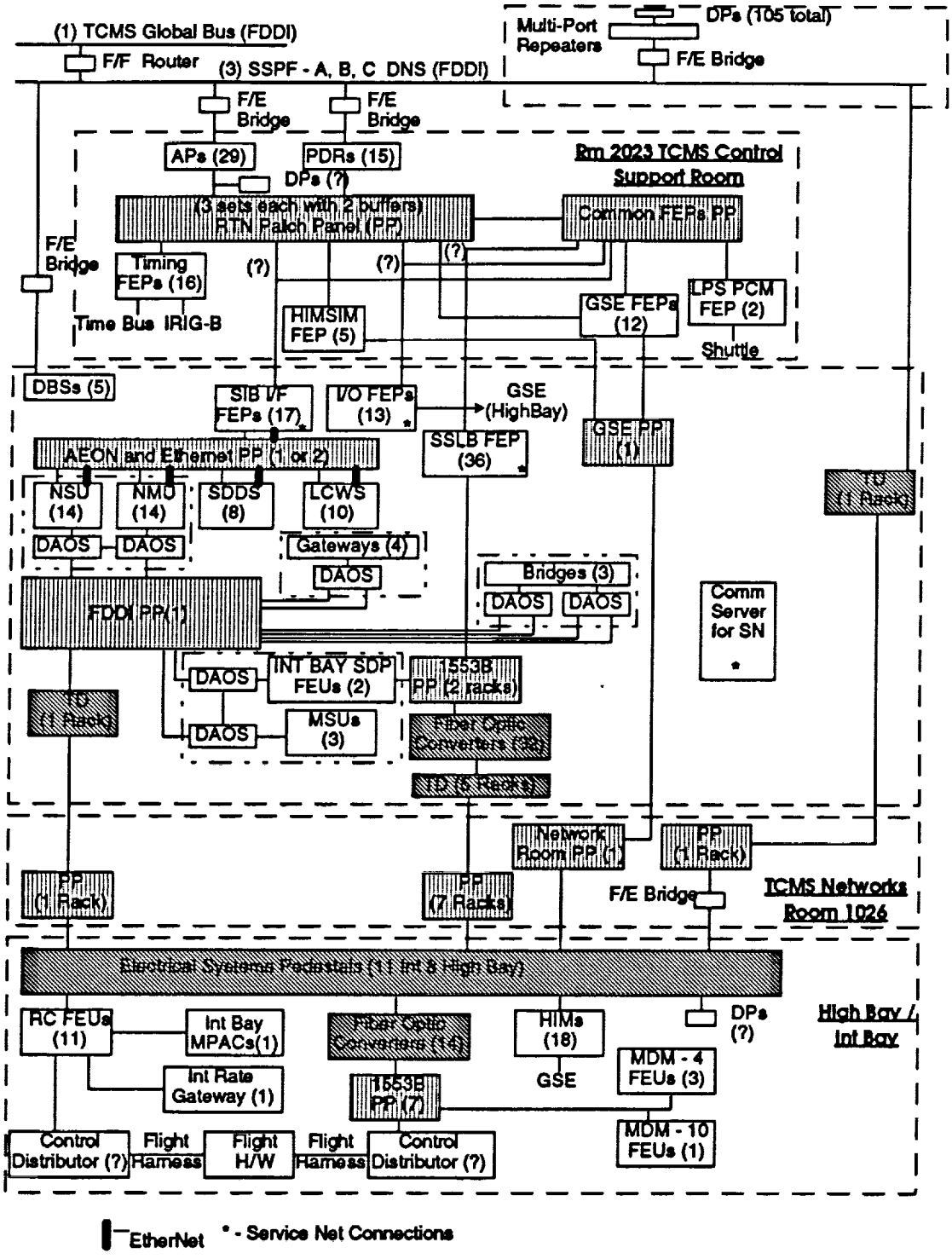


FIG B-3
PATCHING DIAGRAM

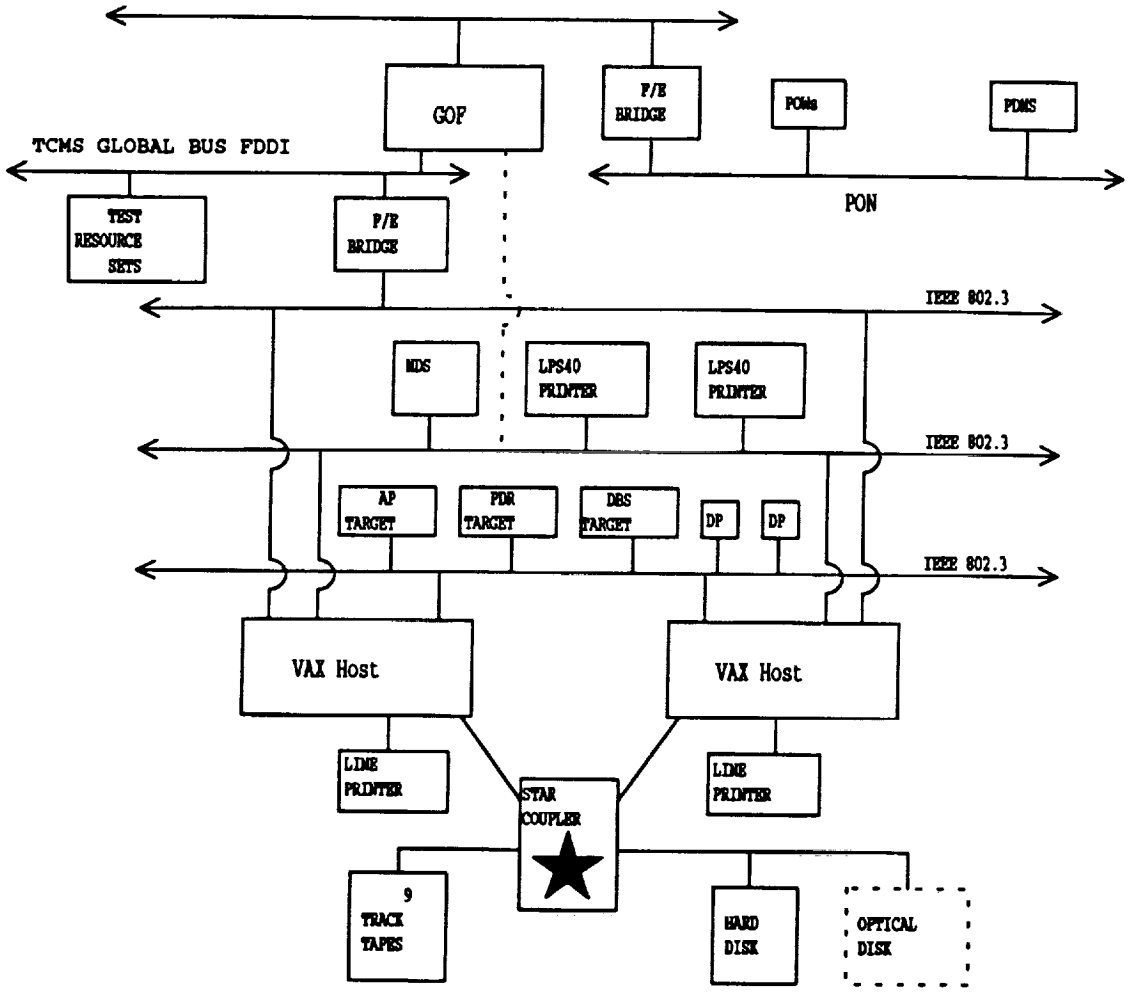


FIG B-4
SPF ARCHITECTURE

B.2.12 SOFTWARE PRODUCTION FACILITY. The SPF is the hardware set used for development and configuration management of applications and simulation software. It allows software developers to perform final compiles on the target subsystems and serves as a local repository for downloaded Master Object Data Base (MODB) data, build data, and test configuration functions. The SPF is composed of the following baseline equipment:

- Host Computer Systems
- Cluster Controller to Disk Drive Interface

- Disk Drive Storage Unit
- Tape Drive
- Target APs
- Target PDR
- Target DBS
- Line Printers

Figure B-4 describes the SPF architecture. For a more detailed description of the SPF equipment see Hardware Design and Maintenance for the SPF HWCI (83K03802).

B.2.13 NETWORK INTERFACES. TCMS internal network interfaces include the DNS, the SN, and the RTN. The DNS; which consists of the TCMS Global Bus, the GDPB, and the LDPB, provides the communication path for normal system operations. The SN provides the communication path used for maintenance and diagnostic operations. The RTN provides for test data flow between the FEPs and the AP and PDR. In addition, it provides subsystem interfaces, message routing, common data storage, and a data logging interface. Through control of the subsystem interfaces, the RTN provides for the addition, deletion, and logical partitioning of attached resources into Test Resource Sets (TRSs).

TCMS external network interfaces are accessed via the Payload Operations Network (PON). The PON is an administrative network that provides connectivity to PDMS, Payload Office Workstations (POWs), the Production Tracking System (PTS), Computer Aided Design/Computer Aided Engineering (CAD/CAE), Broadband Communication Distribution System (BCDS), and Program Support Communications Network Internet (PSCNI). Once approved, Security ESRs that are now pending will protect TCMS and Test Articles from access by unauthorized clients.

Figure B-5 describes the TCMS network interfaces. For more detailed information on TCMS network interfaces, refer to the TCMS Communications and Patching Plan (TS-TCMS-92004).

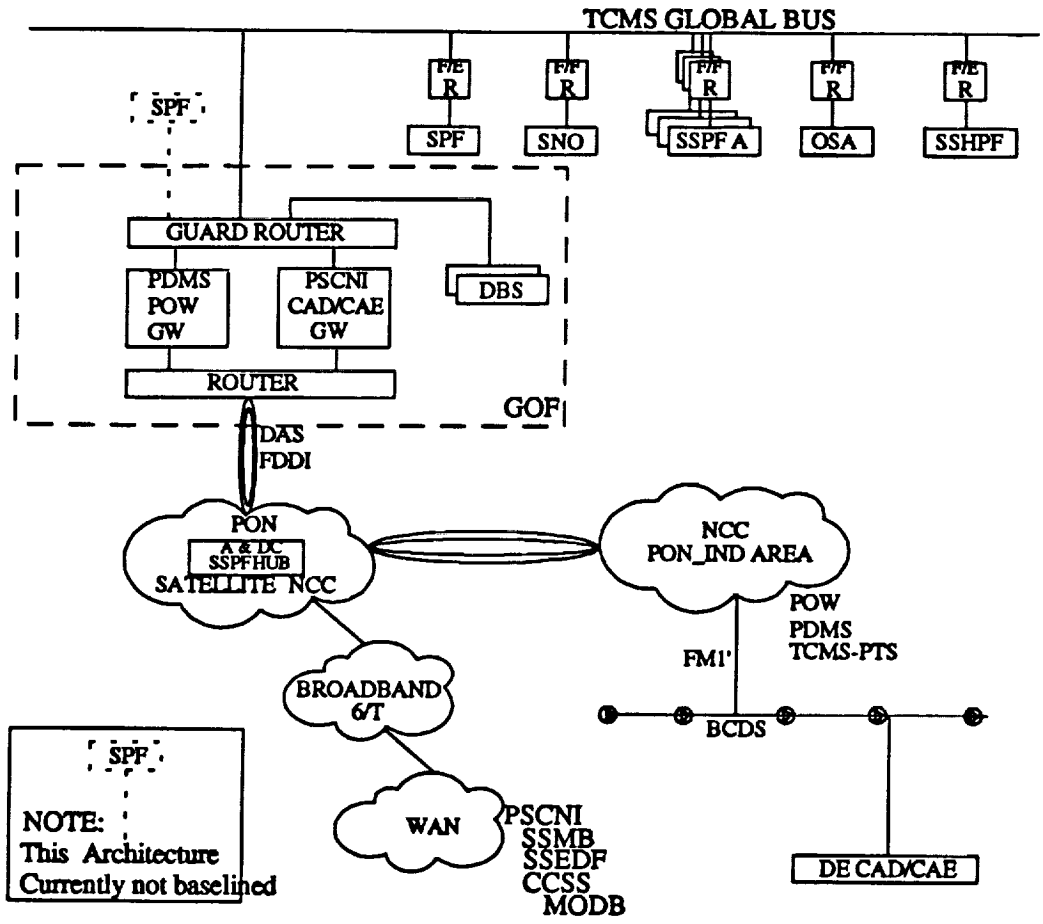


FIG B-5
NETWORK INTERFACES

APPENDIX C

TCMS SOFTWARE ALLOCATION AND INTERACTION

PURPOSE: The purpose of the Allocation portion of the document is to show the individual TCMS Hardware platforms and all of the system and COTS software that is either resident on or interactive with the particular HWCI. The second part of the appendix shows the individual CSCIs, and how they interact with each other. The direction of the arrow shows the direction of the data flow.

This document is to be used by TCMS O&M as a tool to guide in the locating of software related anomalies. It is intended to be a helpful tool that can be used for ease of reference and speed in the tracking and correcting of software related anomalies.

Test, Control and Monitor System (TCMS)

Software Allocation & Interaction

Release Date: September 28, 1992
TCMS O&M - F468
Dan Perreten 867-1615

Table of Contents:

Software allocation to specific Hardware platforms:

Hardware Platform: *Page Number:*

1. Applications Processor *AP HWCI* 1
2. Display Processor *DP HWCI* 2
3. Database Subsystem *DBS HWCI* 3
4. Data Management Subsystem *DMS HWCI* 4
5. Ground Support Equipment Front End Processor *GSE FEP HWCI* 5
6. Hardware Interface Module SIM Front End Processor *HIM SIM FEP HWCI* 6
7. Input/Output Front End Processor *I/O FEP* 7
8. Simulation Interface Buffer Front End Processor *SIB FEP HWCI* 8
9. Space Station Local Bus Front End Processor *SSLB FEP HWCI* 9
10. Timing Front End Processor *Timing FEP HWCI* 10
11. Payload Office Workstation *POW HWCI* 11
12. Processed Data Recorder *PDR HWCI* 12

13. Real Time Network *RTN HWCI* 13

14. Software Production Facility POSIX Host *SPF HWCI* 14

CSCI to CSCI interaction:

15. Test End Item Database Manager *TDM CSCI* 16

16. Data Storage Management *DSM CSCI* 16

17. Retrieve and Format Test Data *RFD CSCI* 16

18. System Management *SMG CSCI* 17

19. Configure Tests *CTS CSCI* 17

20. Record Test Data *RCD CSCI* 18

21. Command Processing *CMP CSCI* 18

22. Test Build *BLD CSCI* 19

23. CCMS-II Bulk Input *CBI CSCI* 19

24. Commercial Development Environment *CDE CSCI* 19

25. Configuration Management Services *CMS CSCI* 20

26. Configure Tests *CTS CSCI* 20

27. HCI Real Time Services *HRT CSCI* 20

28. HCI Support Environment *HSE CSCI* 21

29. HCI Test Development Services *HTD CSCI* 21

30. Link Configuration Database Manager *LDM CSCI* 21

31. Monitor Data for Distribution *MDD CSCI* 22

32. Network Manager *NMG CSCI* 22

33. Resource Manager *RMG CSCI* 22

34. Software Production Facility (SPF) Manager *SPM CSCI* 22

35. System Software Services *SSS CSCI* 23

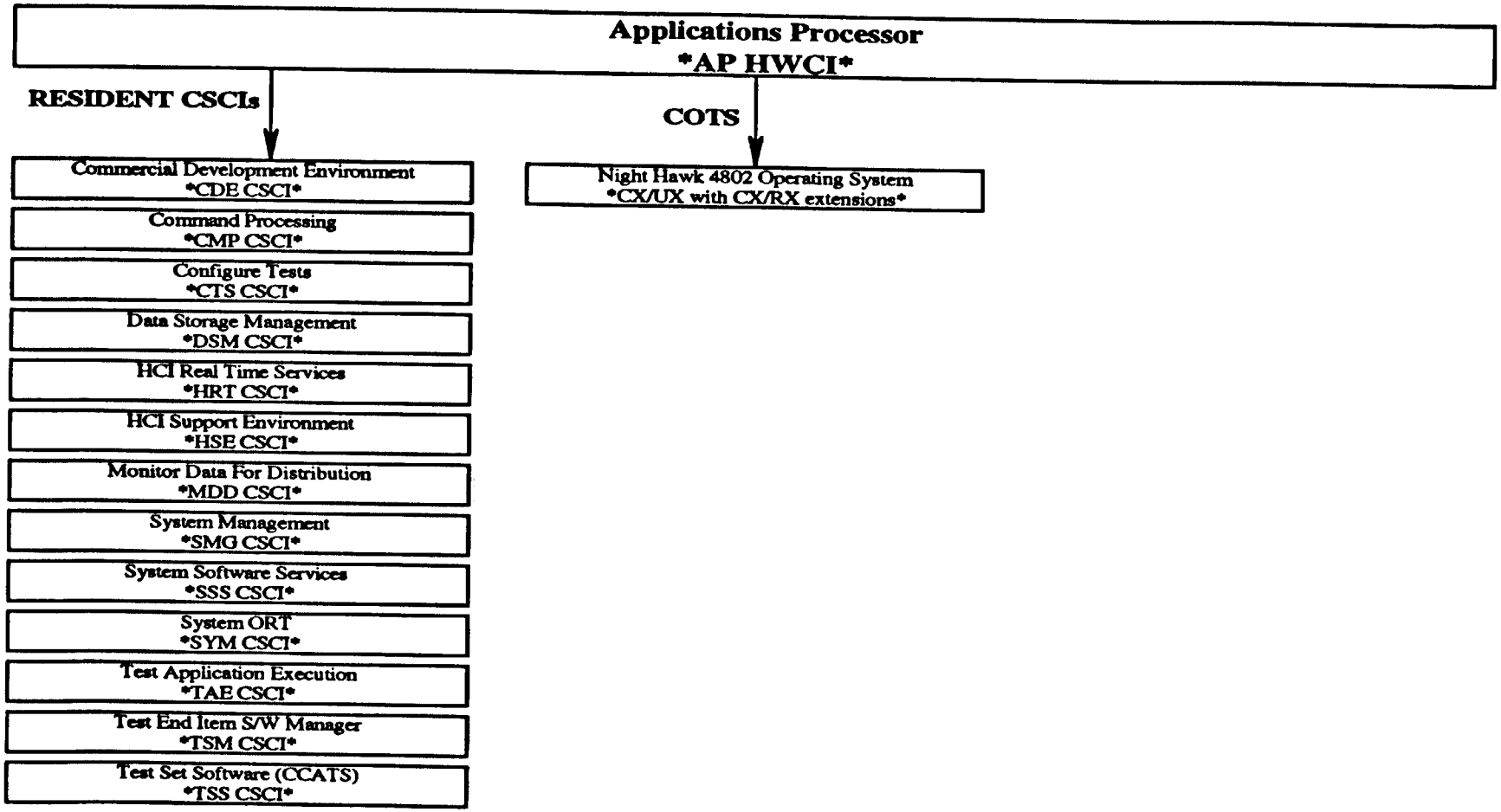
36. System ORT *SYM CSCI* 23

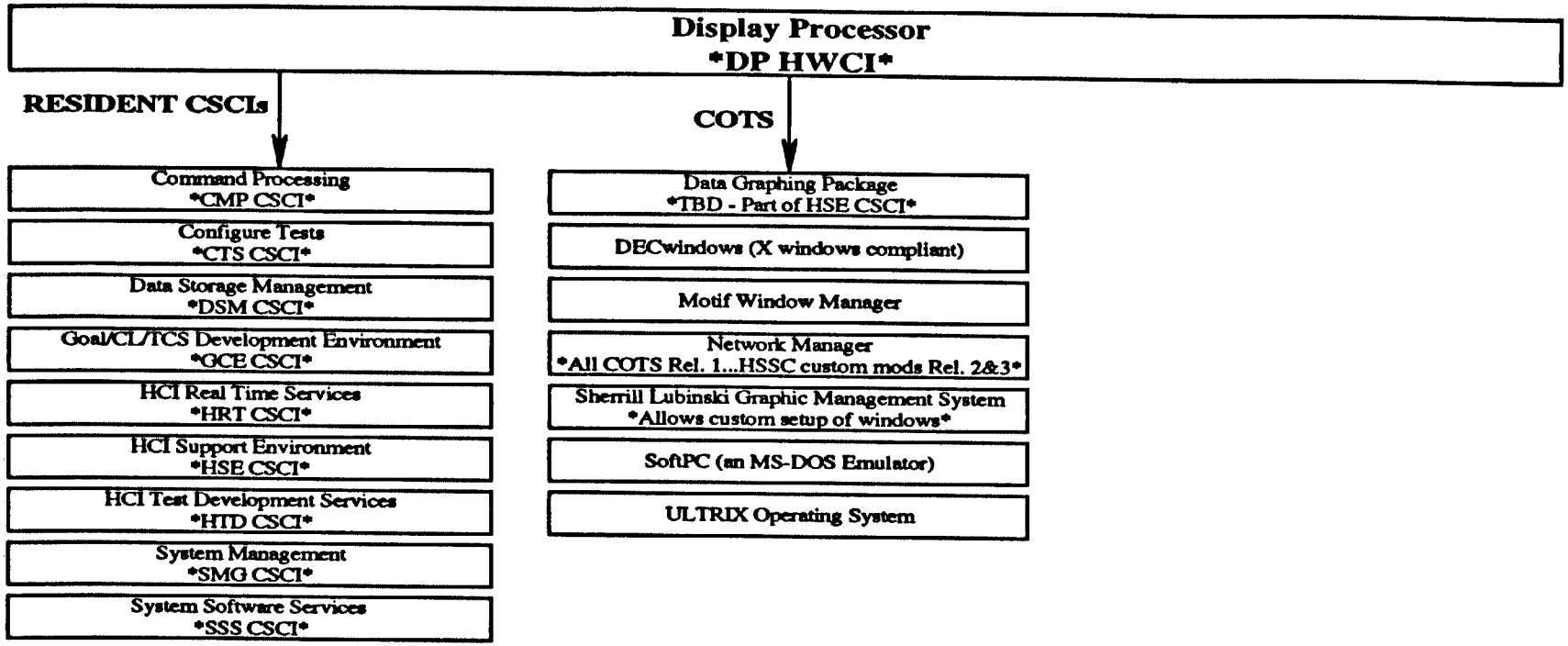
37. Test Application Execution *TAE CSCI* 23

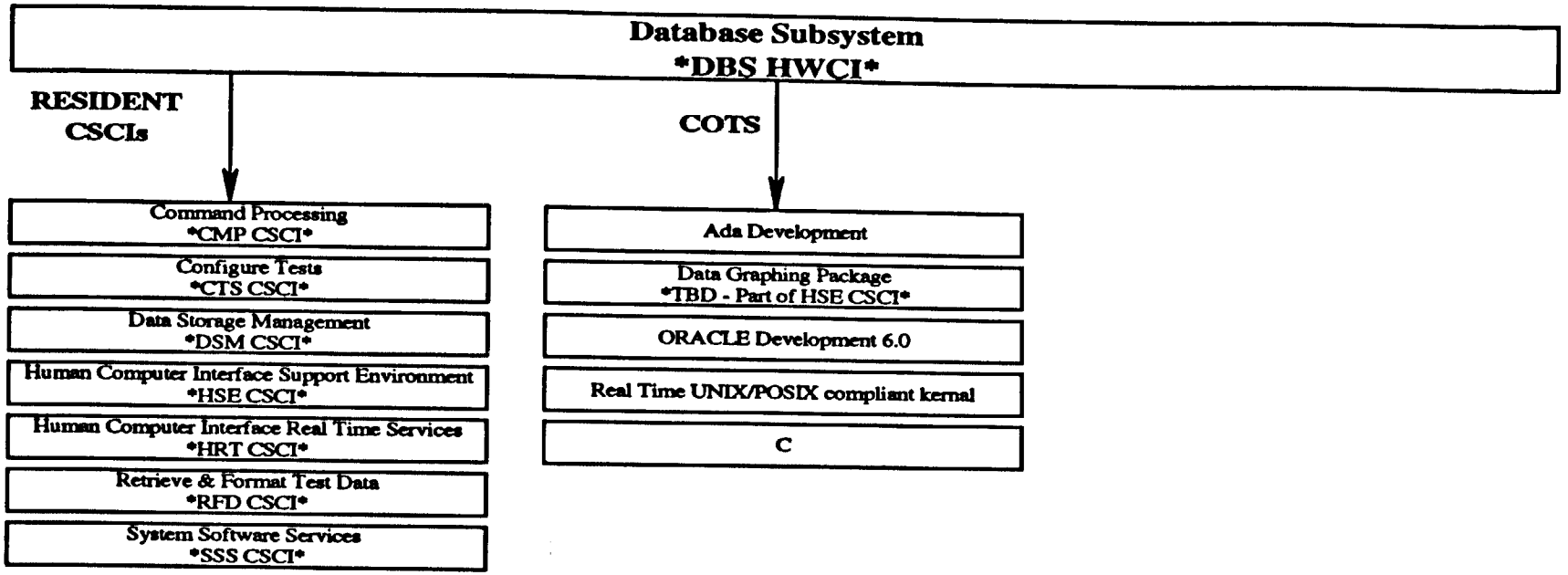
38. TCMS Bulk Input *TBI CSCI* 24

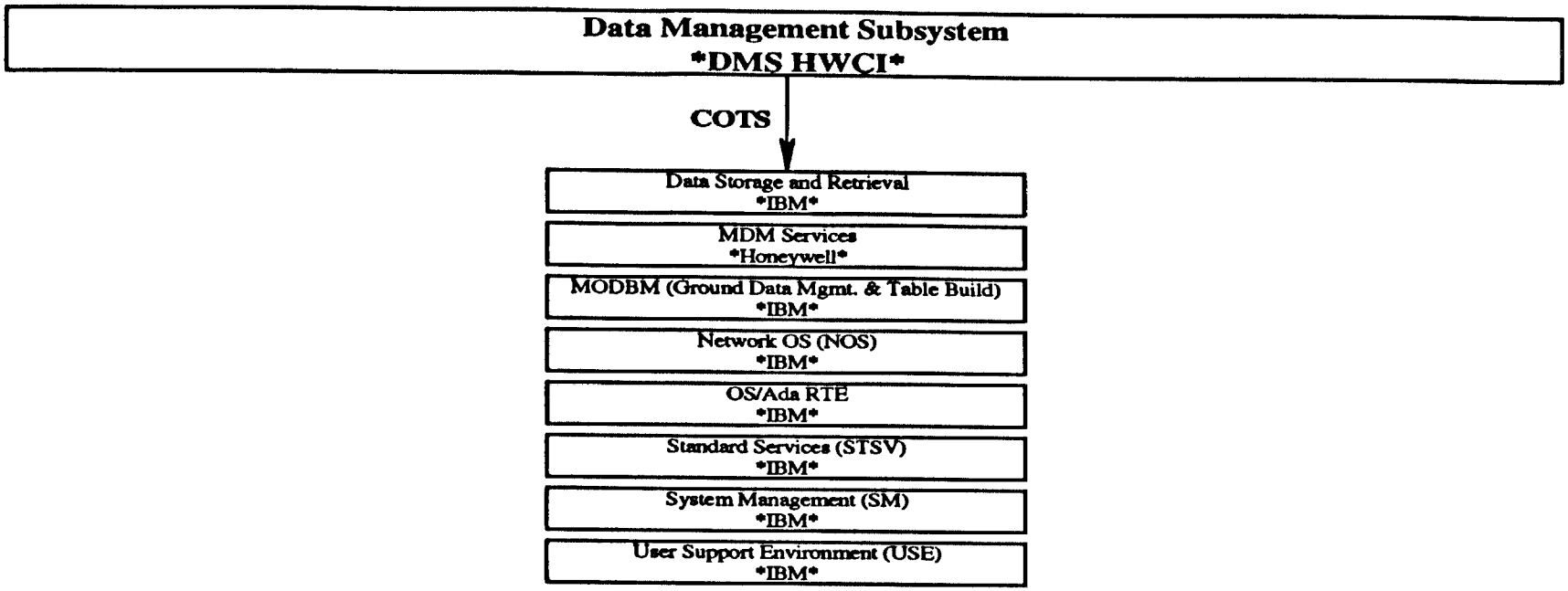
39. Test End Item Software Manager *TSM CSCI* 24

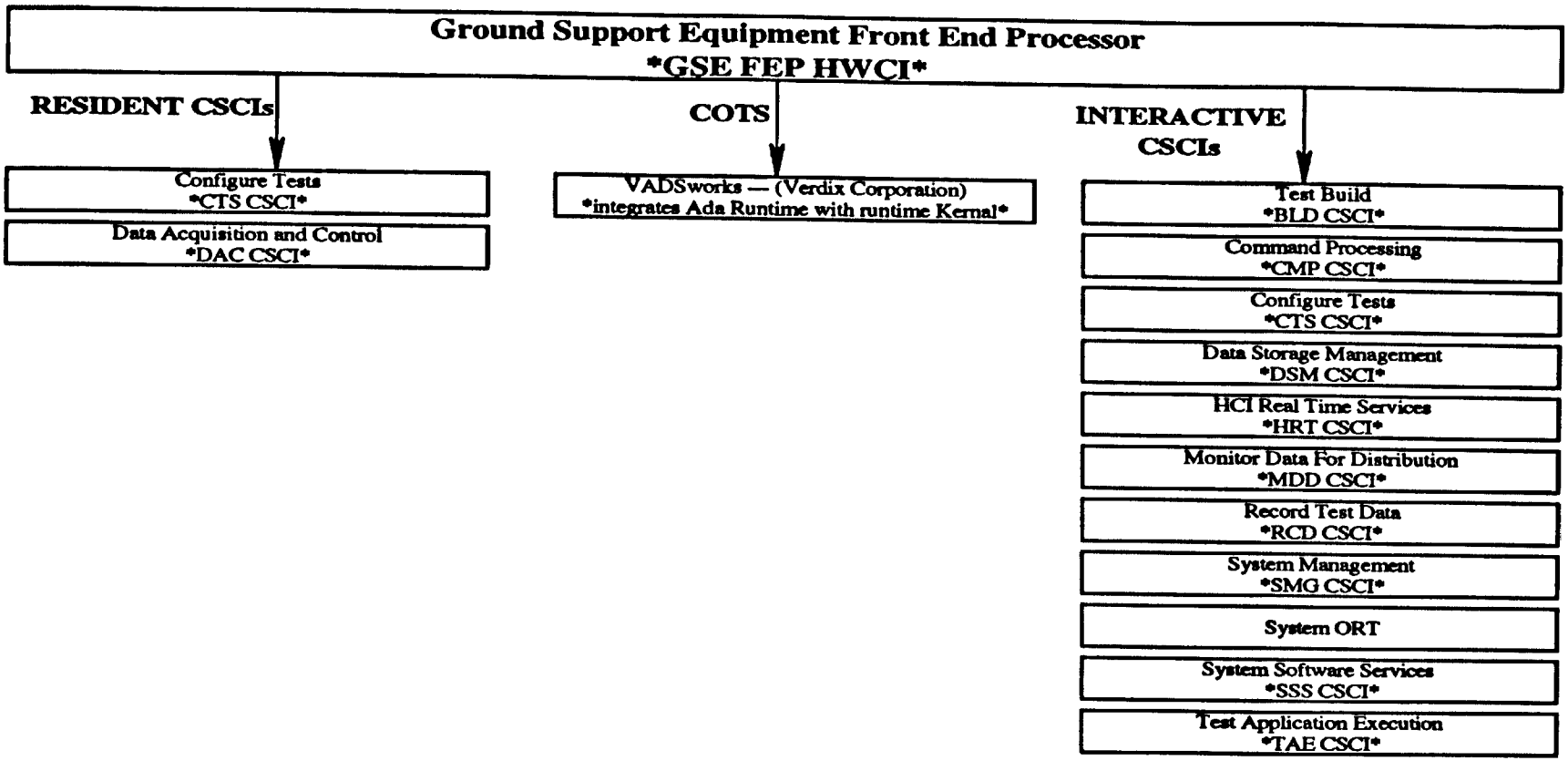
40. Configuration and Calibration and Test Set *TSS CSCI* 24

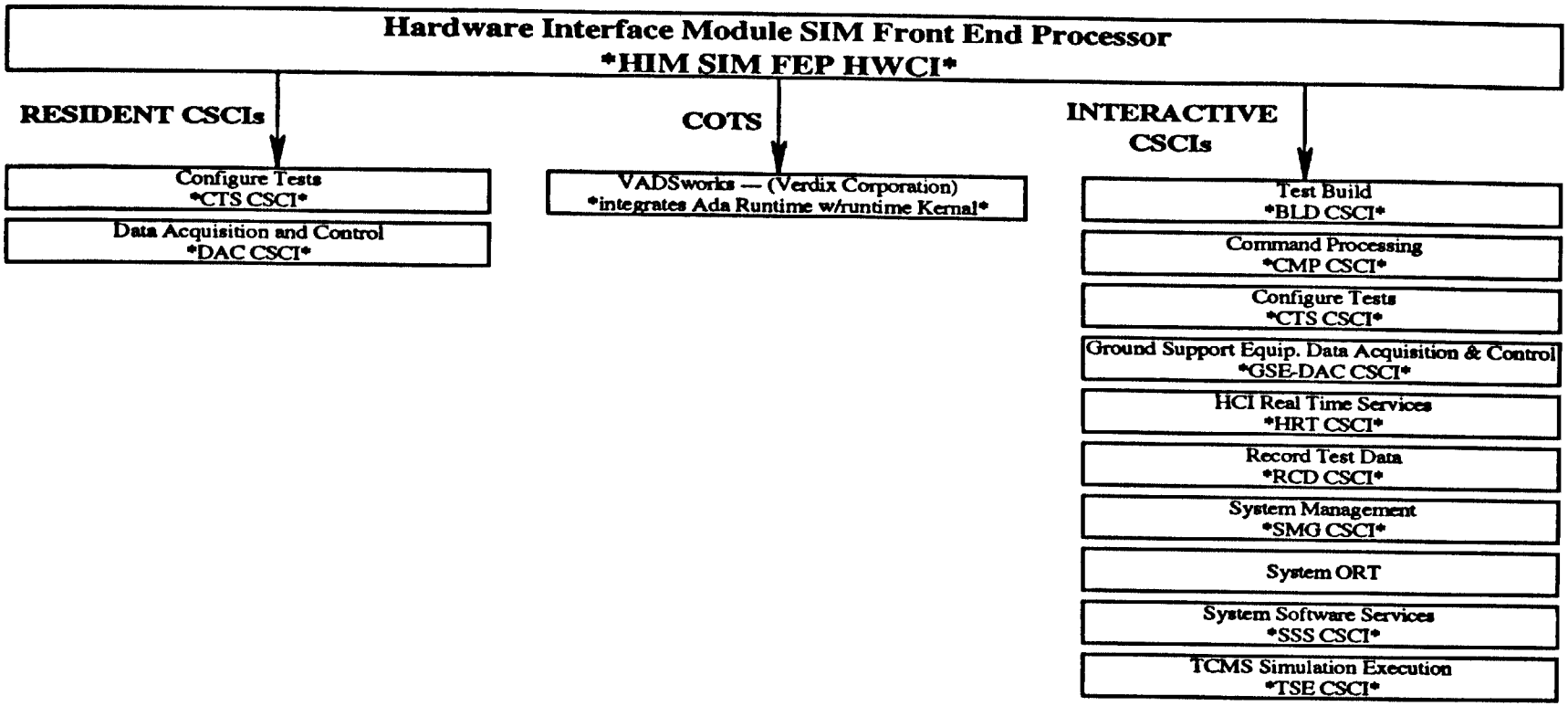

Applications Processor
AP HWCI
RESIDENT CSCIs
COTS
Commercial Development Environment
CDE CSCI
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI
HCI Support Environment
HSE CSCI
Monitor Data For Distribution
MDD CSCI
System Management
SMG CSCI
System Software Services
SSS CSCI
System ORT
SYM CSCI
Test Application Execution
TAE CSCI
Test End Item S/W Manager
TSM CSCI
Test Set Software (CCATS)
TSS CSCI
Night Hawk 4802 Operating System
CX/UX with CX/RX extensions

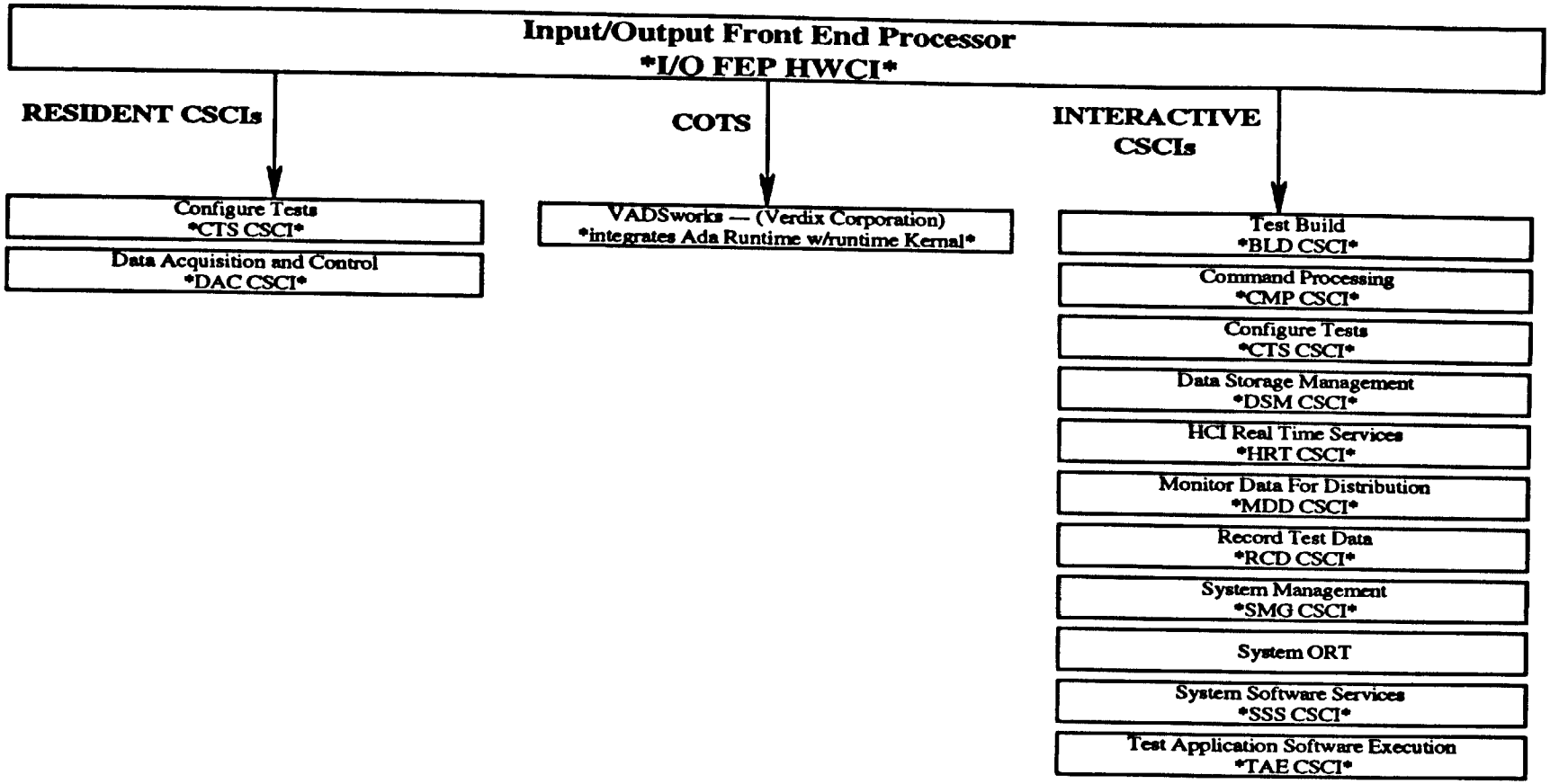

Display Processor
DP HWCI
RESIDENT CSCIs
COTS
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
Goal/CL/TCS Development Environment
GCE CSCI
HCI Real Time Services
HRT CSCI
HCI Support Environment
HSE CSCI
HCI Test Development Services
HTD CSCI
System Management
SMG CSCI
System Software Services
SSS CSCI
Data Graphing Package
TBD - Part of HSE CSCI
DECwindows (X windows compliant)
Motif Window Manager
Network Manager
All COTS Rel. 1...HSSC custom mods Rel. 2&3
Sherrill Lubinski Graphic Management System
Allows custom setup of windows
SoftPC (an MS-DOS Emulator)
ULTRIX Operating System

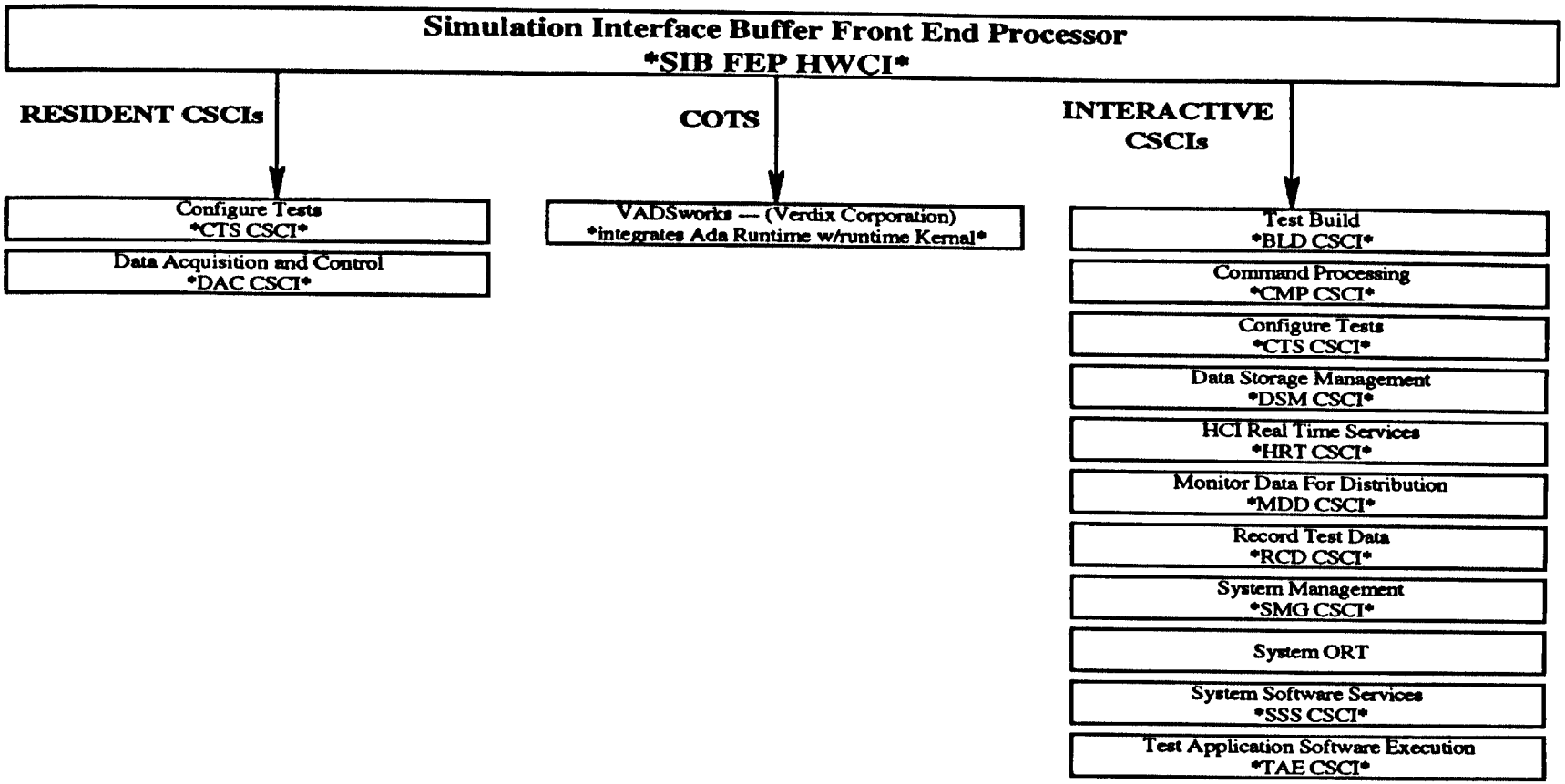

Database Subsystem
DBS HWCI
RESIDENT CSCIs
COTS
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
Human Computer Interface Support Environment
HSE CSCI
Human Computer Interface Real Time Services
HRT CSCI
Retrieve & Format Test Data
RFD CSCI
System Software Services
SSS CSCI
Ada Development
Data Graphing Package
TBD - Part of HSE CSCI
ORACLE Development 6.0
Real Time UNIX/POSIX compliant kernal
C

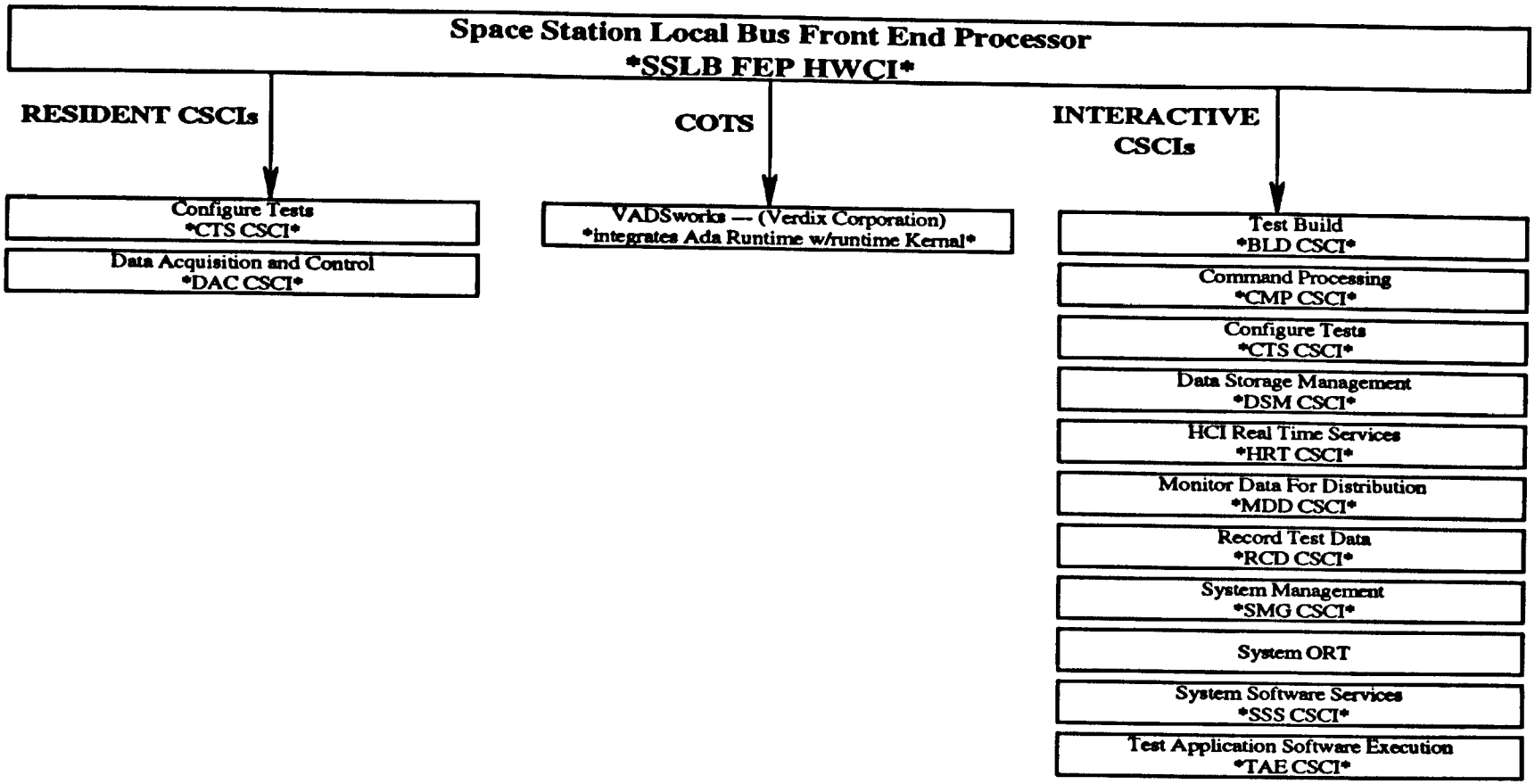

Data Management Subsystem
DMS HWCI
COTS
Data Storage and Retrieval
IBM
MDM Services
Honeywell
MODBM (Ground Data Mgmt. & Table Build)
IBM
Network OS (NOS)
IBM
OS/Ada RTE
IBM
Standard Services (STSV)
IBM
System Management (SM)
IBM
User Support Environment (USE)
IBM

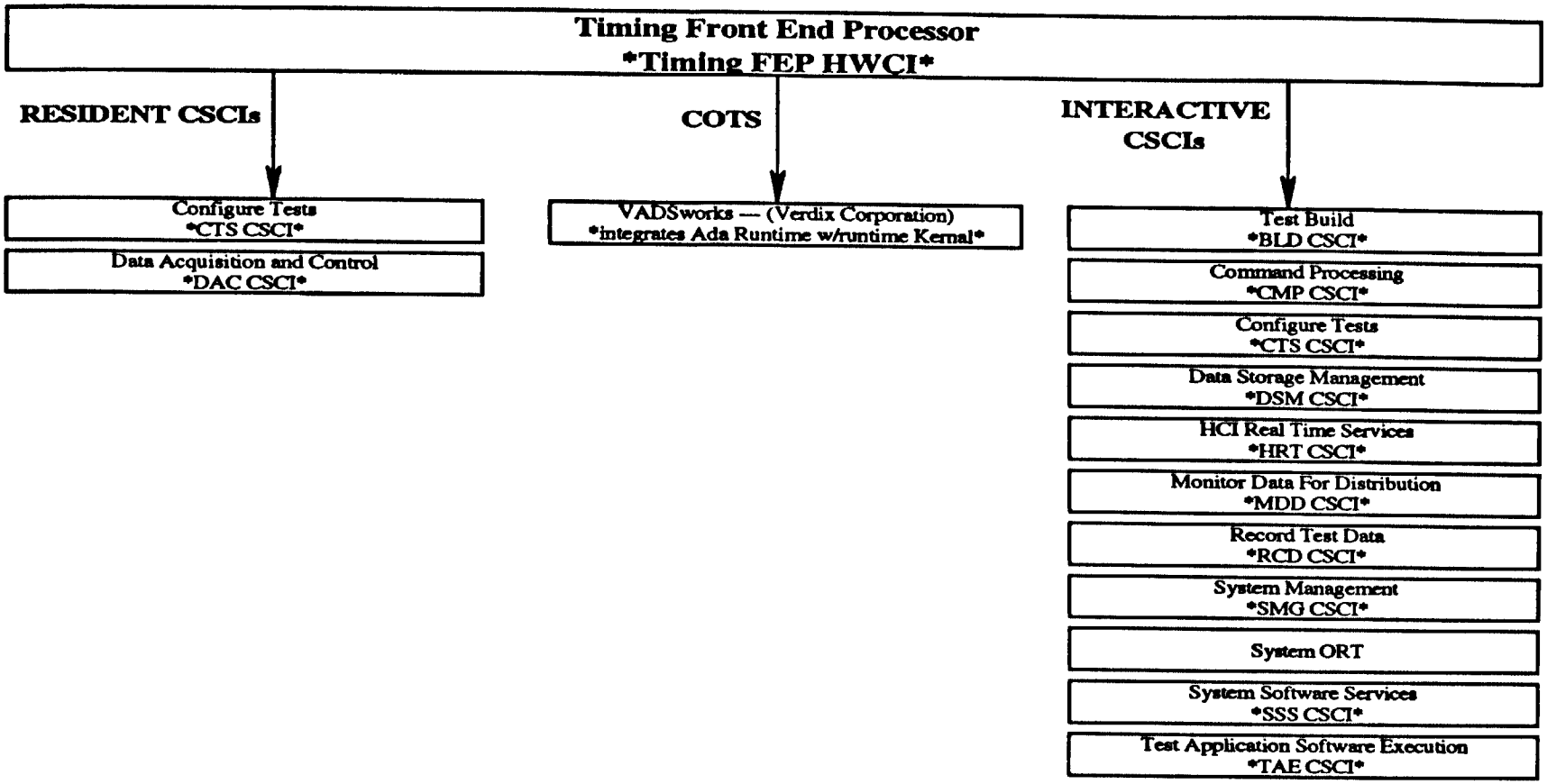

Ground Support Equipment Front End Processor
GSE FEP HWCI
RESIDENT CSCIs
COTS
INTERACTIVE CSCIs
Configure Tests
CTS CSCI
Data Acquisition and Control
DAC CSCI
VADSworks — (Verdix Corporation)
integrates Ada Runtime with runtime Kernal
Test Build
BLD CSCI
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
System Management
SMG CSCI
System ORT
System Software Services
SSS CSCI
Test Application Execution
TAE CSCI

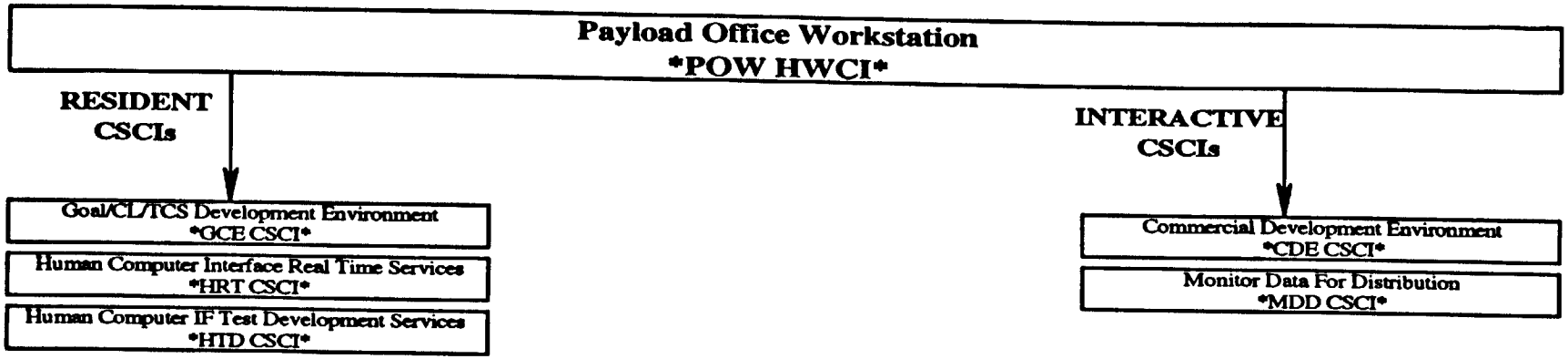

Hardware Interface Module SIM Front End Processor
HIM SIM FEP HWCI
RESIDENT CSCIs
COTS
INTERACTIVE CSCIs
Configure Tests
CTS CSCI
Data Acquisition and Control
DAC CSCI
VADSworks — (Verdix Corporation)
integrates Ada Runtime w/runtime Kernal
Test Build
BLD CSCI
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Ground Support Equip. Data Acquisition & Control
GSE-DAC CSCI
HCI Real Time Services
HRT CSCI
Record Test Data
RCD CSCI
System Management
SMG CSCI
System ORT
System Software Services
SSS CSCI
TCMS Simulation Execution
TSE CSCI

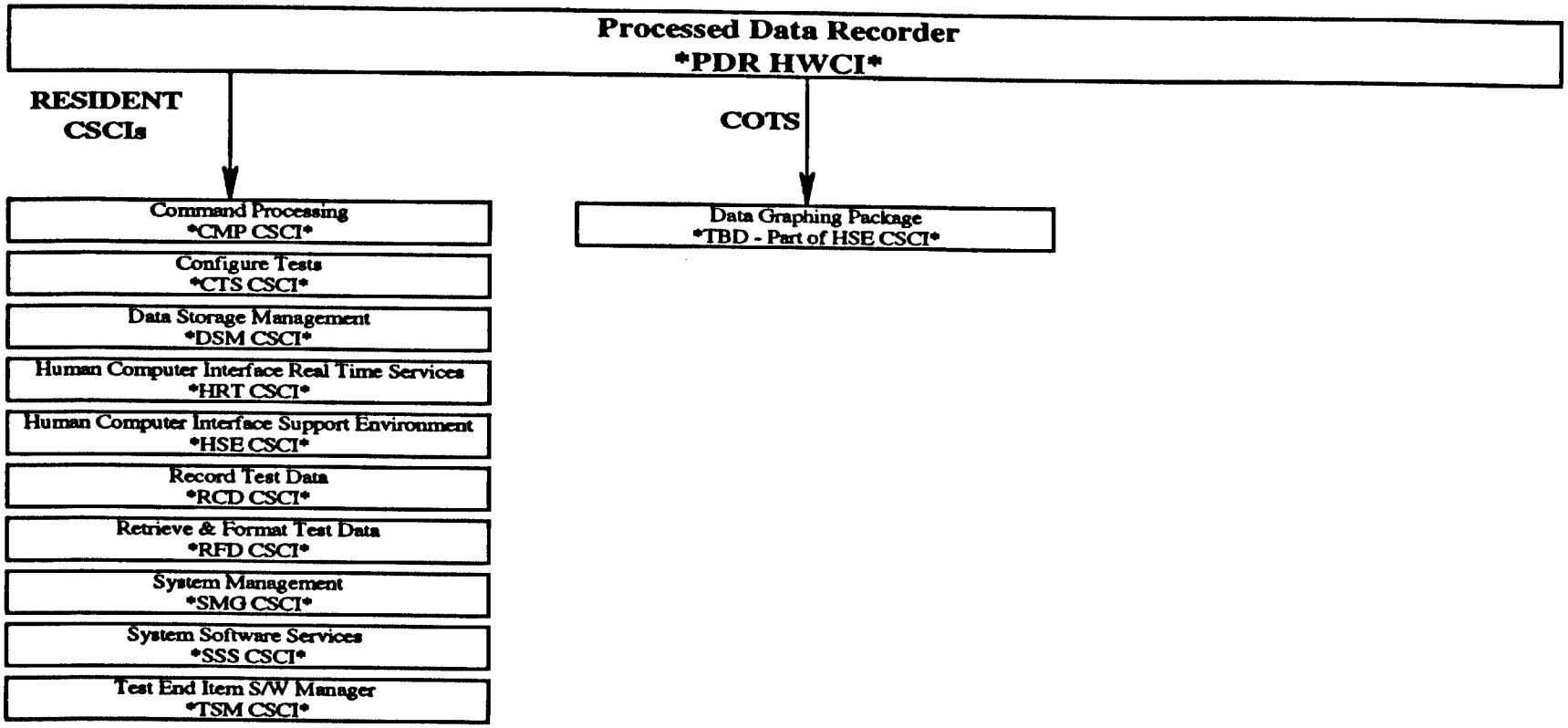

Input/Output Front End Processor
I/O FEP HWCI
RESIDENT CSCIs
COTS
INTERACTIVE CSCIs
Configure Tests
CTS CSCI
Data Acquisition and Control
DAC CSCI
VADSworks — (Verdix Corporation)
integrates Ada Runtime w/runtime Kernal
Test Build
BLD CSCI
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
System Management
SMG CSCI
System ORT
System Software Services
SSS CSCI
Test Application Software Execution
TAE CSCI

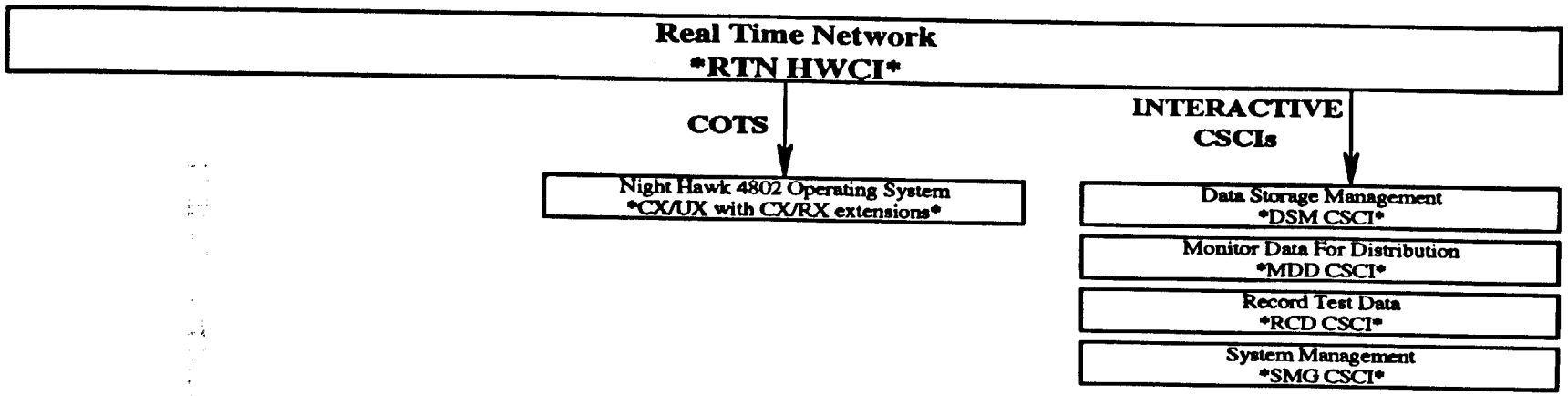

Simulation Interface Buffer Front End Processor
SIB FEP HWCI
RESIDENT CSCIs
COTS
INTERACTIVE CSCIs
Configure Tests
CTS CSCI
Data Acquisition and Control
DAC CSCI
VADSworks — (Verdix Corporation)
integrates Ada Runtime w/runtime Kernal
Test Build
BLD CSCI
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
System Management
SMG CSCI
System ORT
System Software Services
SSS CSCI
Test Application Software Execution
TAE CSCI

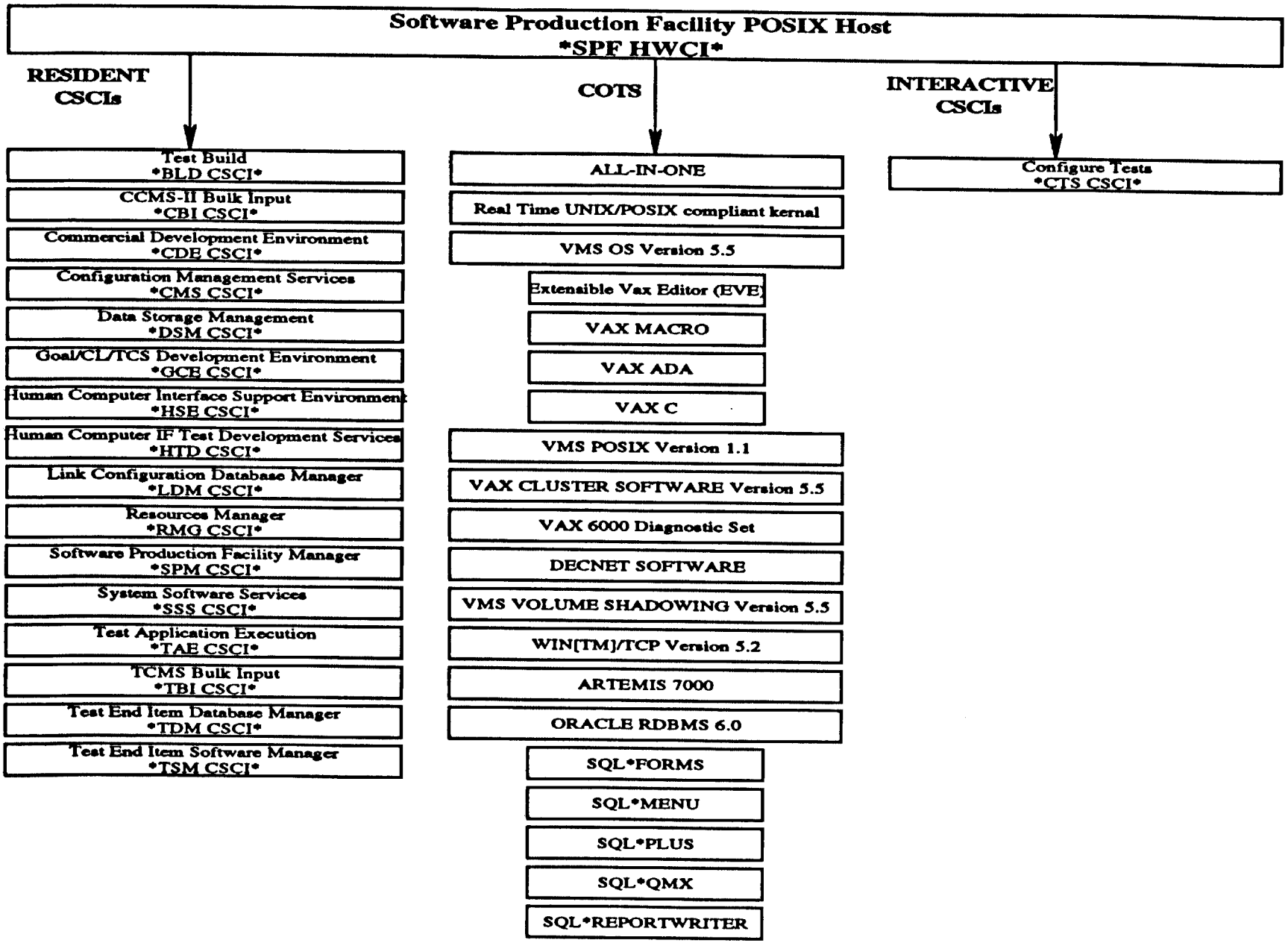

Space Station Local Bus Front End Processor
SSLB FEP HWCI
RESIDENT CSCIs
COTS
INTERACTIVE CSCIs
Configure Tests
CTS CSCI
Data Acquisition and Control
DAC CSCI
VADSworks — (Verdix Corporation)
integrates Ada Runtime w/runtime Kernal
Test Build
BLD CSCI
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
System Management
SMG CSCI
System ORT
System Software Services
SSS CSCI
Test Application Software Execution
TAE CSCI


Timing Front End Processor
Timing FEP HWCI
RESIDENT CSCIs
COTS
INTERACTIVE CSCIs
Configure Tests
CTS CSCI
Data Acquisition and Control
DAC CSCI
VADSworks — (Verdix Corporation)
integrates Ada Runtime w/runtime Kernal
Test Build
BLD CSCI
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
System Management
SMG CSCI
System ORT
System Software Services
SSS CSCI
Test Application Software Execution
TAE CSCI


Payload Office Workstation
POW HWCI
RESIDENT CSCIs
INTERACTIVE CSCIs
Goal/CL/TCS Development Environment
GCE CSCI
Human Computer Interface Real Time Services
HRT CSCI
Human Computer IF Test Development Services
HTD CSCI
Commercial Development Environment
CDE CSCI
Monitor Data For Distribution
MDD CSCI

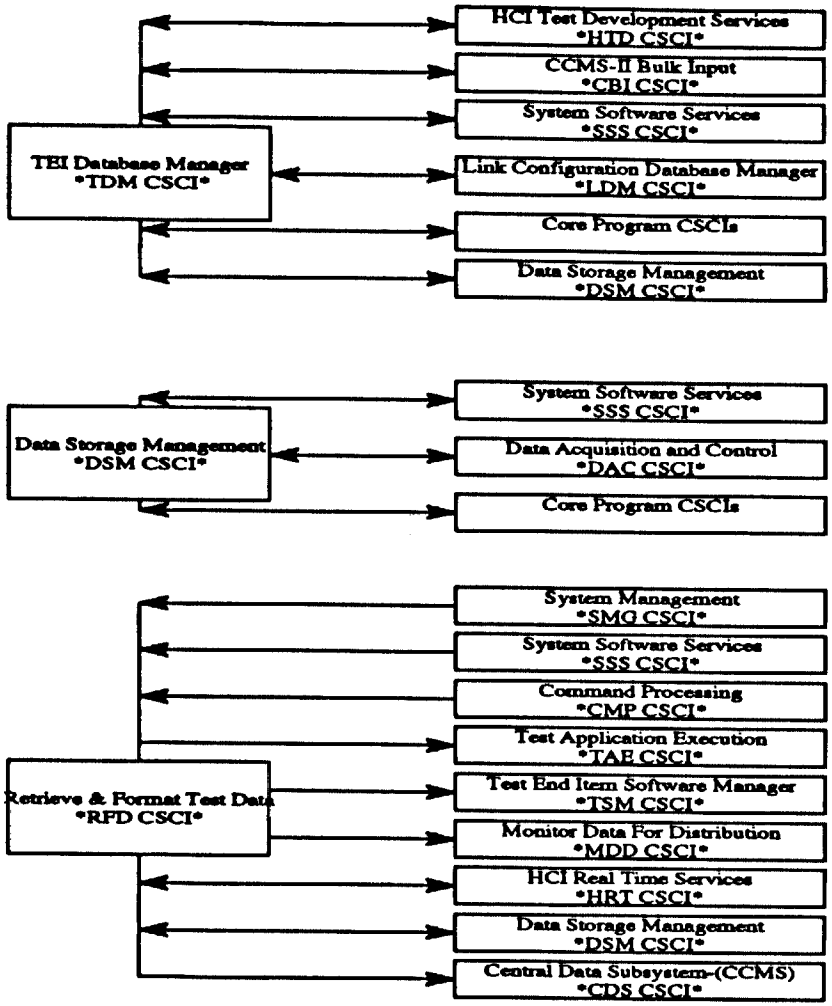

Processed Data Recorder
PDR HWCI
RESIDENT CSCIs
COTS
Command Processing
CMP CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
Human Computer Interface Real Time Services
HRT CSCI
Human Computer Interface Support Environment
HSE CSCI
Record Test Data
RCD CSCI
Retrieve & Format Test Data
RFD CSCI
System Management
SMG CSCI
System Software Services
SSS CSCI
Test End Item S/W Manager
TSM CSCI
Data Graphing Package
TBD - Part of HSE CSCI

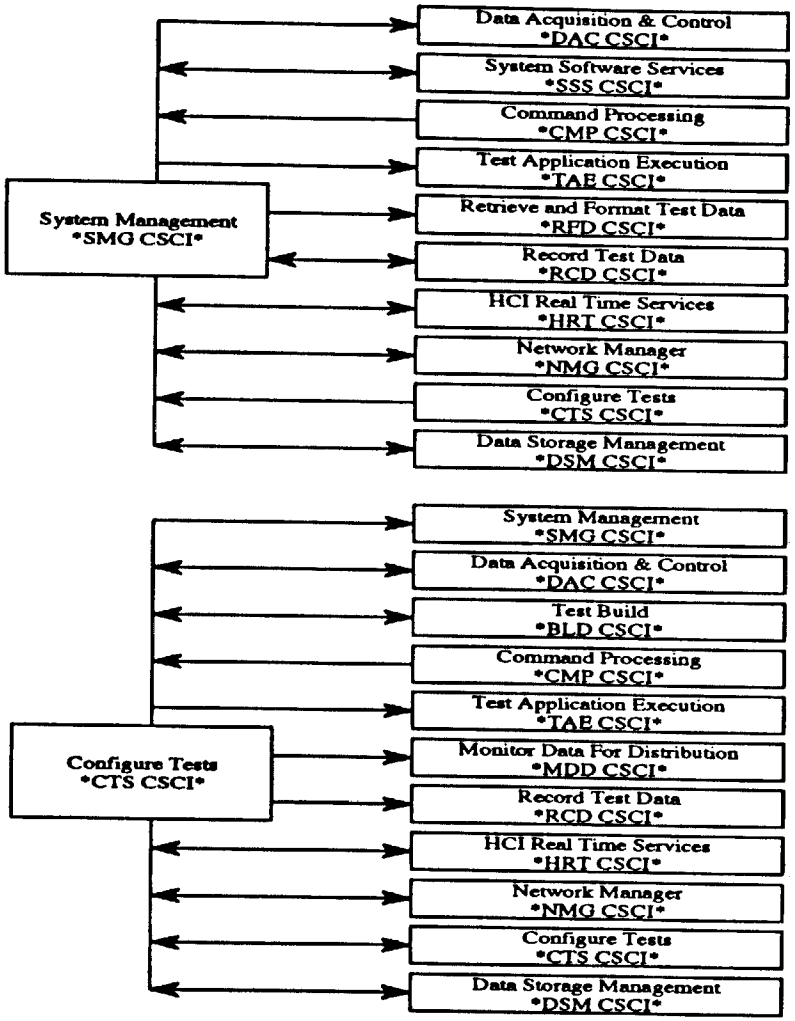

Real Time Network
RTN HWCI
COTS
Night Hawk 4802 Operating System
CX/UX with CX/RX extensions
INTERACTIVE
CSCIs
Data Storage Management
DSM CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
System Management
SMG CSCI

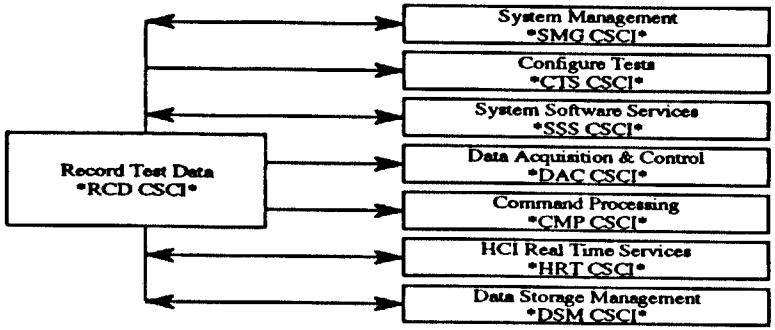

Software Production Facility POSIX Host
SPF HWCI
RESIDENT CSCIs
COTS
INTERACTIVE CSCIs
Test Build *BLD CSCI*
CCMS-II Bulk Input *CBI CSCI*
Commercial Development Environment *CDE CSCI*
Configuration Management Services *CMS CSCI*
Data Storage Management *DSM CSCI*
Goal/CL/TCS Development Environment *GCE CSCI*
Human Computer Interface Support Environment *HSE CSCI*
Human Computer IF Test Development Services *HTD CSCI*
Link Configuration Database Manager *LDM CSCI*
Resources Manager *RMG CSCI*
Software Production Facility Manager *SPM CSCI*
System Software Services *SSS CSCI*
Test Application Execution *TAE CSCI*
TCMS Bulk Input *TBI CSCI*
Test End Item Database Manager *TDM CSCI*
Test End Item Software Manager *TSM CSCI*
ALL-IN-ONE
Real Time UNIX/POSIX compliant kernal
VMS OS Version 5.5
Extensible Vax Editor (EVE)
VAX MACRO
VAX ADA
VAX C
VMS POSIX Version 1.1
VAX CLUSTER SOFTWARE Version 5.5
VAX 6000 Diagnostic Set
DECNET SOFTWARE
VMS VOLUME SHADOWING Version 5.5
WIN[TM]/TCP Version 5.2
ARTEMIS 7000
ORACLE RDBMS 6.0
SQL*FORMS
SQL*MENU
SQL*PLUS
SQL*QMX
SQL*REPORTWRITER
Configure Tests *CTS CSCI*

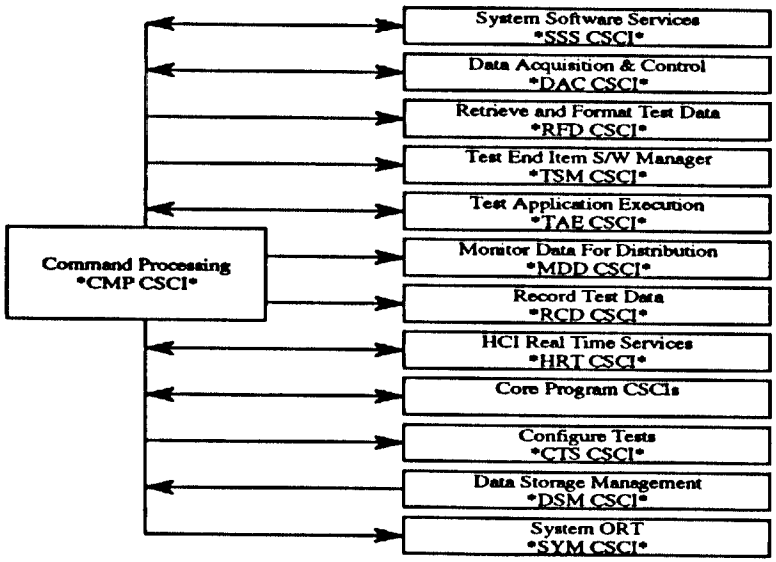
TCMS System Software

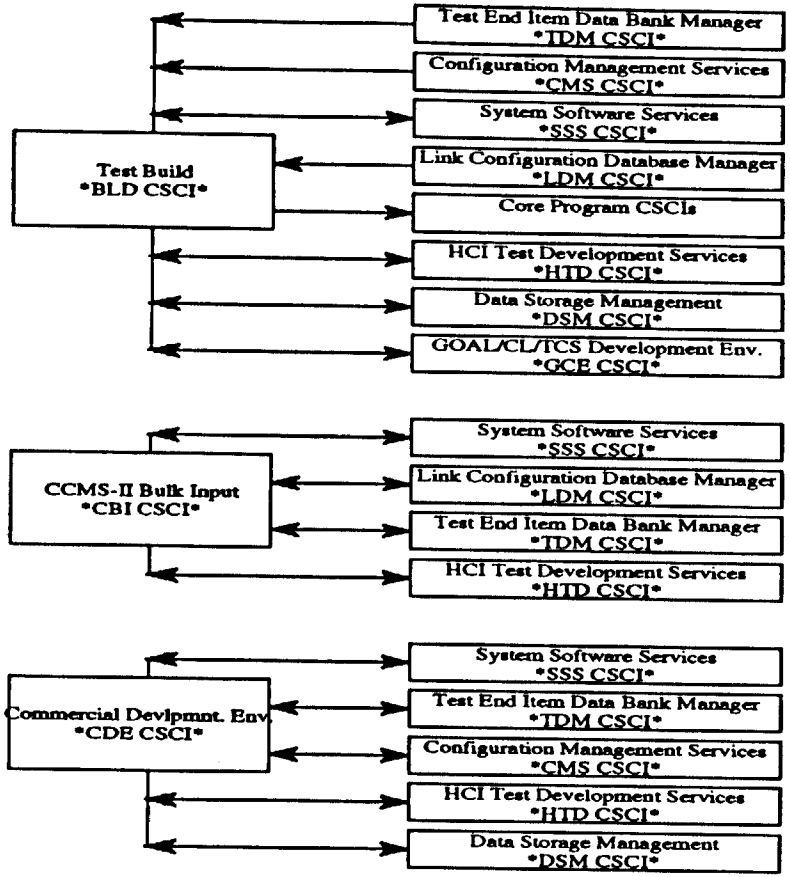
CSCI - CSCI Interaction

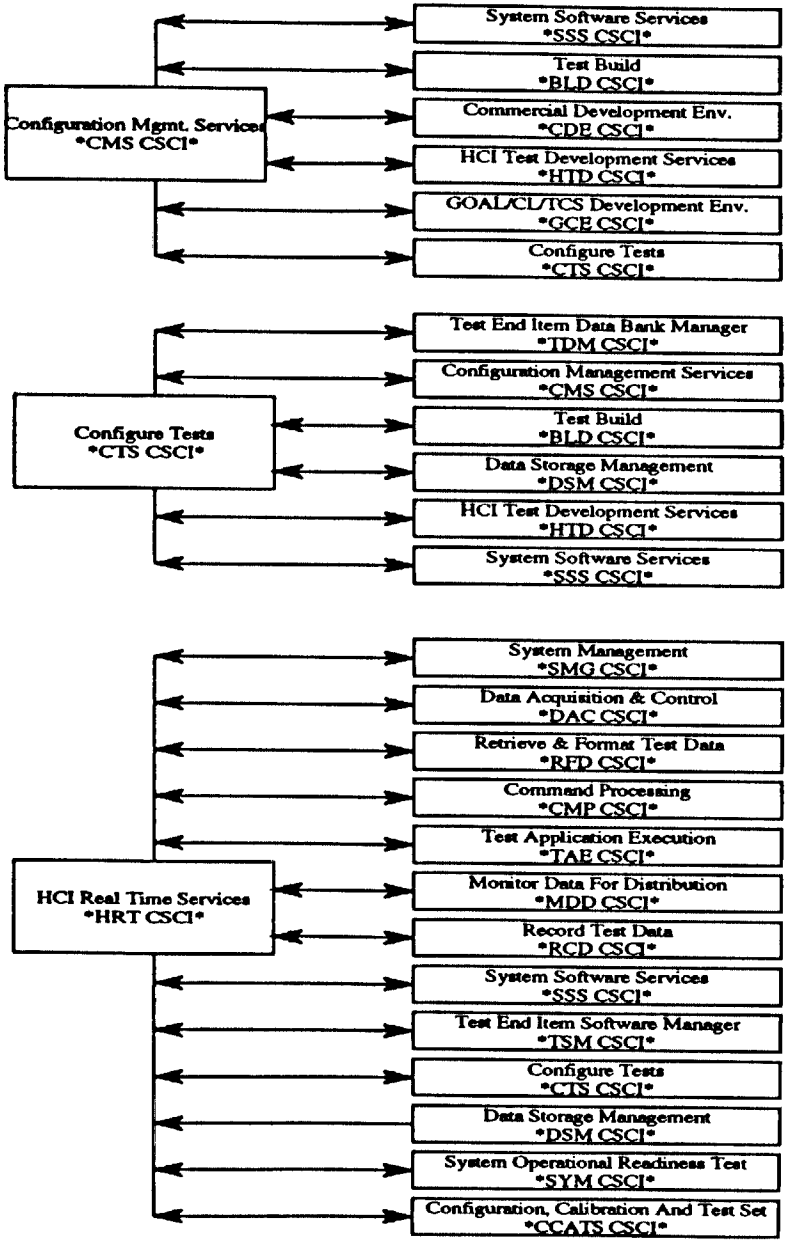

TEI Database Manager
TDM CSCI
HCI Test Development Services
HTD CSCI
CCMS-II Bulk Input
CBI CSCI
System Software Services
SSS CSCI
Link Configuration Database Manager
LDM CSCI
Core Program CSCIs
Data Storage Management
DSM CSCI
Data Storage Management
DSM CSCI
System Software Services
SSS CSCI
Data Acquisition and Control
DAC CSCI
Core Program CSCIs
Retrieve & Format Test Data
RFD CSCI
System Management
SMG CSCI
System Software Services
SSS CSCI
Command Processing
CMP CSCI
Test Application Execution
TAE CSCI
Test End Item Software Manager
TSM CSCI
Monitor Data For Distribution
MDD CSCI
HCI Real Time Services
HRT CSCI
Data Storage Management
DSM CSCI
Central Data Subsystem-(CCMS)
CDS CSCI

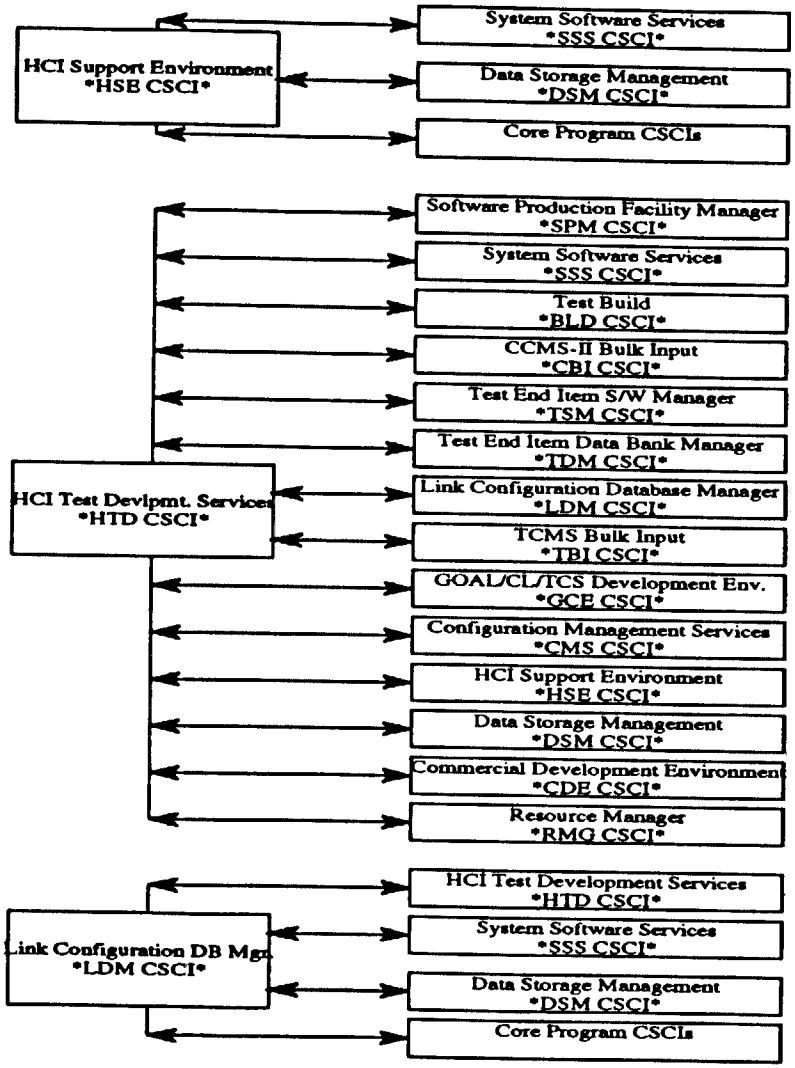

System Management
SMG CSCI
Data Acquisition & Control
DAC CSCI
System Software Services
SSS CSCI
Command Processing
CMP CSCI
Test Application Execution
TAE CSCI
Retrieve and Format Test Data
RFD CSCI
Record Test Data
RCD CSCI
HCI Real Time Services
HRT CSCI
Network Manager
NMG CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
Configure Tests
CTS CSCI
System Management
SMG CSCI
Data Acquisition & Control
DAC CSCI
Test Build
BLD CSCI
Command Processing
CMP CSCI
Test Application Execution
TAE CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
HCI Real Time Services
HRT CSCI
Network Manager
NMG CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI

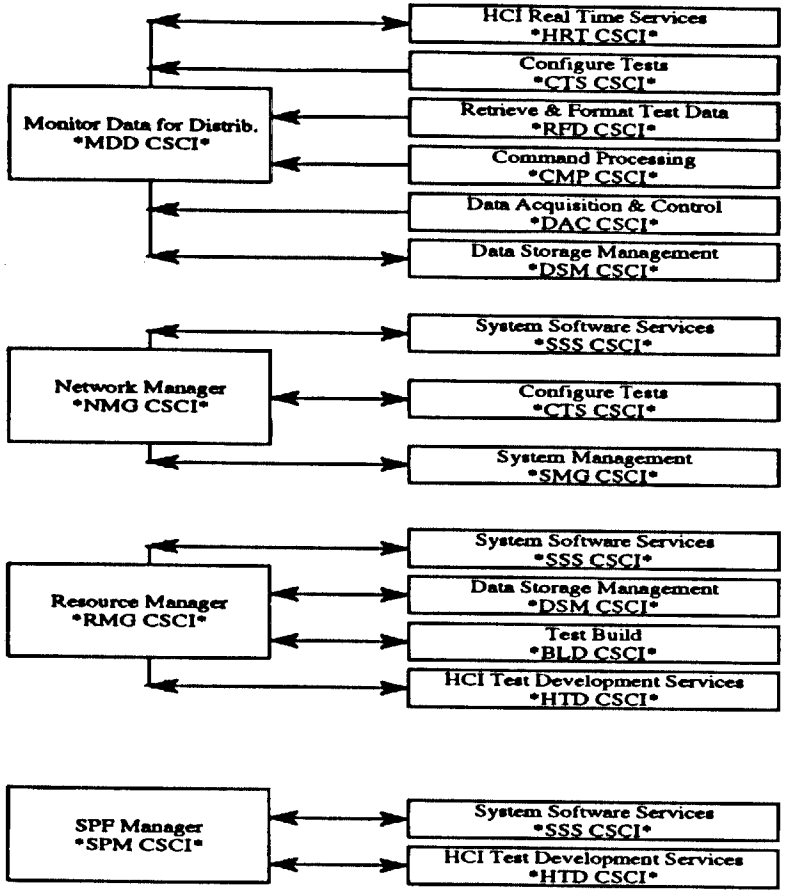

Record Test Data
RCD CSCI
System Management
SMG CSCI
Configure Tests
CTS CSCI
System Software Services
SSS CSCI
Data Acquisition & Control
DAC CSCI
Command Processing
CMP CSCI
HCI Real Time Services
HRT CSCI
Data Storage Management
DSM CSCI

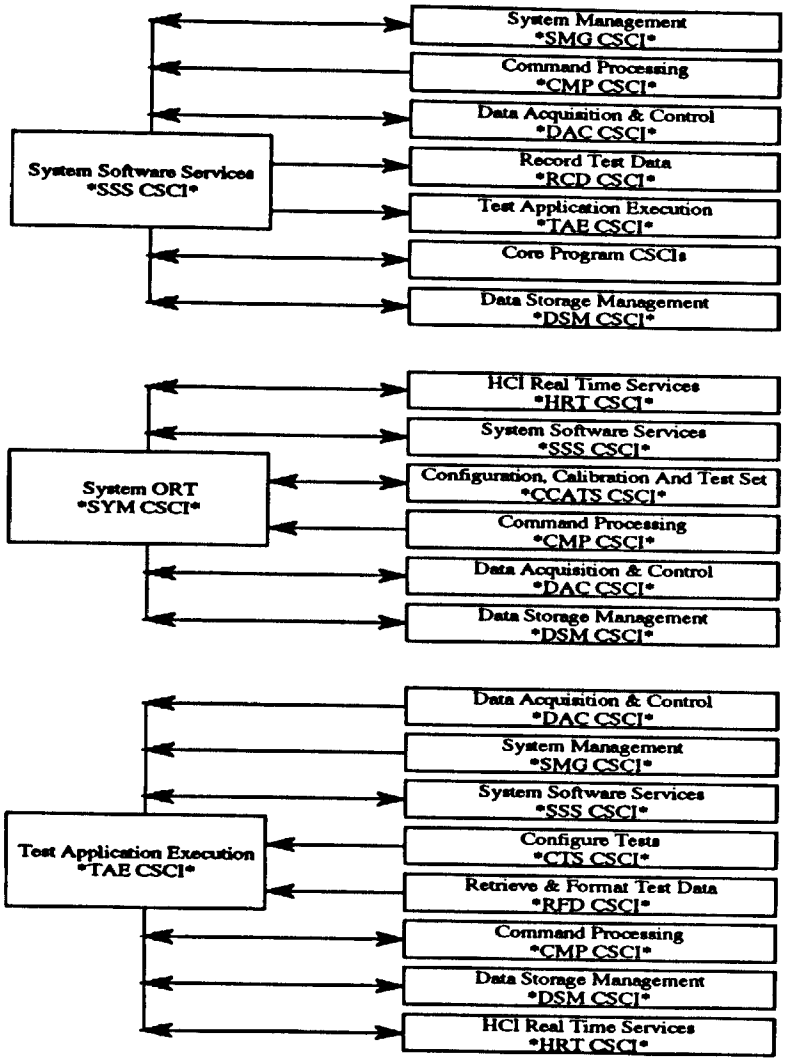

Command Processing
CMP CSCI
System Software Services
SSS CSCI
Data Acquisition & Control
DAC CSCI
Retrieve and Format Test Data
RFD CSCI
Test End Item S/W Manager
TSM CSCI
Test Application Execution
TAE CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
HCI Real Time Services
HRT CSCI
Core Program CSCIs
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
System ORT
SYM CSCI

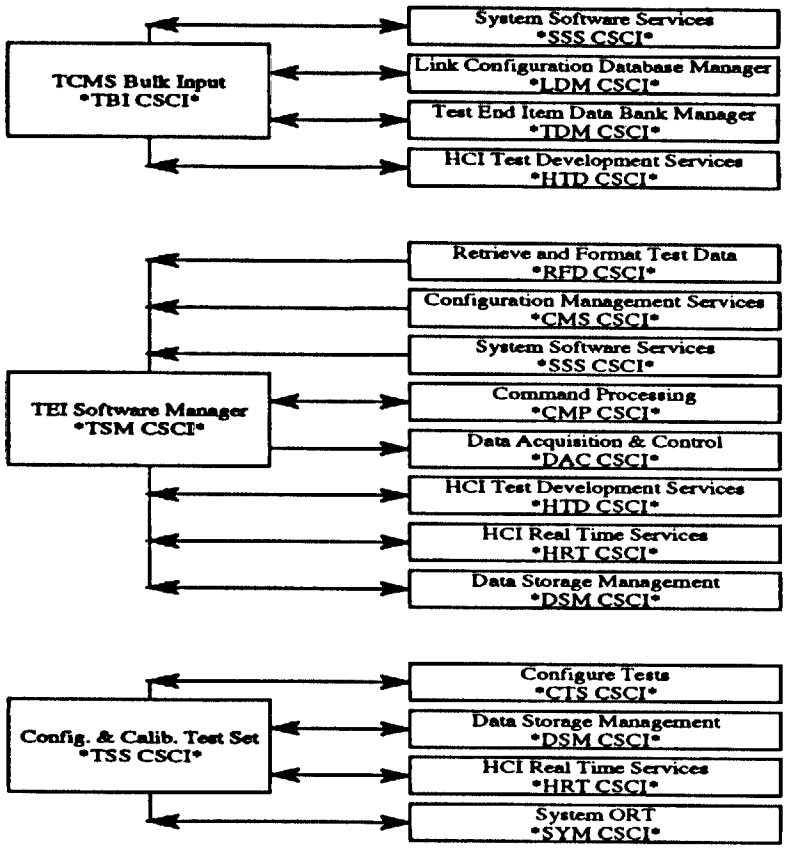

Test End Item Data Bank Manager
TDM CSCI
Configuration Management Services
CMS CSCI
System Software Services
SSS CSCI
Test Build
BLD CSCI
Link Configuration Database Manager
LDM CSCI
Core Program CSCIs
HCI Test Development Services
HTD CSCI
Data Storage Management
DSM CSCI
GOAL/CL/TCS Development Env.
GCE CSCI
System Software Services
SSS CSCI
CCMS-II Bulk Input
CBI CSCI
Link Configuration Database Manager
LDM CSCI
Test End Item Data Bank Manager
TDM CSCI
HCI Test Development Services
HTD CSCI
System Software Services
SSS CSCI
Commercial Devlpmnt. Env.
CDE CSCI
Test End Item Data Bank Manager
TDM CSCI
Configuration Management Services
CMS CSCI
HCI Test Development Services
HTD CSCI
Data Storage Management
DSM CSCI


Configuration Mgmt. Services
CMS CSCI
System Software Services
SSS CSCI
Test Build
BLD CSCI
Commercial Development Env.
CDE CSCI
HCI Test Development Services
HTD CSCI
GOAL/CL/TCS Development Env.
GCE CSCI
Configure Tests
CTS CSCI
Configure Tests
CTS CSCI
Test End Item Data Bank Manager
TDM CSCI
Configuration Management Services
CMS CSCI
Test Build
BLD CSCI
Data Storage Management
DSM CSCI
HCI Test Development Services
HTD CSCI
System Software Services
SSS CSCI
HCI Real Time Services
HRT CSCI
System Management
SMG CSCI
Data Acquisition & Control
DAC CSCI
Retrieve & Format Test Data
RFD CSCI
Command Processing
CMP CSCI
Test Application Execution
TAE CSCI
Monitor Data For Distribution
MDD CSCI
Record Test Data
RCD CSCI
System Software Services
SSS CSCI
Test End Item Software Manager
TSM CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
System Operational Readiness Test
SYM CSCI
Configuration, Calibration And Test Set
CCATS CSCI


HCI Support Environment
HSB CSCI
System Software Services
SSS CSCI
Data Storage Management
DSM CSCI
Core Program CSCIs
HCI Test Devlpmt. Services
HTD CSCI
Software Production Facility Manager
SPM CSCI
System Software Services
SSS CSCI
Test Build
BLD CSCI
CCMS-II Bulk Input
CBI CSCI
Test End Item S/W Manager
TSM CSCI
Test End Item Data Bank Manager
TDM CSCI
Link Configuration Database Manager
LDM CSCI
TCMS Bulk Input
TBI CSCI
GOAL/CL/TCS Development Env.
GCE CSCI
Configuration Management Services
CMS CSCI
HCI Support Environment
HSE CSCI
Data Storage Management
DSM CSCI
Commercial Development Environment
CDE CSCI
Resource Manager
RMG CSCI
Link Configuration DB Mgt
LDM CSCI
HCI Test Development Services
HTD CSCI
System Software Services
SSS CSCI
Data Storage Management
DSM CSCI
Core Program CSCIs


Monitor Data for Distrib.
MDD CSCI
HCI Real Time Services
HRT CSCI
Configure Tests
CTS CSCI
Retrieve & Format Test Data
RPD CSCI
Command Processing
CMP CSCI
Data Acquisition & Control
DAC CSCI
Data Storage Management
DSM CSCI
Network Manager
NMG CSCI
System Software Services
SSS CSCI
Configure Tests
CTS CSCI
System Management
SMG CSCI
Resource Manager
RMG CSCI
System Software Services
SSS CSCI
Data Storage Management
DSM CSCI
Test Build
BLD CSCI
HCI Test Development Services
HTD CSCI
SPF Manager
SPM CSCI
System Software Services
SSS CSCI
HCI Test Development Services
HTD CSCI


System Software Services
SSS CSCI
System Management
SMG CSCI
Command Processing
CMP CSCI
Data Acquisition & Control
DAC CSCI
Record Test Data
RCD CSCI
Test Application Execution
TAE CSCI
Core Program CSCIs
Data Storage Management
DSM CSCI
System ORT
SYM CSCI
HCI Real Time Services
HRT CSCI
System Software Services
SSS CSCI
Configuration, Calibration And Test Set
CCATS CSCI
Command Processing
CMP CSCI
Data Acquisition & Control
DAC CSCI
Data Storage Management
DSM CSCI
Test Application Execution
TAE CSCI
Data Acquisition & Control
DAC CSCI
System Management
SMG CSCI
System Software Services
SSS CSCI
Configure Tests
CTS CSCI
Retrieve & Format Test Data
RFD CSCI
Command Processing
CMP CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI


TCMS Bulk Input
TBI CSCI
System Software Services
SSS CSCI
Link Configuration Database Manager
LDM CSCI
Test End Item Data Bank Manager
TDM CSCI
HCI Test Development Services
HTD CSCI
TEI Software Manager
TSM CSCI
Retrieve and Format Test Data
RFD CSCI
Configuration Management Services
CMS CSCI
System Software Services
SSS CSCI
Command Processing
CMP CSCI
Data Acquisition & Control
DAC CSCI
HCI Test Development Services
HTD CSCI
HCI Real Time Services
HRT CSCI
Data Storage Management
DSM CSCI
Config. & Calib. Test Set
TSS CSCI
Configure Tests
CTS CSCI
Data Storage Management
DSM CSCI
HCI Real Time Services
HRT CSCI
System ORT
SYM CSCI

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