SPERRY UNIVAC

188

PRODUCT DESCRIPTION
Summary Sheet

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UTS 4000 (UTS 400 Mode) Cluster Controller Product Software Description

PERFORMANCE OBJECTIVES

This software product is intended to provide the functionality which allows the UTS 4000 to operate as a UTS 400 compatible terminal system. Primary objectives of the product are to maintain UTS 400 compatibility while providing functional enhancements and increased cluster sizes at lower cost. User programmability is to be provided via COBOL.

ABSTRACT

This Product Software Description (PSD) defines the system control software, UTS 4000 mode program product, for UTS 4000 cluster controllers. When equipped with this program product, a UTS 4020 or UTS 4040 cluster controller and its attached workstations (either the UTS 20W or UTS 40W) provide a follow-on product for the UTS 400 intelligent terminal system.

Software described in this PSD consists of two system control programs, T6180-00 and T6180-01, which are released as separate programs products. T6180-00 supports the functionality described for a UTS 4020 Cluster Controller and T6180-01 supports the functionality described for a UTS 4040 Cluster Controller.

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RELATED SPECIFICATIONS AND STANDARDS

R-50223	UTS 4000	Product Family Description
R-50224	UTS 4000	Cluster Controller Product Description
S500 E 000	Content and Format for a System Product Description	

NOTES, UNUSUAL REQUIREMENTS, UNIQUE CHARACTERISTICS

APPROVALS

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1 INTRODUCTION

1.1 SCOPE

This Product Software Description (PSD) defines the system control software, UTS 400 mode program product, for UTS 4000 cluster controllers. When equipped with this program product, a UTS 4020 or UTS 4040 cluster controller and its attached workstations (either the UTS 20W or UTS 40W) provide a follow-on product for the UTS 400 intelligent terminal system. In addition to supporting the features, protocols, user program interfaces, and operational procedures of the UTS 400, the UTS 4000-based system offers selected enhancements in adaptability to a wider range of customer requirements.

The UTS 400 mode program product operates in an environment established jointly by the hardware and the loadable microcode. Required microcode is defined in separate CPSDs and is not within the scope of this PSD. The UTS 4000 family also includes various models of single stations that are not included within the scope of this PSD.

Certain members of the UTS 4000 will support attachment to public data networks. Such support, even if implemented with the UTS 400 mode program product for cluster controllers, is not included in this PSD. A separate CPSD on PDNs will address the topic, and any additions required in this PSD will be put in by RPDC (Request for Product Description Change) at that time.

1.2 PURPOSE

The purpose of this PSD is to serve as a controlling document for software development of a UTS 400-mode program product operating on the UTS 4000 Cluster Controller, including features that represent enhancements over the UTS 400 baseline. New elements may be added to this PSD (to cover added functionality) after it has been approved by using the RPDC method.

Software described in this PSD consists of two system control programs, T6180-00 and T6180-01, which are released as separate program products. T6180-00 supports the functionality described for a UTS 4020 Cluster Controller and T6180-01 supports the functionality described for a UTS 4040 Cluster Controller.

2 PRODUCT REQUIREMENTS

2.1 TERMINAL FAMILY

Operating in UTS 400 mode, the UTS 4020 and UTS 4040 cluster controller with System Control software and workstations (the UTS 20W and UTS 40W) constitute a family of terminal systems. This new family builds on the functionality of the

UTS 400 by providing a way for the UTS 400 customer to move user programs onto larger systems with increased functionality and more cost-effective display stations for clusters of six or more workstations. Within this family, a UTS 4020 with workstations represents a basic system for effective clustering of interactive terminals to a host processor. At the high end, a UTS 4040 with UTS 40W workstations, high-speed printers, and diskette peripherals represents a more powerful capability that can be useful even when offline from the host. Throughout this range, compatibility is maintained. Since this family is built upon a new technology hardware base and employs loadable microcode for the basic functionality, it is possible to adapt to a wide variety of customer requirements without changes to the hardware.

2.2 HOST COMPUTER IMPACT

The UTS 4000 cluster is required to operate with 1100 Series and Series 90 hosts with or without TELCON networks, in the same manner that these processors work with the UTS 400. In fact, any processor that supports the UTS 400 with feature F2999 is capable of supporting the UTS 4000 in UTS 400 mode. Feature F2999 for the UTS 400 provided host communication including character protection compatible with prior products. Minor changes are required to host software or user programs to allow full support of the new capabilities made possible by the UTS 4000 System.

2.3 COMMUNICATION CONFIGURATIONS

Using the UTS 400 mode of operation, a UTS 4000 cluster is compatible, from a communciations standpoint, with the UNISCOPE 100 and 200 Display Terminals as well as the UTS 400. A UTS 4000 cluster can be mulitdropped or multiplexed along with these terminals communicating with the host processor.

2.4 EARLY ACCESS TO NEW TECHNOLOGY

Through the use of UTS 400 mode on a UTS 4000 cluster, the customer is allowed to have immediate access to a product of new technology, directly supplementing or replacing his existing products at low cost and with little or no impact to his current system.

Inherent with this new technology are improvements in ease of installation, maintenance, reliability, and human factor considerations. In additon, this new hardware base will be capable of supporting the Distributed Communications Architecture (DCA) through new software and loadable microcode.

3 DESIGN TRADE-OFFS AND PRODUCT OBJECTIVES

3.1 DESIGN TRADE-OFFS

3.1.1 Compatibility

Since host compatibility with UTS 400 is required, some of the additional features provided in UTS 400 mode are available to the terminal operator and to user programs, but are not visible to the host communications systems software. Examples include support of named files and file/device assignment.

3.1.2 Product Cost

The requirement to provide a low-cost terminal family has resulted in simplified capabilities in the low end of the UTS 4000 family. The basic hardware features and software capabilities have been selected to meet these product cost objectives with additional features available as extra cost options. Program products are modular in nature and subject to separate pricing so that a customer may purchase only what he needs for his application environment.

3.1.3 Ease of Installation

A UTS 4000 system, including many of the peripheral devices, can be installed and configured by untrained individuals through customer set-up (CSU) provisions.

The software used in the UTS 4000 cluster controller is loadable, making it possible to change or add software elements without requiring changes to the hardware or other intervention by Univac support personnel. The integral load device (ILD) provides the loading capability, while a system configuration utility allows a user to tailor the system software to his configuration requirements.

3.2 PRODUCT OBJECTIVES

One of the primary product objectives is to provide a terminal system that complements Sperry Univac host processors. The product is intended primarily for online application with Sperry Univac host products in both U.S. domestic and international markets.

3.2.1 UTS 400 Compatibility

An objective met by the UTS 4000 System is to provide a functionality which is UTS 4000 compatible with respect to:

- UTS COBOL user programs
- Communications protocol
- Operational procedures
- Diskette media
- Printer support

3.2.2 Migration Ability

Migration from UTS 400 to UTS 4000 is facilitated through support of the same diskette files, control page capabilities, user programs, and 8-bit peripherals (excluding the 250 kilobyte diskette drive) which are used by the UTS 400 System. The UTS 400 diskette media for TCS-formatted diskettes is transferable between the UTS 400 and UTS 4000 systems. The Sperry Univac terminal product objectives pertinent to migration that are met by UTS 400 mode include the following:

- Low-cost UNISCOPE 100 or 200 display terminal replacement
- Low-cost UTS 400 replacement
- COBOL user programmability transition

3.2.3 Ease of Use

The UTS 4000 System is designed to improve ease of use for terminal system operations, both online and offline, using programmable and nonprogrammable capabilities. (These capabilities are defined in Sections 4.2.6 and 4.2.7, respectively, in this PSD.) Customers do not need a knowledge of programming to accomplish nonprogrammable tasks on the UTS 4000 system. Operating procedures for each of these functional areas (file manipulation, display control, host computer interaction, and so forth) are provided by user documentation.

3.2.4 System Software Modularity

UTS 4000 cluster controller system software has been designed to be modular, thus allowing one or more modules to be changed without affecting the others. A set of modules loaded into a cluster controller is tailored to those required for support of the configuration in use, thus allowing more space for user programs. Basic system modules developed for UTS 400 mode will also be used in the DCA/DDP mode (or native mode) of operation to reduce development time and

to preserve as much system software as possible between the UTS 400 mode and the later, more sophisticated DCA/DDP mode. The software is configurable to enable any additions or deletions required to reflect evolution of the hardware.

3.2.5 Performance Improvement

The UTS 4000 System offers an improved cost/performance ratio over the UTS 400 and simultaneously provides hardware and software enhancements. Some of the factors which are responsible for this overall system improvement include distributed workstation functionality, faster microprocessors, and intelligent line modules. Unlike the UTS 400 units where each workstation shares the same firmware in the master workstation or controller, UTS 20W and UTS 40W workstations are loaded with their own microcode; thus, their internal functions do not interrupt the central processor. The microprocessors used in the UTS 4000 family of products are twice as fast as those used with the UTS 400. Intelligent line modules internal to the cluster controller are allocated to specific functions, reducing processing cycles required by the central processor of the system to support communications.

3.2.6 Expanded User Memory

A UTS 4000 cluster controller provides more memory for user programs than is available on the UTS 400 and allows multiple user programs to be resident and capable of simultaneous execution. The increased amount of memory permits the cluster controller to govern more workstations than a UTS 400 System.

3.2.7 UTS 4000 Family Enhancements

The UTS 4000 with a UTS 400 mode program product provides several capabilties not found on the UTS 400, including the following:

- Device Assignment. Peripheral device and file assignment provide multiple- as well as single-user access to files or devices.
- Multiple Files per Device. The UTS 4000 System software provides multiple files per diskette device.
- Multiple Programs. The UTS 4000 allows multiple user programs to operate in the cluster controller.
- Loadable Character Sets. Loadable character sets permit the customer to generate and load a unique character set and to select between it and the standard character set.

- Program Protection. Memory allocation and protection of user programs is provided by system software through utilizing provisions of the cluster controller architecture.

- User Protection. Security keylocks are provided to prevent unauthorized use of the terminal and to control the ability to change configuration parameters.

- System Software Protection. User programs are prevented from accessing system software memory areas and from accessing system software on the ILD.

3.2.8 User Programmablity

User programs are supported which are written in the UTS COBOL language. Assembly-level user programming is not supported on the UTS 4000. With a knowledge of the UTS 400 and with COBOL programs written for the UTS 400, a customer is able to advance to the UTS 4000 system with his existing COBOL programs. The user interfaces remain consistent from one system to the next; however, minor changes may be required to identify the UTS 4000 system, and recompilation is necessary. While UTS 400 user programs in UTS COBOL may be adapted, the UTS 4000 System does not support user programming in PL/M or MAC80.

4 FUNCTIONAL CHARACTERISTICS

4.1 SYSTEM OVERVIEW

The overview describes a system composed of hardware, microcode, and software which allows an operator the necessary flexibility to manage job requirements and provides assistance to accommodate processing needs.

4.1.1 Hardware Overview

The UTS 4000 family of hardware permits a wide variety of terminal system configurations. This section defines the hardware elements that are supported by the system control software.

4.1.1.1 Cluster Controller

The UTS 4000 family of products includes two models of software-compatibile cluster controllers: the UTS 4020 and the UTS 4040, the latter being an extension of the former. The UTS 4040 permits more workstations and peripherals to be configured and has a greater memory expansion capability. In terms of processing power, the UTS 4040 is approximately twice that of the UTS 4020.

Both cluster controllers offer compatible macroarchitectures and support the same software programs oriented to the general-purpose, interactive, terminal system environment.

The UTS 4020 is designed to be effective as a controller of a cluster containing three to twelve workstations; the UTS 4040, however, may be configured with as many as 31 workstations. Both models of cluster controller are capable of supporting user programs, and the peripheral devices configured into the system may be shared among the workstations in the cluster.

Peripheral units may be attached directly to the cluster controller; however, some of the smaller peripherals may be connected to the workstations. Each of these peripherals may be shared (similar to the UTS 400 method), or each may be exclusively assigned to a given workstation. They are managed by the cluster controller system control software and are accessible from any workstation in the cluster or from the host processor.

System software and microcode is loaded from a diskette in the integral load device (ILD). Customer Engineering personnel may use the ILD to load diagnostic programs from their own diskette media.

4.1.1.2 Workstations

Two models of workstations are available: the UTS 20W and the more powerful UTS 40W. These two models are identical in their physical size and shape; however, the UTS 40W is much more capable of being expanded and has more features available.

Both models of workstations are microprocessor-based devices and derive their functionality from microcode loaded into the workstation random-access memory (RAM) from the cluster controller. Each workstation is connected to the cluster controller and is dependent upon the controller for communications to the host processor as well as for access to any peripheral device. There are four different keyboards available.

4.1.1.3 Peripherals and Auxiliary Devices

The peripherals supported by the cluster controller software are:

- Type 0774 Model 800 Terminal Printer
- Type 0786 Printer Subsystem
- Type 0789 300-LPM Printer
- Type 0789 600-LPM, High-Speed Printer

- Type 0791 Correspondence Quality Printer
- Type 0797 Printer Subsystem
- Type 0798 Printer Subsystem
- Type 8406-04/-07 1-Megabyte, Dual-Density Diskette Drive

The UTS 40W workstation permits one diskette controller (with a maximum of two drives) and/or one printer to be attached through an 8-bit peripheral interface. The UTS 20W, however, supports an output-only, RS-232C, bit-serial interface which allows attachment of one printer, either the Type 0798 or 0797.

The magnetic stripe reader auxiliary device is supported on both workstations.

4.1.1.4 User Hardware Considerations

User programs are executed in the cluster controller memory by the cluster controller processor. User programs may be downline loaded from the host computer to the cluster controller, or they may be optionally written on a diskette and later loaded into the cluster controller.

The peripherals attached to a cluster controller or workstation are supervised by the cluster controller system software. As such, these peripherals can be shared among the various user programs or workstation operators. The host configuration does not need to support this type of device sharing and is not aware that peripheral devices are shared.

UTS 4000 clusters can be configured on Sperry Univac host and network processors as is currently being done with UTS 400 terminals. UTS 4000 clusters can be multidropped/multiplexed with existing UTS 400 terminals as well as UNISCOPE 100 and 200 display terminals on the same communications line.

4.1.2 System Software Overview

The system software provides facilities to the operator which allow various system components to be used. A system supervisor is available to coordinate the use of these components. Additional software components are provided for particular functions, such as communication and resource management.

4.1.2.1 Cluster Controller System Control Software

The UTS 4000 cluster controller system software provides operational access for the operator and coordinates hardware and software resource use. Software modules are implemented in a high-level language, where appropriate, or an

assembly language, where needed, to make the system more operationally efficient. The system control software provides control over all hardware and software components as well as user programs, allowing access according to priorities, requests, and configurations. The basic software components are listed below:

- o System Supervisor -- which provides general management of the system operation. All activities within the cluster controller are managed through the system supervisor. Requests for use of system components are evaluated, prioritized, and initialized through the supervisor facilities.

- o Resource Management -- which provides control and coordination of all peripheral usages including requests for peripheral assignment and management of the data stored or transferred to or from peripherals. This is accomplished by the following components:

  - File and device control
  - Control page handler
  - Peripheral handlers for diskettes and printers

- o Communications Support -- which directs and coordinates all external transfers of data to or from the cluster controller. The support consists of communications between:

  - Cluster controller and workstation
  - Cluster controller and host processor

- o System Utilities -- which provide the following capabilities:

  - System configuration. This allows the customer to configure the terminal system and modify changeable operating parameters.
  - System diskette. This utility provides field support capability for system software released on diskettes.
  - File utility. This facilitates maintenance support for file-formatted media.
  - -- Memory dump and print

Software interfaces for system supervisor, resource management, and communications support components are further defined in the UTS 4000 Cluster Controller Programming Interface CPSD (C-43401). Operator interfaces for these three components are further defined in the UTS 4000 Operator Interface in UTS 400 Mode CPSD (C-41411) The system configuration utility is defined in the

UTS 4000 Cluster Controller Configurator and Off Line Utilities CPSD (C-47401). The file utility is described in the UTS 4000 Cluster Controller Utilities CPSD (C-47406).

4.1.2.2 Microcode Interfaces

The hardware functionality is provided by microcode which operates in the cluster controller, cluster controller line modules, and workstations. The microcode for the cluster controller, line modules, and workstations is loaded during the system load and initialization process. Since the microcode provides a basic system interface for software operation, it is briefly identified below. The basic elements of the microcode are:

o Workstation Microcode. This is a microcode module that responds to commands from the cluster controller. The microcode is able to perform functions independently from the cluster controller to provide:

- Workstation control
- Cluster controller interface
- Display management
- Keyboard control
- Peripheral handling
- Loadable character set control

Separate microcode is required for the UTS 20W and UTS 40W workstations, and a system loading process will determine the appropriate load requirements. Differences between workstation models can be summarized by the following:

- Field Control Characters. FCC functionality is supported on the UTS 40W as a standard item. The FCC functionality on the UTS 20W workstation does not include blank.

- RS232C Interface and Printer. The UTS 20W workstation supports a low-cost impact printer on an RS232C interface. The UTS 40W does not.

- Eight-Bit Peripheral Interface. The 8-bit peripheral interface is supported on the UTS 40W, but not on the UTS 20W.

- Loadable Character Set. The loadable character set feature is provided only on the UTS 40W.

- Screen Bypass. Screen bypass is supported only on the UTS 40W. Each screen bypass that is configured will count as a workstation on the workstation interface, thus reducing by one the physical workstations for that interface.

- Line Module Microcode. Line module microcode provides the interface to any device or communication operation external to the cluster controller hardware. The following line modules are provided and are identical for both the UTS 4020 and UTS 4040:

  - Host and network communications
  - Workstation interface
  - Integral load device
  - 8-bit bidirectional byte interface

- Cluster Controller Microcode. Microcode is provided in the cluster controller to support I/O interfaces and macroinstruction execution. The facility for power-on confidence tests and bootstrap loading is also provided. Different microcode is required for the UTS 4020 and UTS 4040 because of the machine characteristics. The load and error reporting processes on each controller are identical for customer use.

The relationship of software to microcode is illustrated with Figure 4.1.2.2.1.

4.1.2.3 User Program Interfaces

The term "user program," as used in this document, refers to the use of programming facilities provided by system software for special customer applications. These facilities allow execution of program products released for use on the UTS 4000. Program products, or UTS COBOL programs prepared by the customers, execute in the cluster controller within the memory and configuration constraints of the hardware (as defined in each program product document). These programs have access to the system supervisor, communication, and resource management components. Using these facilities, access is available for selected data from and to the workstation keyboards and displays, host communications, the peripherals on the cluster controller, and workstation peripherals. When a program is active for a workstation, any data designated for that workstation is provided to the program which has complete responsibility for disposition of that data.

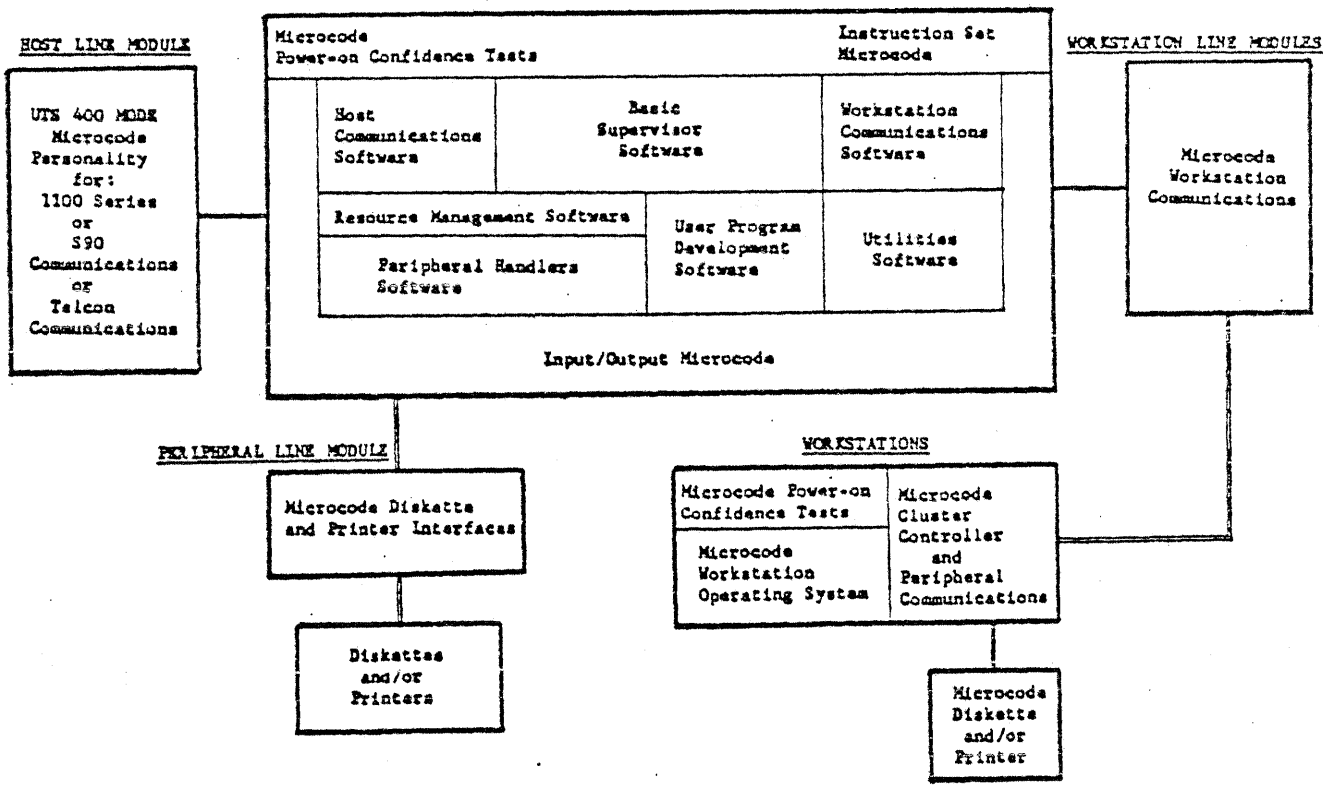

Figure 4.1.2.2.1 Software/Microcode Relationship

A user program may be reentrant, allowing any number of workstations within a given cluster to use it. The workstation operator may select a specific user program to control his individual terminal, or the operator may elect to communicate directly with the host without user program intervention. Multiple user programs may reside in the cluster controller.

UTS COBOL is the only programming language provided for customer use. Customer programs are compiled on a host system and subsequently downline loaded to the cluster controller.

The system supervisor provides protection for the operation of user programs as well as user data. Each user program is allowed to have visibility only to the program and data areas designated for its use. A user program that makes reference outside of its area of control is terminated by the system software. File access is limited to files that are identified for a particular program operation by the operator.

4.2 TERMINAL SYSTEM USAGE

4.2.1 Basic Operations

The UTS 4000 hardware/software structure allows a user having limited programming knowledge to produce an operational system. The following functionality is basic to both online and offline usage of the system.

4.2.1.1 Workstations

Two models of workstations are available for UTS 4000 cluster systems: the UTS 20W and the UTS 40W. A total of up to 12 workstations in any combination are supported on the UTS 4020 cluster controller; for the UTS 4040, 31 are supported. The workstations are addressed internally in the UTS 4000 cluster controller by line module and workstation interfaces.

4.2.1.1.1 Keyboard Support

Four different keyboards are available for the two workstations:

- Model A: a 70-key, typewriter-style, ISO-standard keyboard
- Model B: a 94-key, typewriter-style, ISO-standard keyboard with numeric and function keypads
- Model C: a 113-key, Katakana/English, ANSI-standard keyboard with numeric and function keypads

- Model D: a 113-key, typewriter-style, ANSI-standard keyboard with numeric and function keypads (similar to the UTS 400 keyboard)

The key layouts for these keyboards are depicted in Figures 5.1.2-1, 5.1.2-2, 5.1.2-3, and 5.1.2-4, respectively. Further details on these keyboards are available in the product description entitled UTS 4XX Product Family, (R-50223).

A magnetic stripe reader, available for both workstations, inputs data through the keyboard interface of the workstation. Magnetic stripe data is displayed concurrently with the transmission to the cluster controller by use of a control page parameter field entry for the UTS 20W and by a parameter field entry or FCC intensity entry for the UTS 40W workstation. A selection option is available to suppress or display the data at the workstation.

4.2.1.1.2 Master Workstation

Each cluster controller has one of the workstations available as a "master workstation." This console-like functionality is achieved by connecting workstation "1" to line module position "0". Control operations which affect the basic system configuration and operation are allowed through the master workstation, but are inhibited through all other workstations. Unlocking a built-in security keylock enables the master workstation functionality; however, when this keylock is locked, the master workstation behaves like any other workstation in the cluster.

The operations specifically allowed only at the master workstation are:

- System load and initialization
- Initial configuration
- Reconfiguration

4.2.1.1.3 Security Keylock

The UTS 4000 workstations can be equipped with a keylock used to restrict access to configuration-related information. The cluster terminal system requires that the master workstation be equipped with a security keylock. If the keylock is turned off or is not installed in a workstation designated as Master, the user is prevented from using the workstation to change system configuration. For workstations other than the master workstation, the keylock is used to control access to workstation parameterization using the control page. If there is no keylock, the parameters can only be changed during the system configuration process. Details concerning the parameters are documented in CPSD C-41411, UTS 4000 Operator Interface in the UTS 400 Mode.

4.2.1.1.4 Loadable Character Set

A loadable character set capability on the UTS 40W provides up to 256 customer-definable, dot-matrix characters. This set may be used to supplement the standard character set. The standard character set and a loadable character set can be active at the same time, thus allowing shared usage. Use of a default condition during shared usage will always reference the standard character set.

4.2.1.2 System Diskette

The cluster controller microcode and software is loaded from a diskette utilizing the ILD. This diskette contains all system elements necessary to operate the terminal cluster. System elements on the diskette include:

- Cluster controller microcode
- Line module microcode
- Workstation microcode
- System software
- Available space for configuration tables
- Error log

This diskette is strictly for the terminal system program product with space left, as required, for system tables as well as other program products released for use with this system. The customer is precluded from using this diskette for his user programs or data storage.

4.2.1.3 System Loading

The system loading process is structured to require minimal operator assistance. All of the microcode and software needed to implement this process is contained on the system diskette. After starting the procedure, operator interaction consists of responding to displayed prompts which either report errors or request data about the configuration. If the master workstation keylock is not enabled, system loading will occur automatically without soliciting operator interaction.

4.2.1.4 System Configuration

The system configuration process is implemented through a software module contained on the system diskette. The configuration module interfaces with the

operator through queries. By answering the questions displayed, the operator inputs information needed to establish the required configuration. Configuration tables are created and maintained on the system diskette and reflect the latest configuration entries for subsequent system reference.

4.2.2 Control Page

The control page is an array of control and status information stored in a dedicated location of memory. It is presented to an operator in form of a two-line display and is used in conjunction with several of the peripheral interface function keys to control transfer of data to and from the peripherals and to control the type of transmission from the cluster controller to a host processor. Information entered by the operator in the control page fields is not recognized by the system control software until the control page is removed from display. Once a function is defined in the control page, that function will be performed each time the appropriate key (XMIT, XFER, BOB, PRINT, REP ADR, SEARCH, or STATUS) is pressed.

The control page is the only direct operator interface to system software during operation of the terminal. Utilities and user programs provide an additional indirect interface. The following functions are provided by the control page:

- Peripheral/device selection
- File selection
- Transmission type (data transmission to host)
- Transfer type (data transfer to peripheral)
- Peripheral status
- Report address
- Command initiation
- Maintenance status
- Search operation
- Workstation address
- Set-up parameters for workstation
- User program load and initialization

o Record separator

An operator calls the control page display to the screen with the CONTROL PAGE key. When the control page is displayed, any data present on the corresponding display lines is shifted to temporary storage in memory. These lines are returned to the display when the control page is removed from the screen, or "stored." The operator has the selection option of which display lines are to be used for the control page.

4.2.2.1 Access To Files and Peripherals

File and peripheral access using the UTS 4000 control page is accomplished compatible with the UTS 400 control page (for the UTS 400/TCS-type operation). The file formatted enhancement of the UTS 4000 requires some modifications to the control page file and peripheral access. These modifications consist of special command enhancements and extensions to the peripheral references which allow use of file formatting. All files and peripherals must be assigned prior to use which is different from the UTS 400.

4.2.2.2 Identification of Files and Peripherals

File and peripheral naming capability is an enhancement for the UTS 4000 and allows a file-formatting capability. These files, as well as the peripherals, can be assigned with a label or name for reference in the file and peripheral operation. File naming is accomplished through specific control page fields.

4.2.2.3 User Program Initiation

UTS COBOL user programs may be initiated in one of two ways: either downline loaded from the host processor or loaded from a local diskette. If the program is downline loaded, it may be directed either to the cluster controller or to a local file for storage. Program product user programs may be loaded from a local diskette or ILD.

Host downline load procedures must be followed for the appropriate host program loading. Local program loading is accomplished by referencing the program name in the workstation control page. If the referenced program is already loaded into the cluster controller memory, the requesting workstation will be connected to it, thus assuring that only one copy of the same program is located in the cluster controller memory at the same time.

Multiple user programs, whether they are program products or user-generated UTS COBOL user programs, may be stored in memory and operating in the cluster controller at the same time depending on the resources of that terminal system.

4.2.3 Field Control Characters (FCCs)

Field control characters give the workstation operator several special controls over data fields. Field control characters cannot be generated by operators of workstations equipped with the Model A keyboard.

A field control character (FCC) defines characteristics of a field of one or more screen positions. The definition FCC is in the first field location and end of field is defined by the next sequential FCC or the end of screen, whichever comes first.

An FCC can be set for each screen location, thus allowing up to 80 FCCs per display line. Each FCC occupies a location in the memory of the workstation, but does not occupy a screen location. All screen positions are available for data. FCCs can be established by the host processor, user program, or by a workstation operator.

FCCs established by the host processor or user program are entered in the display text as defined in the UTS 400 Programmer's Reference Manual and the UTS COBOL Component Product Software Description.

The following operation control capability is available through FCCs:

- o Display Rendition, which allows choices of the intensity characteristics listed below:
  - Normal intensity
  - Alternate brightness (either reverse video or low intensity as selected through the control page)
  - Blank (where the characters in the field are not displayed) (Note: This is not supported on the UTS 20W workstation.)
  - Blink (where the display blinks between normal intensity and the alternate brightness)
- o Display Emphasis Features available on the UTS 40W, which include:
  - -- Column separator
  - Underscore
  - Strike-thru
- o Input Validations, which give these choices:
  - Protect (where no keyboard entry is allowed)

- Unprotected (where any keyboard entry is allowed)
- Alphabetic only (where only alphabetic and space characters are allowed)
- Numeric only (where only numeric and some punctuation characters are allowed)

o Field Justification (either normal [left] or right justified)

o Tab Stop

o Changed Field Indicator (where the FCC indicates whether or not the operator has changed data in that field)

The character protect (SO/SI) mode is supported to provide compatibility between the UTS 400 mode of UTS 4000 terminals, UNISCOPE display terminals and UTS 400 display terminals.

The communications capability of a basic cluster controller system is compatible with the UTS 400 character-protect mode and the UTS 400 FCC mode, as used by host software. It allows users of UNISCOPE display terminals to move up to a UTS 4000 system using SO and SI control codes, then convert those codes to the FCC equivalents. The user may operate in both SO/SI mode and FCC mode concurrently. When performing a "transmit unprotect" function (in the character protect mode), nonsignificant spaces at the end of each unprotected field are suppressed.

To provide UTS 400 compatiblity, the user may or may not set as many of the FCC bits as he needs on the basic machine. All FCC settings are supported on the communications link. The "BLANK" option (see above) is not supportable with UTS 20W hardware.

When UTS 400 FCC functionality is configured with the Katakana feature, the SO and SI control codes are used to affect the eighth data bit which invokes the Katakana character set. Thus, character protect mode and Katakana are mutually exclusive.

4.2.4 File Structure and Usage

There are two basic operating modes for files on the UTS 4000 system:

o UTS 400 compatible (TCS-formatted) mode

o File formatted

The TCS-style file formatting is identical to UTS 400 file support. Diskette media is transferable between the UTS 400 and the UTS 4000 system using this formatting.

File formatted operation provides for the following file structures:

- o Sequential
- o Relative

Multiple files may be stored on a diskette with the directory residing on the diskette itself. Resource Management uses the directory to provide the requested use of data files. A utility is provided for file maintenance functions; such as, PREP, COPY, and PACK. This utility is initiated through the control page user program operation. Files may be shared between the workstations and user programs; however, the software system controls accessing.

4.2.5 Peripheral Usage

The basic philosophy of the UTS 4000 operating environment is that all peripherals of the system may be made available to all workstations and user programs. However, system control of peripherals is based on the system configuration that specifies which workstations will have access to devices through their control pages. Local peripherals attached to a workstation are assigned and controlled by the cluster controller.

Printers are supported as sequential, write-only files by the file management process. The diskette is supported in the sequential read/write usage for TCS formats with sequential and relative for file formatting.

4.2.6 Online Usage

The UTS 4000 terminal system operates online to host processors, providing nonprogrammable and programmable capabilities. Implementation is through the UTS 400 host implementation for programmability and interactive communications.

4.2.6.1 Nonprogrammable Mode

A workstation can interact with host operating systems as an interactive terminal being driven through the UTS 400 protocol. The customer is not required to develop special UTS 4000 programs to accomplish this task.

A terminal system configuration is created to be compatible with the host configuration requirement. Communication with the host is through the RID-SID-DID addressing scheme which is recognized by the terminal system and translated

to internal addressing requirements. The workstation operator controls peripheral devices through the host/UTS 400 device control protocol. Host protocol allows peripheral and screen control using standard procedures that require no programming on the part of the customer for his use.

4.2.6.2 Programmable Mode

The UTS 4000 cluster controller may be loaded with user programs which can direct the terminal, peripheral, or host interaction. The user programs have access to selected data to or from the workstation under program control. UTS 4000 system software, in conjunction with host facilities, provides the capabilities for user program development and control of the terminal system resources.

- o User program development on host systems provides:
  - Source code creating and editing processes
  - UTS COBOL cross compiler
  - Collector
  - Downline load processor
- o Resource control, with or without host systems, provides:
  - File/device assignment
  - File manipulation
  - Keyboard and display control
  - Control page commands from host or cluster resident user programs
- o User program execution control provides:
  - Multiple user programs per cluster controller
  - Reentrant user program for multiple workstations
  - User program segment loading
  - User program activation and deactivation by workstation users
  - Symbolic COBOL interactive debugger

4.2.7 Offline Usage

A cluster controller, with the attached workstations, can operate in an offline mode. The system provides capability to execute in a nonprogrammable or programmable mode, or combinations of both.

4.2.7.1 Nonprogrammable Mode

The UTS 4000 provides capabilities which allow the user to operate his system in an offline, nonprogrammable mode. These capabilities are provided through the control page and field control character (FCC) functionality which allow operator interface to the system software.

4.2.7.2 Programmable Mode

The addition of user programs in the form of program products or user UTS COBOL programs provides a large expansion of the offline capability for the customer. The user programs have access to all cluster controller facilities (hardware and software) available in nonprogrammable mode. In addition, user programs can establish an application dialogue with the operator to perform any data manipulation required within the constraints of the system. Operator control uses the following available resources:

- File structures identified in paragraph 4.2.4
- File/device assignment
- File manipulation
- Keyboard and display control
- Control page commands and operations
- File utility

In addition to the operator control discussed in paragraph 4.2.7.1. local program control provides:

- Multiple user programs per cluster controller
- Reentrant user programs for multiple workstations
- User program segment loading
- User program activation and deactivation by workstation operators

Local program development capability on the cluster controller provided by program products described in Section 4.5 includes:

- Source code creation, update and edit
- UTS COBOL program creation via IPG utility
- Local UTS COBOL program collection
- Resident UTS COBOL compilation

4.3 CLUSTER CONTROLLER SYSTEM CONTROL SOFTWARE

The UTS 4000 system software provides interfaces between the internal hardware elements of the cluster controller. It establishes the operator, communication, and user program operation for the terminal system. This is acomplished through the following major functional software components:

- Supervisor
- Resource management
- Communications

4.3.1 Supervisor

The supervisor provides the internal operating environment for all components of the terminal system. It is developed to take full advantage of the speed and hardware capabilities of the UTS 4000 cluster controllers.

The supervisor permits concurrrent operation of many tasks. It allows the system to react to inquiries, requests, and demands of many different workstation users. It harmonizes the demands of real-time applications, and it makes the best use of available hardware facilities.

4.3.1.1 Supervisor Functions

The basic system functions provided by the supervisor component are:

- Task Management. The task manager controls sequencing, setup, and execution of all tasks. It is designed to control the execution of a number of independent and interdependent tasks. It schedules requests for execution, allocates state resources, and serially dispatches control. The task manager also initializes a memory map for each task.

- I/O Handlers. All I/O requests must use an I/O handler to sequence the I/O requests and prevent overlapping of requests to the microcode. The I/O handler receives control when I/O has completed or when status has been presented.

- Supervisor Request Management (SVRs). Requests are made for supervisor services through SVRs. Each request specifies the action to be taken and gives the appropriate parameters. SVR returns may be immediate or through task management.

- Memory Management. The UTS 4000 memory manager controls the allocation of memory space as needed for the loading of utility programs, user programs, and the expansion of memory for user programs. It provides memory security for the software system and user programs.

- Buffer Management. The buffer manager controls all allocation and deallocations of the system buffer pool. The buffer pool is only for use by the operating system.

- ILD Handler. The ILD handler is required to provide the interface between the system supervisor and ILD. Reading and writing of the system diskette is accomplished via this software.

- Common Subroutines. Subroutines that are commonly used in the software modules are provided by the supervisor. These are only available for terminal system software use.

- Task Loader. The task loader is used to load all external application programs and segment into memory for execution. External programs can either be loaded from the communication line, ILD, or freestanding diskette.

- Error Processing. System errors are logged and displayed locally.

4.3.1.2 System Loading and Initialization

The system loading and initialization process is structured to require minimal operator assistance. All of the software and microcode required to affect the process is contained in the cluster controller or on the system diskette. A self-test capability in the form of power-on confidence (POC) tests is provided for evaluation of the basic software operability. Initiation of this cluster controller process occurs whenever the power is turned on, but may also be started by an operator load request. The initial load activity consists of a cluster controller POC test which is ROM-resident and accomplishes the following:

- Validation of the ILD load path and micromemory

- Establishment of communication with the load device
- Loading and execution of "super" POC test
- Loading of all line modules
- Loading the system load and initialization module

Three operator selections are possible through a master workstation for the loader upon successful completion of the ROM-resident tests. These are:

- Load the system described by the configuration tables on the system diskette.
- Call the configuration utility.
- Call the system diskette utility.

When the operator of a master workstation chooses a system load (after the configuration procedure is completed), the system is loaded in the following sequence:

- Load microcode to all workstations having power applied.
- Configuration tables are loaded and execution begun for all line modules.
- Terminal operating system necessary to support the configuration is loaded.
- Host communication is established.
- Operator is notified that the system is available.

Errors encountered in the initialization and load process are either displayed by the cluster controller indicator lights (for cluster controller POC), or on the master workstation (for other elements in error). The error condition, as well as a probable cause, is identifiable to the operator.

4.3.1.3 User Program Loading

UTS COBOL user programs may be loaded downline from the host processor through the communication link or from a local diskette. Program products may be loaded from a local diskette or from the ILD. Program products and downline-loaded UTS COBOL programs may be directed to a local peripheral for future use on the cluster controller.

The downline load process used by the host is assisted by host resident software. The load procedure is initiated either by a workstation operator or a host-resident user program.

A downline loaded program from the host processor can either be loaded directly to the cluster controller memory, or it may be loaded to a local peripheral for future use. Initiation of the host load procedure without assigning a local file for storage of the program will result in that program being directed to the cluster controller memory. The name contained in the downline load header must be used for reference by workstations that are subsequently assigned to this program. The program will be active in memory until all workstations using it sign off, or the system is turned off.

All functions necessary for an auxiliary storage operation to a local peripheral are provided by a program load module within the terminal system software. If a peripheral storage operation is desired, the operator must first assign a local file to be used, identifying it as a downline load file. This is accomplished through the control page. After this file is assigned to the workstation, a subsequent downline load request will cause the host processor to direct the program load to the cluster controller which in turn will write it on the designated file. The file name used for peripheral storage must be used for reference by workstations that are subsequently assigned to this program.

UTS COBOL programs may be segmented for operation on the cluster controller. Segmented programs are downline loaded by directing them to a peripheral storage device. References to segments during operation of the program will cause the task loader to extract the segment from the program file and load it to memory for execution.

Program products on the integral load device are assigned standard file names. Local requests are initiated through the extended commands and file referencing conventions. References to these products after they have been transferred to other peripheral files must conform to the user-specified file names established when the initial file transfer is requested.

Multiple requests for the same user program name will result in only one program being loaded into memory. When additional workstations are assigned to a program that is already in memory, the task loader will link the workstation to the program in memory.

4.3.2 Resource Management

Resource management provides all access to and from external cluster controller interfaces. Included in resource management services are:

- File and device control
- Control page handling
- Peripheral handlers

4.3.2.1 File and Device Control

4.3.2.1.1 File Structure and Usage

There are two basic operating modes with files on the terminal system:

- o UTS 400 compatible (TCS formatted)
- o File formatted

The UTS 400 compatible (TCS formatted) mode provides a single, sequential file structure per peripheral media. The control and operating procedures for the TCS formatted operation are in accordance with the UTS 400 terminal system. It is assumed that the reader is familiar with these operations as described in the UTS 400 manuals.

The file-formatted operating mode provides the following structures:

- o Sequential
- o Relative

Formats available for these files include both IBM type H and BDE. The type H format adheres to the IBM type H data exchange format with the exception that data is encoded in ASCII, rather than EBCDIC. The diskette is defined as a double-sided/double-density medium containing 256 bytes per sector. It is assumed that the last sector of a track on side 0 is logically followed by the first sector of the same track on side 1.

The BDE format refers to IBM single-density Basic Data Exchange (BDE) format. The manner of support is the same as for type H, except that BDE is 128 bytes per sector and single-sided only.

The file-formatted operation will provide multiple files per storage device. A file directory is maintained on each storage medium which will identify the files and their characteristics. The system will use this directory to manage the storage resources. These files can be assigned through the control page or through a user program, but they are not accessible to the host. The host can transfer files to or from the cluster using the TCS format only. A file utility is available with the system to provide file maintenance functions, such as PREP, COPY, and PACK for file-formatted devices. These functions are not provided through the control page for file-formatted media but are provided by the file utility. The following file usage is available:

- o Read/write files
- o Read-only files

- Write-only files
- Exclusive-use files
- Shared-use files

4.3.2.1.2 File and Device Assignment

Device and file assignment for UTS 400/TCS operational capability is referenced in the control page identical with the UTS 400 control page. The file formatted enhancement, however, requires modifications to the control page file and device assignment method. These modifications consist of special command enhancements and extensions to device references. Assignment is accomplished by using the transfer (XFER) filed in conjunction with the search (SEARCH) field for file naming. The device identifier is used in the XFER "from" subfield, and the desired command is entered in the "function" subfield. When a file or device name is used in conjunction with the command, it is included in the "SEARCH( )" field.

4.3.2.1.3 File and Device Naming

The following terms pertain to file and device naming conventions:

- realname — Refers to the name encoded in the data set label on a file-formatted diskette. For a TCS-style device, the realname is the UTS 4000 device identifier.
- aliasname — Refers to the user-supplied name used for accessing a file or device.

The UTS 4000 file naming conventions allow real or alias file names that are up to 17 characters long. Names terminate on a blank or the seventeenth character.

When specifying file names in a UTS 4000 command, the following conventions are used. The realname is listed first. To specify an aliasname for the field, the user puts an exclamation point (!) before the name. This convention is also followed when giving an aliasname to a UTS 400-style device. For example:

```
SEARCH(realname                    )
```

The command operates on file "realname."

```
SEARCH(realname!aliasname          )
```

The command operates on file "realname" and gives it an alias of "aliasname."

SEARCH(!aliasname)

The operator has given a device an "aliasname."

The user may only have one file or device assigned with any one real or alias name. Users may refer to a file by either the realname or the aliasname. Although a file name may be up to 17 characters long, the user is limited when entering two file names in a command because the SEARCH field of the control page allows only 23 characters. This prevents the user from specifying both a 17-character realname and a 17-character aliasname. The user is also prevented from using files on file-formatted diskettes in host or UTS 400-style peripheral operations. File editing, copying, and other operations should be done using the UTS 4000 file and edit utilities.

Device naming conventions restrict identification of devices to a two-character device identifier. The first character specifies the device type and the second specifies a particular device of that type. The following list defines the device identifiers for a UTS 4000 system. The symbol "#" is used as the device specifier and represents a character from the set of characters "A" through "Z" and "1" through "9," inclusive. This provides identifiers for up to 35 diskette drives and 35 printers in a single system.

P# Printer Unit #

D# Tape-cassette-format diskette drive #

F# File-formatted diskette drive #

B# Screen bypass "screen" #

I1 Integral load device (there is only one ILD)

W# Workstation #

4.3.2.2 Control Page

Because of UTS 400 compatibility considerations, the control page is the only operator interface to the system software while the system is operating. Therefore, enhancements are required to accommodate an increased functionality of the UTS 4000 system software. A detailed description of how to use the control page in UTS 400 mode may be found in the UTS 4000 Operator Interface CPSD, C-41411.

The following functions are defined through the control page:

o Peripheral selection

- Communication "transmission type" selection
- Peripheral "transfer type" selection
- Peripheral status
- Report address*
- Command extension**
- Maintenance mode*
- Search field*
- Workstation address*
- Customer set-up parameters**

*UTS 400 control page modified for the UTS 4000 systems
**Enhancements over the UTS 400

4.3.2.2.1 UTS 400 Control Page Modifications

4.3.2.2.1.1 Report Address

The address displayed will be the next read/write position on the specified TCS-formatted diskette.

4.3.2.2.1.2 Maintenance Mode

The maintenance mode has a restricted usage in UTS 4000 workstations as opposed to the UTS 400 and the UTS 4000 single stations. The memory partitioning is not applicable; therefore, usage of this field is restricted to the record separator function.

4.3.2.2.1.3 Workstation Address

The cluster controller configuration workstation address appears on the control page rather than RID and SID address (as found on the UTS 400).

4.3.2.2.1.4 Search Field

Modifications have been made to the search field which allows file naming and multiple file usage when using the file formatted UTS 4000 addressing

capability. This expands the basic system over the UTS 400 to support the IBM type H and BDE diskette.

4.3.2.2.2 Enhancements Over the UTS 400 Control Page

4.3.2.2.2.1 Command Extensions

The control page command extensions broaden an operator's control of the peripherals by adding commands which assign or reserve peripherals or files needed by a particular application or workstation. The command extensions are documented in CPSD C-41411, UTS 4000 Operator Interface for UTS 400 Mode.

4.3.2.2.2.2 Set-up Parameters

The initial parameters for a cluster controller configuration are specified in the controller configuration and loaded after the power-up procedure. Some of these parameters can be altered in the control page for temporary use. Any parameter changes entered by the operator are lost when power is turned off or the Reset key is depressed. The set-up parameters are documented in CPSD C-41411, UTS 4000 Operator Interface for the UTS 400 Mode.

4.3.2.3 Peripheral Handlers

Resource management provides software handlers for various kinds of peripherals operating on the system. These handlers are used by the UTS 4000 system software to control traffic requests to and from the external cluster interfaces. The handlers provided message queuing, peripheral commands, and error recovery functions. Included are:

- Diskette
- Printers

Concurrent operation of peripherals is available for separate line module attachments. There are two operational modes available for peripherals, operating on a specific line module, referenced by mode 1 and mode 2. Mode 1 operation allows only sequential operation of the peripherals on a single line module. Mode 2 operation will allow multiple peripherals on a line module to operate concurrently.

4.3.2.3.1 Diskette Handler

The diskette handler operates in conjunction with the 8-bit peripheral line module in either mode 1 or mode 2 to transfer data to and from a diskette. It provides diskette services and/or issues commands for:

- Read/write
- PREP
- Search
- Error recovery

All data to or from the diskettes attached to the cluster controller or workstations is controlled by this handler.

4.3.2.2.2 Printer Handler

The printer handler operates in conjunction with the 8-bit peripheral line module or UTS 40W workstation in mode 1 operation to support the following printers:

- Type 0774 Model 880 Terminal Printer
- Type 0786 Printer Subsystem
- Type 0791 Correspondence Quality Printer
- Type 0797 Printer Subsystem
- Type 0798 Printer Susbsystem
- Type 0789 Line Printer

Mode 2 peripheral operation is supported for the following printers:

- Type 0797 Printer Subsystem
- Type 0798 Printer Subsystem
- Type 0789 Line Printer

Functional support consists of:

- Data transfer
- Forms control
- Error recovery

4.3.3 Communications Support

Communications is the responsibility of the system control software and requires no special programming by the customer. Communications is composed of two distinct processes: communications between cluster controller and workstations, and communications between cluster controller and host.

4.3.3.1 Cluster Controller to Workstation

The cluster controller regulates data transmission to and from the workstations. The protocol used is transparent to user programs and requires no special action by a user program beyond sending and receiving data.

Control commands are transmitted between the cluster controller and the workstation as data, and, as such, they do not affect the protocol. These control commands are used for control page functionality, workstation status and other general interactive functions. Error recovery between the cluster controller and workstations is provided by the workstation line module and workstation communication handler.

4.3.3.2 Cluster Controller to Host

The cluster controller communicates with a host system using UTS 400 protocol through a microcoded line module. Enhancements include host communications software which supports data transmission throttling for user program interaction. The UTS 4000 system may be interfaced with a Series 1100 or Series 90 host directly with TELCON network or any other processor that supports the UTS 400 protocol. Error recovery between the cluster controller and host system is provided by the line module and host communication handler. Nonrecoverable error conditions are reported through the operator's workstation and via the standard host procedure (as implemented for the particular host system). Communication capability of the UTS 4000 allows line speeds of up to 19.2 kbps.

4.4 SYSTEM UTILITIES

4.4.1 System Configuration Generation

The configurator is a stand-alone system module loaded into memory during the system load and initialization process. The configurator module will converse with an operator using a configuration query (prompt) sent to the operator's screen. The initial prompt to the operator is a statement to identify basic tasks performed by the configurator module. This is followed immediately by a request for an operator response to indicate which task to perform. The basic tasks are:

- Initialize. This will completely configure the system.
- Modify. This will modify the current system configuration.
- Exit. This will terminate the configuration session and load the configured system.

Configuration tables of the terminal system hardware and software are maintained on the system diskette. These tables are used in the operation of the software system as requests are made for facility use. The configuration process is used to establish and modify these tables as directed by the operator. As the configuration module prompts an operator through the request for initial or modification information, a set of tables is developed, capturing the operator responses and establishing a logical system configuration that reflects the terminal system hardware arrangement. Prompts for information include:

- Workstation types, RID and SID address, logical line module and workstation address, and parameters
- Peripheral types, DID address and associated RID and SID address, logical line module and workstation address, and parameters
- Cluster controller line module and workstation address, and parameters
- Other system specifications, as required

Upon an EXIT task response, these tables are placed on the system diskette, overlaying any previosuly stored table values. The new tables now represent the system configuration to be used by system software. Upon operator command, this system is initialized, and all configured and operational workstations and line modules are loaded with the required microcode; software modules needed to support the configuration are also loaded. All modules are loaded when needed by reference to the configuration tables and are not generated through a system generation process, thus a rapid reconfiguration capability is provided. The configuration process can only occur through a master workstation.

4.4.2 System Diskette Utilities

There are two capabilities provided for customer maintenance of the software system. These are called System Diskette Software Maintenance and Dump Print Utility.

4.4.2.1 System Diskette Software Maintenance

The system diskette software maintenance utility is a stand-alone, field-support utility providing the means by which a customer can modify or duplicate the system diskette. The specific capabilities provided are:

- Diskette PREP for ILD
- Copy system diskette for security or back-up purposes
- Enter software fixes to resolve system problems
- Add or delete program products delivered to the customer on separate media.

The updates can occur either through the master workstation entry when needed for software fixes or through diskette media. UTS COBOL user programs or data files will not be allowed to reside on the ILD diskette. The ILD diskette is reserved for Sperry Univac-supplied program products only.

4.4.2.2 Dump Print Utility

The dump print utility allows a user to reformat and print memory data that has been stored on a dump diskette. The utility operates as a user program on the cluster controller and prints the diskette data from a previous system dump. The listing is in hexadecimal as well as ASCII format.

When a system memory dump is required for user programs or system software, a diskette is inserted in place of the system diskette in the ILD, and a dump is initiated. The cluster is offline during the dump process. When the dump is completed, the system diskette is reinserted into the ILD, the dump diskette is inserted into a freestanding peripheral diskette and printing is initiated. The hardware requirements for use of this utility are a printer and a freestanding peripheral diskette.

4.4.2.3 Foreign Language Prompt Utility

The foreign language prompt utility provides the capability to alter the text of prompts and error messages in system software. When the messages are displayed on the screen through this utility, a utility operator may create a changed version. This new version is stored in the system files for use by system software. Subsequent system use of these messages will result in display of the new content.

4.4.3 File Utility

The file utility provides maintenance support for file-formatted media. TCS formatted files are supported through the control page, as presently operating on the UTS 400. (Details on the TCS process may be found in the UTS 400 Programmer'S Reference Manual.)

This utility is contained on the system diskette and is initiated as a user program through the control page. It is designed for offline, operator-friendly use by prompting an operator through the maintenance process. The following functions are available on operator request:

- PREP diskette
- Copy diskette to printer
- Copy file-formatted diskette to TCS-formatted diskette
- Copy TCS-formatted diskette to file-formatted diskette
- Pack diskette
- Translate diskette (ASCII/EBCDIC)
- Display table of contents
- Display/change sector
- Create file
- Modify file description
- Delete file
- Undelete file
- Copy/concatenate file

4.5 APPLICATION SUPPORT

Facilities are provided within the terminal system to accommodate application (user) program. These take two forms: program products supplied by Sperry Univac and UTS COBOL programs developed by the customer using UTS 4000-supplied programming products.

4.5.1 Program Products

The following program products are provided by the UTS 4000 program as user-available operating processors.

4.5.1.1 Edit Processor

The edit facility on the UTS 4000 system is a file edit processor and operates in the UTS 4020 or UTS 4040 cluster controller. The operator identifies a file to be edited and executes the edit processor from a workstation. Changes made to the file are reflected in a mass storage work area until the edit processor is directed by the operator to save an updated file in the user data space.

Functions which may be performed by the edit processor includes:

- Line deletion, insertion, and replacement
- Character string deletion, insertion, and replacement
- Line display on the screen
- Location of character strings within a file

The CPSD C-44406 may be consulted for additional details.

4.5.1.2 Text Processing Utility

The text processing utility provides document maintenance on disk and diskette as well as word processing functions which permit the terminal operator to easily create and modify text. It greatly facilitates the storage and revision of documnets and thus will be attractive to a wide user group, which extends across almost all industry segments.

The text processing utility provides word processing functions including text formatting, text insertion, deletion, and manipulation. It also provides for document storage and retrieval, screen paging (allowing for document pages larger than the standard 24 by 80 screen configuration), host interaction with host-resident data files, and printing using the correspondence quality printer. A detailed discussion may be found in CPSD C-47405.

4.5.1.3 Interactive Program Generator

An Interactive Program Generator (IPG) utility is supplied as a means of generating UTS COBOL user programs. It is provided primarily to support the large number of potential users who are not professional programmers, but is

also expected to ease the process of program development even for professionals. The functions of the utility are:

- Generate source data entry programs.
- Generate query/update programs.
- Generate programs for obtaining statistics and/or lists.
- Facilitate entry of UTS COBOL programs in general.
- Provide an easy mechanism for screen format description.
- Interact with the user via a dialogue suited to the user's capabilities to obtain application-oriented knowledge necessary for application program generation.
- Provide tutorial direction to whatever extent it is required.

The CPSD C-47402 may be consulted for additional details.

4.5.1.4 UTS COBOL

A UTS COBOL compiler transforms source programs written in the UTS COBOL language into interpretable instructions and places them into an object element. Both syntactic and semantic checking of the user source code is done. Violation of UTS COBOL language standards result in warning or error messages. The UTS COBOL compiler may be executed in a host system as a cross-compiler or in the cluster controller as a resident compiler. The CPSD C-44404 may be consulted for additional details.

4.5.1.5 Character Set Generation Utility

This utility provides the user with the ability to build and store a loadable character set on a cluster controller or host system. Character sets are loaded into the workstation to be used by the display character generator. This hardware feature provides 256 user-definable, dot-matrix characters and is in addition to the character generator provided with the display (which forms the standard character set). For further details, consult CPSD C-47407.

4.5.2 UTS COBOL Interpreter

Included with the UTS 4000 system software system diskette is the cluster-controller-resident interpreter. An interpreter is loaded to user memory by the task loader when a request is made for a UTS COBOL program load. The

interpreter is used to interpret the code that is produced from the UTS COBOL compiler into cluster controller executable instructions. This interpreter is used to provide a system-independent interface for user programs execution on terminal products. The customer is not aware of the interpreter load process at the time of request; therefore, no operator action is required. Only one copy of the interpreter is in the memory at a time. This single interpreter supports all of the UTS COBOL programs operating in a multiple-program operation and provides an interface between the operating system and UTS COBOL programming.

4.5.3 Application Execution and Control

User program execution is controlled by the operating system software acting on requests from workstation operators for loading or linking to user programs. The operating system provides memory space for user programs, attachment to the interpreter for program execution, and attachment to the workstations and peripherals.

- User program memory is provided for each program requested by the operator in real memory. Segmentation capability is provided and linkage to these segments is established when the load occurs. User programs may not exceed 64 kilobytes of memory; however, segmentation allows the total program to be larger than 64 kilobytes.

- Attachment to the interpreter occurs for UTS COBOL programs upon load request. The UTS COBOL user program segmentation is directed through the interpreter.

- Workstations and peripherals are attached and detached as requested by the operator or user programs.

4.6 HOST SOFTWARE

4.6.1 UTS 4000 Support Software on Host Systems

The following host software is provided for the UTS 4000 system:

- UTS COBOL Program Preparation. Host software provides a UTS COBOL compiler and collector for building programs in interpretive language to execute on the UTS 4000 processors.

- Program Load Utilities. Host utilities are provided for preparing program files to be downline loaded to UTS 4000 systems. These utilities format and transmit programs that are recognizable to UTS 4000 systems.

- UTS 400 Communications Compatibility. Host communications software supporting the UTS 400 is supported by the UTS 4000 system without change.

4.6.2 Additions and Changes to Current UTS 400 Host Utilities

The UTS COBOL compiler will be enhanced to add new features to the UTS 400 compiler.

4.6.3 Host Modification

One change is required in host communication systems to allow output throttling from the terminal system. The implementation is required when a user program or local operator requests multiple messages and the program attempts to process each message before the next arrives. This may result in a message arriving at the terminal before the program has finished processing a previous one, thus destroying the previous data. To avoid this situation, a user program in the UTS 4000 can inform the UTS 4000 supervisor to allow only one text message from the host which is conveyed to the host via throttling implementation. The host software change is only required when the above condition exists. In addition, the UTS 4000 system operates up to 19.2 Kbps, and the maximum size buffer transmitted or received by the system is 4 kilobytes.

5 ENVIRONMENTAL CHARACTERISTICS

5.1 HARDWARE SUPPORTED

The UTS 4000 family consists of two basic kinds of equipment: single stations operating as individual terminals and clustered systems where a number of workstations are attached to a controller and share the resources provided by this central device. This PSD is concerned only with the clustered systems. The general category of clustered systems includes:

- Cluster Controllers
- Workstations and Keyboards
- Peripherals and Auxiliary Devices
- Communications
- Additional Hardware Features Supported

5.1.1 Cluster Controllers

Two models of cluster controller are available: a UTS 4020 and a more powerful UTS 4040. Each controller may have a complement of UTS 20W or UTS 40W workstations attached to it; up to 12 of these may be configured on the UTS 4020

and up to 31 on the UTS 4040. The UTS 4020 cluster controller may have up to 256 kilobytes of memory installed; the UTS 4040, up to 512 kilobytes. Both models come equipped with 64 kilobytes of memory for system control software in addition to the memory required by the loadable microcode. This memory is expandable in 64-kilobyte increments up to the maximum for the respective models.

Each model of cluster controller may govern a variety of peripherals attached directly to it as well as controlling the various peripherals attached to the workstations. A complete description of the hardware comprising the system may be found in the UTS 4XX Product Family (R-50223).

5.1.1.1 UTS 4020 Cluster Controller

This controller is targeted for clusters of up to 12 workstations. It allows sharing of user programs and peripherals, hence reducing the effective cost per workstation. The data generated at each workstation passes through the cluster controller in the process of interacting with the host processor. Up to four workstations (of either model) may be connected into one of up to three cables with a maximum length of 5000 feet which, in turn, connects to the cluster controller. The workstations on each line are multidropped. Peripherals may be attached directly to the UTS 4020 cluster controller or to the UTS 20W or UTS 40W workstations.

System software is loaded via system diskette from the ILD of the UTS 4020. This diskette provides storage for configuration data and error logs. By using different diskettes, system software updates or entirely new system personalities may be loaded.

5.1.1.2 UTS 4040 Cluster Controller

The UTS 4040 cluster controller is "upward compatible" with the smaller UTS 4020 and presents the same macroarchitecture as implemented by the loadable microcode. It provides a further growth path for customers having UTS 400 terminals or UTS 4020 cluster controllers. The UTS 4040 is targeted for larger clusters configured in the 12 to 32 workstation range. Up to four workstations can be configured on each of eight 5000-foot lines connecting to the cluster controller, providing a potential total of 32 workstations; however, due to protocol restrictions, the UTS 400 mode supports a maximum of 31 workstations. Peripherals may be attached to the controller and workstations as with the UTS 4020 cluster controller.

System software is loaded from the ILD diskette as with the UTS 4020. The differences between the UTS/4020 and the more powerful UTS 4040 are fundamentally that the UTS 4040 can have more memory, more workstations, more peripherals, and that the UTS 4040 operates at a higher rate of instruction execution.

5.1.2 Workstations and Keyboards

Two models of workstations are provided: the UTS 20W and the more sophisticated UTS 40W. These two models are different in expandability, available features, and peripheral choices. Either workstation attaches to either cluster controller through a 250 Kbps cable link. The personality of each workstation, as viewed by the operator, is supported jointly by the individual workstation and the cluster controller. For example, the peripheral assignment and sharing are provided by the cluster controller. User programs residing in the controller have access to keyboard data from each attached workstation.

The UTS 20W is a general-purpose workstation which provides a minimal degree of expandability. The screen format may be up to 24 lines by 80 characters and is displayed on a 12-inch CRT. A single peripheral printer may be attached to a UTS 20W workstation. Data is transferred to the printer using an RS-232C bit-serial, output-only, nonmodem interface. The UTS 20W supports the magnetic stripe reader as an auxiliary device.

The UTS 40W, also a general-purpose workstation, provides the same basic functionality as the UTS 20W, but uses a standard 8-bit interface for peripherals. In addition to a 1 megabyte diskette subsystem, one of a wide range of printers may be attached. The UTS 40W supports a magnetic stripe reader as an auxiliary device and has the capability of using the loadable character set.

Four different keyboards are supported on the UTS 20W, Model A, B, C, and D. The UTS 40W supports three keyboards, Model B, C, and D. These keyboards include two different sizes which meet ISO standards and two different sizes which meet ANSI standards. Of the ANSI keyboards, one fulfills the requirements of the Japanese language (Katakana) and the other fulfills the marketing requirements for a UTS 400-style keyboard layout.

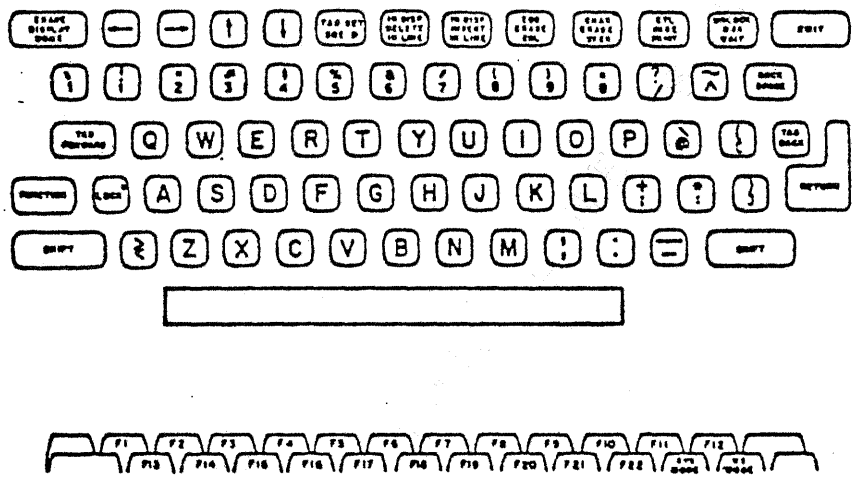

Figure 5.1.2-1. The Model A Keycap Layout.

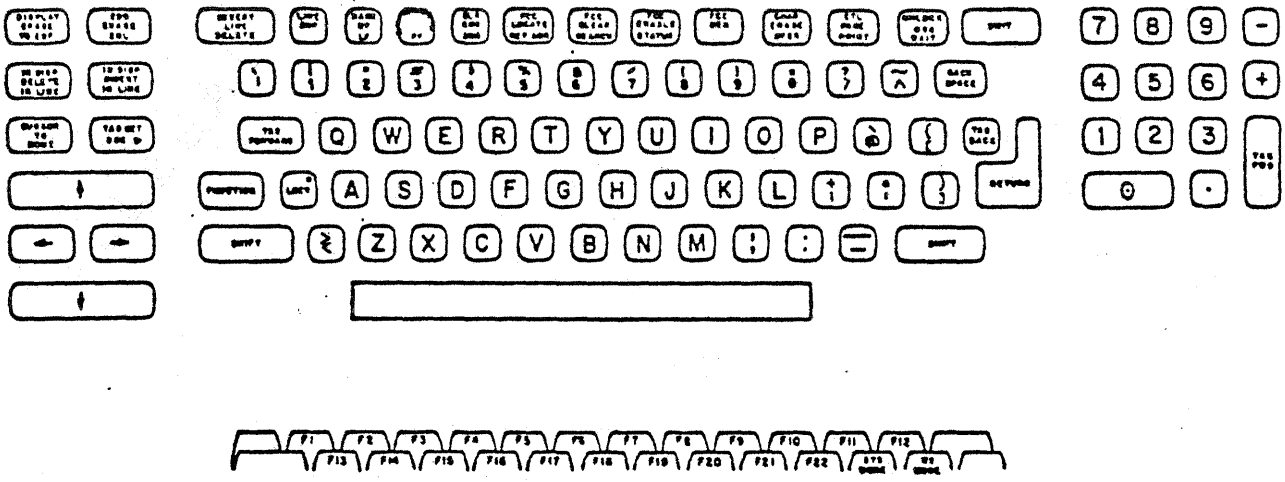

Figure 5.1.2-2. The Model B Keycap Layout

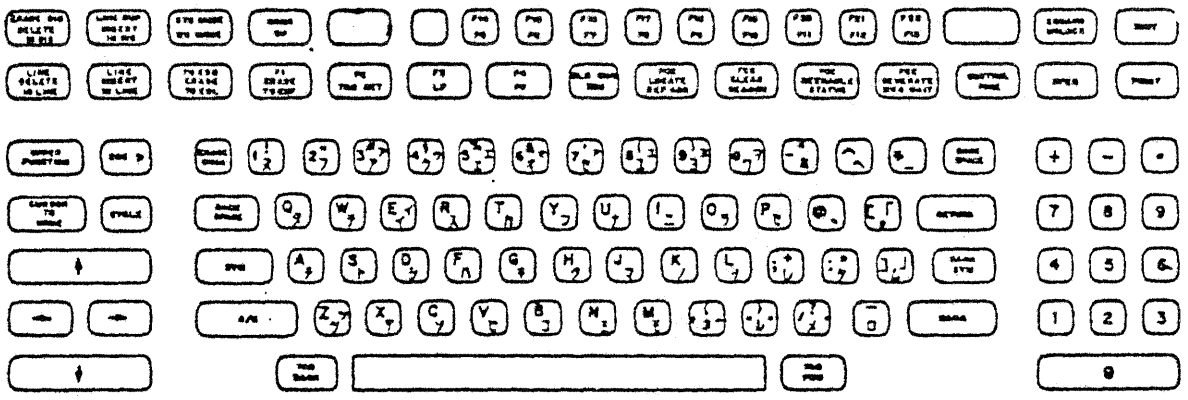

Figure 5.1.2-3. The Model C Keycap Layout.

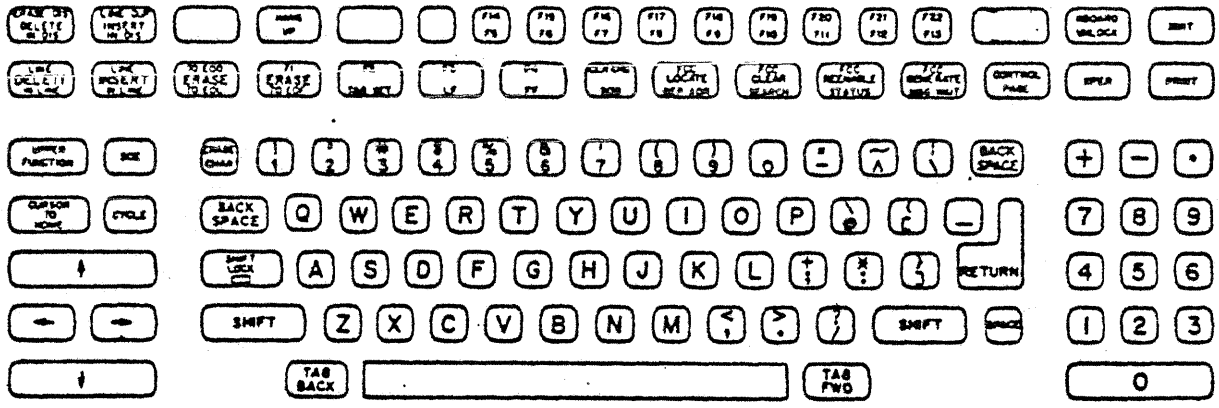

Figure 5.1.2-4. The Model D Keycap Layout

5.1.3 Peripherals and Auxiliary Devices

Available peripherals include a variety of printers and a double-density, double-sided diskette subsystem. A magnetic stripe reader is implemented as an auxiliary input device on both workstations.

5.1.3.1 Peripherals

5.1.3.1.1 Printers

The printers used in the UTS 4000 system may be categorized into three groups based on the individual units to which they are attached: the cluster controller, the UTS 20W workstation, or the UTS 40W workstation. All the printers listed below are supported on the UTS 4020 and UTS 4040 cluster controllers using the standard 8-bit interface.

- Type 0774 Model 800 Printer Subsystem
- Type 0786 Printer Subsystem
- Type 0789 Line Printer -- 300 LPM and 600 LPM
- Type 0791 Correspondence Quality Printer Subsystem
- Type 0797 Printer Subsystem
- Type 0798 Printer Subsystem

The Type 0789 Line Printer is supported only on the two models of cluster controllers. The other printers listed are supported on a UTS 40W when equipped with the 8-bit interface. The type 0797 and 0798 printer subsystems are supported on the UTS 20W when these peripherals are equipped with the RS-232C serial interface.

5.1.3.1.2 Diskette Subsystem

Both cluster controllers and the UTS 40W workstation support the type 8406-04 through -07 double-density, double-side diskette subsystem. This diskette provides mass storage for user programs and data. File formats, codes, and access methods are compatible with those provided by the UTS 400 product.

5.1.3.2 Auxiliary Devices

5.1.3.2.1 Magnetic Stripe Reader

A magnetic stripe reader is provided for the UTS 20W and UTS 40W workstations. Inputting data through the keyboard interface to the workstation, the magnetic stripe reader attaches physically between the keyboard and the keyboard connector on the terminal. This auxiliary device reads both American Banking Association (ABA) format and International Air Transport Association (IATA) A and B formats.

5.1.4 Communications

Operating in UTS 400 mode, the UTS 4000 system supports UTS 400 byte-oriented protocol for link-level communications. Communications support includes synchronous EIA RS-232C/CCITT V.24 and direct-connect to Sperry Univac host systems. The synchronous interface supports point-to-point, multidrop, and multiplexer applications.

5.1.5 Additional Hardware Features Supported

5.1.5.1 Loadable Character Set

Reference paragraph 4.2.1.1.5.

5.1.5.2 Security Keylocks

Reference paragraph 4.2.1.1.3.

5.2 HARDWARE REQUIRED

5.2.1 Minimum Configuration

5.2.1.1 UTS 4020 Cluster Controller

The minimum UTS 4000 cluster system consists of a UTS 4020 cluster controller and one UTS 20W workstation equipped with a security keylock. The UTS 4020 comes equipped with 64 kilobytes of memory to contain the operating software, one workstation line module, a communication line module, and the ILD.

One workstation, called the "master" workstation, must be assigned as "logical Station 1." This is done by physically connecting the workstation cable to the first line module and positioning the device address switches for the lowest value. The master workstation provides a means to initialize the system during

the period of time when the user configuration is unknown to the software. This workstation is used to provide system control and the channel through which configuration data is entered.

The integral load diskette in the cluster controller is used for system storage and is not available to the customer. The system diskette is not to be removed after the system is initialized and operational. This requirement is necessary to allow the workstations to be downline loaded, utility programs to be loaded, and to provide a place for system and peripheral errors to be logged.

A minimum 64-kilobyte system does not support user programmability. However, host interactive communication is available with the system operating with a single workstation. This operation is similar to that available with a corresponding single station.

5.2.1.2 User Programs

User programmability in the UTS 4000 system requires an additional 64 kilobytes or more of memory; however, 12 kilobytes of this amount is required for system support of the UTS COBOL user programs. User program memory requirements may not exceed 64 kilobytes of memory; however, segmentation allows the total program to be larger than 64 kilobytes.

The UTS COBOL compiler, executing resident on a cluster controller, requires 64 kilobytes of user memory to perform a compilation process. If concurrent user program operation with the compiler is needed, the minimum user memory required is 128 kilobytes.

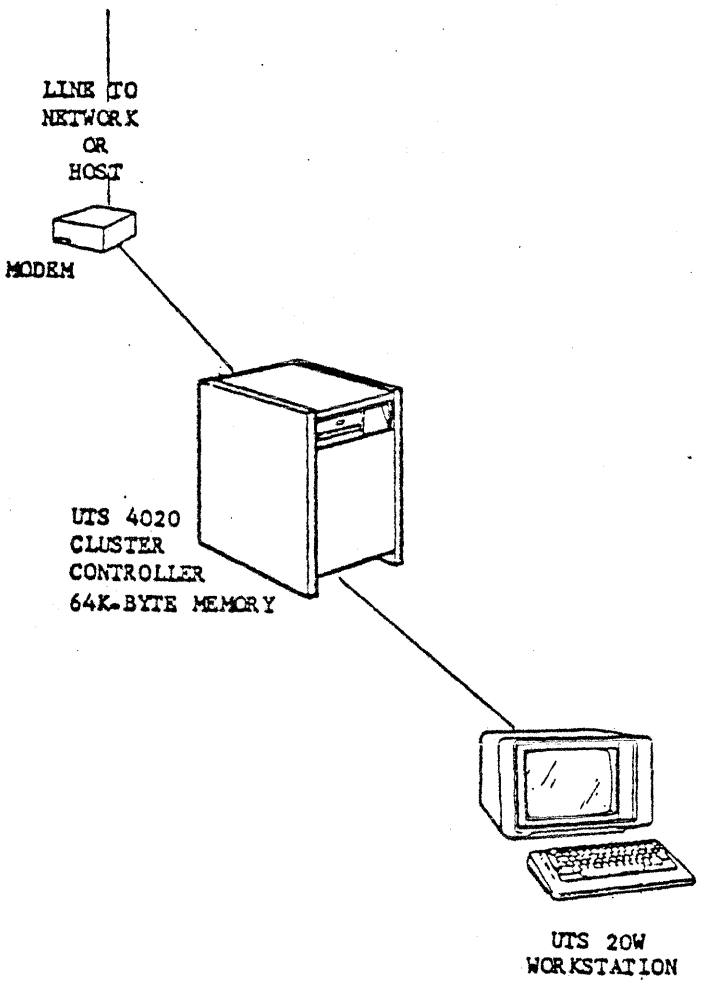

Figure 5.2.1-1. UTS 4000 Minimum Configuration

5.2.2 Maximum Configurations

5.2.2.1 UTS 4020 Cluster Controller

The minimum cluster system can be expanded by adding memory to the UTS 4020 controller up to a maximum of 256 kilobytes. The additional memory is used to increase the buffer space (necessary as the configuration expands) and to support user programmability. At least 128 kilobytes of memory will be available for user program storage. Due to visibility restrictions, no individual user program may be larger than 64 kilobytes.

Workstations may be added up to a maximum of twelve without regard for the combination of workstation models. A workstation feature is required to be installed in the cluster controller for each four workstations. The UTS 4020 may be expanded up to a maximum of three workstation interface features. Workstations may be multidropped in any combination on the three available lines subject to the constraints of the minimum configuration stated above.

5.2.2.2 UTS 4040 Cluster Controller

Memory may be added to the UTS 4040 cluster controller up to a maximum of 512 kilobytes. With this amount of storage, at least 320 kilobytes of memory will be available for user program storage.

Up to 31 workstations may be supported on the cluster controller. The UTS 4040 will support a maximum of eight workstation interface features. Limitations as to the number of workstations per line and combination of workstation types are the same as for the UTS 4020.

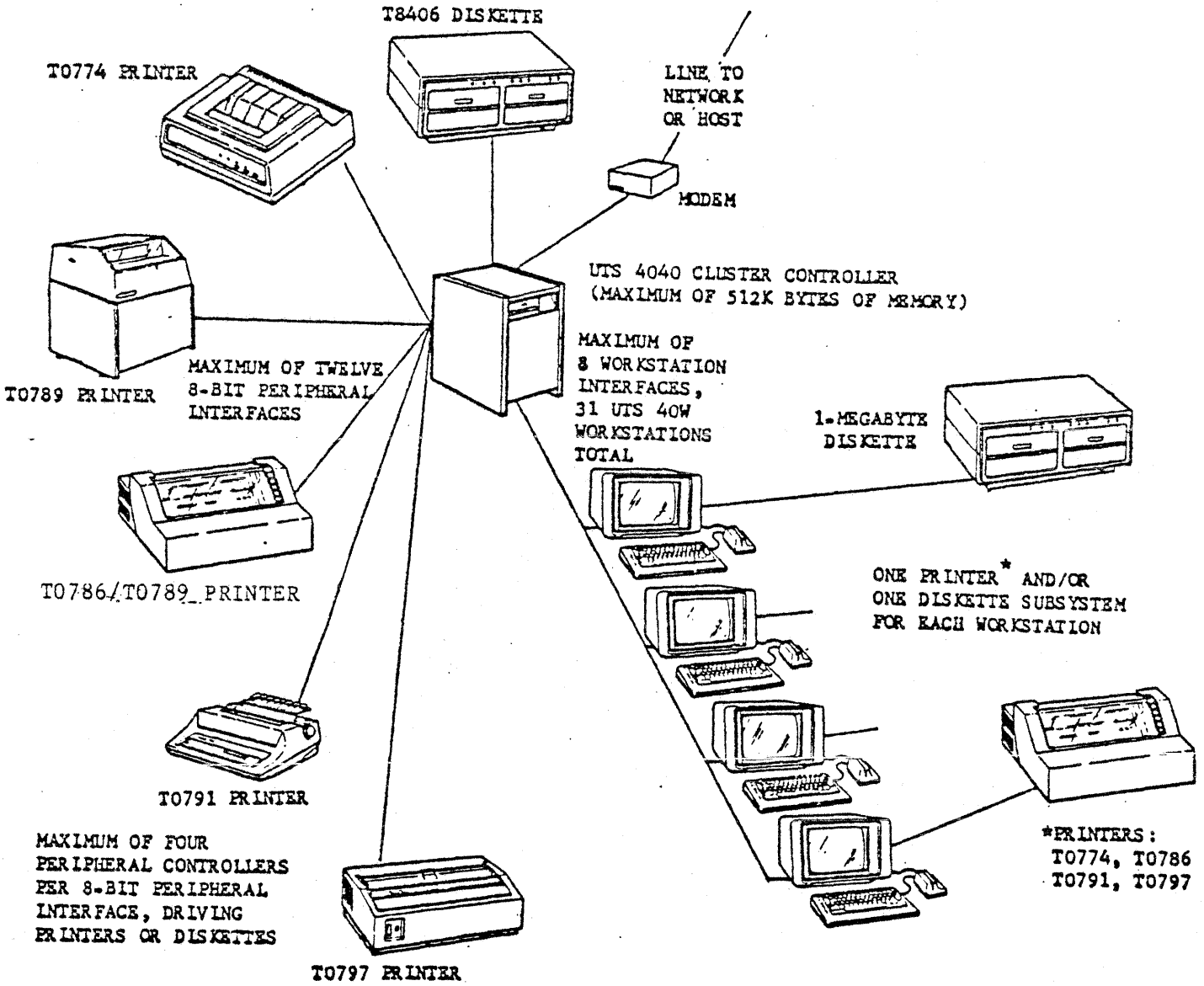

Figure 5.2.2.2-1. UTS 4000 Maximum Configuration

5.2.2.3 Peripherals and Auxiliary Devices

5.2.2.3.1 Peripherals Attached to the Cluster Controller

The UTS 4020 cluster controller supports two dual 8-bit interface features providing a total of four interfaces. The large controller supports six dual 8-bit interface features for a total of twelve interfaces. The maximum configuration can include any combination of printers and diskette drives attached to these interfaces subject to the following limitations. Refer to sections 5.1.3.1 and 5.1.3.2 for peripherals and auxiliary devices supported.

- Maximum printer line speed for both models of cluster controller is 600 lines per minute.
- Maximum number of line printers is two for the UTS 4020 and four for the UTS 4040.
- Maximum number of diskette drives is 35 total for both cluster controllers. This includes those diskette units attached to workstations as well as those connected to the cluster controller.
- Maximum number of character/line printers is 28 for the UTS 4020 and 35 for the UTS 4040. This includes those printers attached to workstations as well as those connected to the cluster controller.

Each 8-bit interface can support a total of four device controllers and this may include four 8406 diskette subsystems (8 drives) or four printers or any combination thereof. In Mode I operation, each 8-bit interface can drive one of the four devices at one time, thus allowing for four concurrent peripheral operations on the UTS/4020 and 12 on the UTS 4040 cluster controller. In Mode II operation, additional concurrency is provided for peripherals attached to the same 8-bit interface.

5.2.2.3.2 Peripherals and Auxiliary Devices Attached to the Workstations

The UTS 20W workstation supports an output-only RS-232C interface that is used to attach a character printer. Each UTS 20W workstation may have one such printer. The UTS 40W workstation has an 8-bit interface for its peripherals, and, in this case, is allowed one character printer and one diskette subsystem (which may contain two drives).

5.3 SOFTWARE REQUIRED

Software required in addition to the system control software for operation of the UTS 4000 software specified in this PSD includes two types: host network interface software and microcode for the UTS 4000 system.

5.3.1 Host Interfaces

5.3.1.1 Communications Protocol

The UTS 4000 will interface to Sperry Univac hosts and network processors using the UTS 400 mode of operation. Reference Section 4.6.3 for host communication requirements.

5.3.1.2 UTS 4000 Device Control from Host Systems

The existing host interface used with terminal systems allows configuring peripherals as well as terminals. The host software has provided software user selection and control techniques for these peripherals. The host system, using the device identifier (DID), can exercise a high degree of device control for terminal operators and host-based user programs. This kind of device control will continue using a logical rather than a physical device selection process for the UTS 4000 system. Logical selection allows peripheral devices to be shared within the system; i.e., devices not physically connected to a given workstation in a cluster may be used by that workstation and program. The host system is configured to know the device type(s) connected to each workstation and, therefore, addresses the cluster in terms of these devices. The UTS 4000 system correlates addresses used by the host with the actual device using a logical device association and issues the host commands to the proper peripheral on the cluster.

5.3.2 Microcode Required

System software relies on microcode modules to provide detailed interfaces and protocols. Included in the microcode are the error detection, recovery, and reporting procedures for hardware.

5.3.2.1 Cluster Controller

The microcode required for the cluster controller includes the following:

- Power-on confidence tests
- System software dump capability
- Macroinstruction emulation.
- I/O control
- Bootstrap loading

5.3.2.2 Cluster Controller Line Modules

The cluster controller uses intelligent line modules as controllers for all devices attached to the cluster controller. Line modules are microprocessor-based devices and require microcode for their operation. These line modules are loaded by the controller as part of the power-up sequence. Line modules included as part of the UTS 4000 system include:

- o Workstation interface line module
- o Host communications line module
- o 8-bit peripheral interface line module
- o Integral load device line module

Microcode required to be loaded in these line modules is dependent on the devices controlled and/or the appropriate line protocols used.

5.3.2.3 Workstations

All UTS 4000 workstations are microprocessor-based devices whose personality is loaded from the controller at workstation power-up. There will be different workstation code required for each workstation model. The controller system software will load each workstation based on the model type.

5.4 SOFTWARE SYSTEMS EVOLUTION

System control software will be provided in a series of releases, each incorporating increased functionality. The UTS 400 provides a base for design of the UTS 4000 system software. Host interfaces from the UTS 400 are preserved along with the basic UTS 400 manner of operation. Enhancements provided to this by the UTS 4000 include significantly larger display station configurations, higher speed printers, basic file control, device assignment, and multiple user program control along with the ability to accommodate significantly larger user programs. UTS 400 user programs written in UTS COBOL will run on the UTS 4000 after minor changes and recompilation. Reference the UTS COBOL CPSD for the required changes.

6 AVAILABILITY, RELIABILITY, AND MAINTAINABILITY

6.1 DEFINITIONS

Availability, Reliability, and Maintainability (ARM) are product qualities which express or measure the ability of the product to be operational a large

portion of the time, to be returned to an operable condition quickly if it should fail or produce erroneous output, and to function correctly for long periods of time between stops.

The following terms, related to ARM and often used interchangeably, are defined here to establish a basis for later subsections:

- Error - A bit or string of bits which is incorrect.
- Fault - A condition in a mechanism which causes it to produce errors. (A mechanism may be hardware, software, or firmware.)
- Failure - A change in a mechanism which produces a fault.
- Propagated Error - An error which is caused by another error rather than a fault.

A fault may be built into a mechanism rather than being the result of a failure. This is the case with most software faults (bugs). Both hardware and software faults, however, may also be introduced when changes are made to the product.

6.2 ERROR PREVENTION

Error prevention applies to activities in the development cycle and system integration that provide protection from errors during the system operation.

6.2.1 System Integrity

A structured, modular approach is incorporated in the software design with well-defined, simple interfaces between software modules, thus improving testability and reducing potential error conditions.

The system software utilizes hardware architecture features to provide security for system operation and user programs operating in the cluster controller, thus protecting system operability from user program errors. These features are:

- Limited memory visibility
- Memory write protect
- Multiple processor states

- Privileged instructions

Reference the UTS 4000 Architecture Specification (SR01041) for detailed discussion.

The use of the features provides supervisor protection by:

- Limiting supervisor to a separate state
- Restricting all I/O to the supervisor buffer pool
- Write protecting system code
- Restricting privileged instructions to supervisor state

User programs are protected through:

- Write protect of executable code
- Restricting visibility to user code only
- Changing to supervisor state when a supervisor function is requested
- User program development provided by UTS COBOL only
- File naming to protect user data files

6.2.2 Language and Coding Practices

The system code is developed in a high-level language where possible. The software is modular and standardized coding procedures are used. System code is more easily checked, and maintenance is facilitated.

6.2.3 Qualification and Validation Tests

Software test programs are provided to validate the system software before it is released. These programs test the functions and software logic paths. Reference Section 13.2 for the types of tests used in system preparation.

6.2.4 Power-On Confidence (POC) Tests

These tests are provided to check the operability of the hardware when power is applied. During system initialization and loading, system software checks the POC status of hardware and restricts loading and operation of those hardware

units that have a bad status indication. Host-originated POC requests are ignored by the cluster controller software.

6.2.5 System Verification Procedure

A system verification procedure is supplied as a part of Customer Setup (CSU) documentation. The procedure is provided for the customer to evaluate system configuration and operation.

6.3 ERROR DETECTION, REPORTING, AND RECOVERY

To limit error propagation, errors will be detected as close to the error source as feasible. Then, if the errors were the result of an intermittent fault, recovery could be effected by simply retrying the operation. The error detection mechanisms must cover all levels of operation; however, if it is not feasible to provide error detection on a low level, it is then necessary to provide it on a higher level to preserve the integrity of data handled by the system. System software provides error detection capability for errors which cannot be readily detected by hardware and firmware. The objective in all of the error detection is to avoid leaving undetected errors in data belonging to users. The user will be notified if erroneous data must be passed to him. It is then left to the user to correct the errors.

Software has the responsibility to detect:

- Operational errors from software mechanisms (for example, executive requests, communications protocols, or file management).
- Propagated errors
- Input errors

6.3.1 Methods for Error Detection by Software

The principal methods used for detection of errors by software are:

- Validity checks on data (Is it in the proper form, format, and range?)
- Validity checks on new data entered into system tables

6.3.2 Error Reporting, Logging, and Analysis

An error log is provided to record errors detected by the system. The detecting mechanism (whether hardware, firmware, or software) provides basic information through the error log for local display.

It is not necessary to display reports of all detected errors. This is especially true of transient errors which are immediately corrected by a low-level retry activity and for those memory errors which are corrected by ECC (UTS 4040 only).

The analysis is a simple decision making process (software) concerned with what to do about the error. If no recovery procedure is available, the error is termed "hard," and the equipment in which it has occurred is stopped. Otherwise, a recovery procedure may be initiated depending on further analysis. When equipment is stopped, the operator or user is informed of the reason for the stoppage and provided with directions to either reinitialize and restart or to obtain maintenance assistance.

6.3.3 Error Recovery

Recovery from an error requires that the error be corrected and that processing proceed with full data integrity. For these reasons, it is desirable that error detection be performed on a low architectural level so that the domain of propagation is both small and known and so that it is feasible to recover from an error by repeating the process which produced it.

In the UTS 4000 equipment, most error detection is on a low architectural level, and most error recovery is accomplished by retry methods which do not involve software except in analyzing the error. When such recovery is either not available or ineffective, software procedures are provided which will do one of the following:

- Attempt recovery on a higher level
- Inform the user of the situation so that he may effect his own recovery
- Stop operating

To facilitate recovery, the software is designed for "fail soft" operation. For example, diskette file handlers always leave the diskette in such a condition that a failure of the cluster controller will make it possible to retrieve the data stored on the diskette.

6.4 REDUCED RESOURCE OPERATION (DEGRADED MODES)

The cluster controller supervisor maintains an awareness of operating equipment versus that which is out of operation. The system provides a degraded operation such that:

- The failure of one workstation shall not affect the operation of other workstations unless they are using system peripherals connected to the failed workstation.

- The failure of a peripheral attached to a workstation shall not affect the operation of the workstation beyond the unavailability of that peripheral.

- The UTS 4000 shall provide recovery from errors with minimal data loss, operator effort, and time.

6.5 FAULT ISOLATION AND REPAIR

The involvement of software in this area is two-fold and provides:

- Software tools (diagnostics) for fault isolation of hardware faults

- The isolation and repair (correction) of software faults

6.5.1 Hardware Diagnostics

The principal diagnostic tools for isolating hardware faults are the power-on confidence (POC) test and super POC test. These tests start with ROM-resident microcode and then expand to software which is read from the diskette. A POC provides a general test of a unit to give confidence that it is capable of operating correctly. The cluster controller POC test program is designed to detect at least 80 percent of the failures in the hardware responsible for loading diagnostics. Isolation is to the PCA level. If other diagnostic programs are required, they will be prepared by Customer Engineering and are not considered part of the UTS 4000 software.

6.5.2 Software Diagnostics and Repair

Software test programs are different from hardware diagnostics mainly because software does not fail spontaneously. Hardware faults are the result of spontaneous or induced failures. Software faults generally fit one of three categories:

- Built-in - Caused by faulty design or mistakes in implementation

- Acquired - Caused by mistakes in making program changes

- Induced - Because of other faults in previously correct operating code. (This may happen during compilation, system configuration, or operation.)

The tests are on two levels: functional and logical. The former provides input and checks responses to assure that all program functions operate correctly. The latter provides input to force program control through all logical path segments of the program. Responses of the program are checked to assure that the logic is correct.

These diagnostic programs are used to validate new releases of the software as well as to validate correct operation after field changes have been made. They must be maintained, in parallel with the programs they test, so that each time a change is made in the software, a corresponding change is reflected in the diagnostic.

Official changes for correction of software faults are made at the software development center and are disseminated through new releases. The existence of faults is made known through SURs from the field and temporary fixes may be made in the field. The permanent fixes must be made and thoroughly validated at the software development center prior to being disseminated in new releases. Reference Section 12 for a discussion of the software development tools.

7 PERFORMANCE OBJECTIVES

The distributed function architecture of the UTS 4000 provides the opportunity for parallel processing among several functions of the system. Workstations, workstation communications, and 8-bit peripheral devices as well as host communication line modules are designed to run concurrently with the cluster controller user and system programs. The I/O line modules contain individual line buffers requiring fewer references to the main memory. The instruction set used by the cluster controller is functionally enriched to improve system performance and utilization of main storage.

The UTS 4000 system software will be designed to take advantage of the hardware architecture in the interest of improved performance and system stability. System and user programs will reduce the number of processor cycles required to perform a given task by using parallel processing. This is provided by various processors executing microcode independently from the cluster controller execution.

System level performance is specified in the following passages for typical configurations of the UTS 4000 both with and without terminal-resident applications.

7.1 PERFORMANCE WITHOUT CLUSTER-RESIDENT APPLICATIONS

For environments without cluster-resident applications, the UTS 4000 family will interact with supporting host processors, accommodating maximum configurations and data transfer rates as specified in the following paragraphs.

7.1.1 UTS 4020 Cluster Controller Performance

The UTS 4020, configured as shown below, uses less than 70 percent of the cluster controller processor cycles.

- Up to twelve workstations, each operating at ten characters per second (cps) in buffered mode, with the combined input and output characters passed to and from all workstations not to exceed 1000 characters per second.

- Transmitting to and receiving from a host processor on a 19.2 Kbps HDX communications line.

- Configured with a full complement of peripherals on each of four 8-bit I/O interfaces. A diskette on one of these 8-bit peripheral interfaces can be actively reading or writing up to three 256-byte sectors per second without the read-after-write function. The combined activity of the other 8-bit peripheral interfaces during the performance measurement can be up to 1200 cps.

7.1.2 UTS 4040 Cluster Controller Performance

The UTS 4040, configured as shown below, uses less than 70 percent of the cluster controller processor cycles.

- Thirty workstations, each operating at 10 cps in buffered mode with the combined input and output characters passed to and from all workstations not to exceed 2000 cps.

- Transmitting to and receiving from a host processor on a 19.2 Kbps HDX communications line.

- Configured with a full complement of peripherals on each of six 8-bit I/O interfaces. A diskette on one of these 8-bit peripheral interfaces can be actively reading or writing up to three 256-byte sectors per second without the read-after write function. The combined activity of the other 8-bit peripheral interfaces during the performance measurement can be up to 1500 cps.

7.2 PERFORMANCE WITH CLUSTER-RESIDENT APPLICATIONS

The UTS 4000 system performance is specified relative to logically-equivalent UTS 400 configurations for typical cluster controller, cluster-resident application environments. An environment is characterized by:

- The configuration of hardware and program products

- The load mix (type of work) and load intensity (amount of work)

The load mix is a set of work schedules for requesting service from systems resources. These schedules are represented by work flows and may have more than one process coursing through it.

For a given load mix, one can increase the load intensity by increasing the number of workstations (e.g., processes) simultaneously coursing through one or more of the schedules representing the load mix.

For each environment, a unit of user work (unit-of-work) is identified and an index of performance, relative to the UTS 400, is defined in terms of:

- The quantity of unit-of-work transactions processed in unit time
- The average transaction on response time as seen by the users

7.3 COBOL PROGRAMS IN CLUSTER CONTROLLERS

The following terms are defined to facilitate discussion of system resource schedules:

- Configuration: A cluster, consisting of either a UTS 4000 or a UTS 4040, with the full complement of memory, a variable number of workstations, and a diskette attached to the cluster controller. The program product used is "UTS 4000 Cluster Controller Program - UTS 400 Mode."
- Unit-of-Work: A COBOL-compiled program which generates a known amount of CPU activity followed by a diskette access such that the diskette I/O is not a limiting factor. The COBOL program is segmented to fit the available memory.
- Load Mix: One workstation running a COBOL program while all others perform interactive communications with the host processor. The service time (designated by steps 5 through 7) is fixed at 1.0 second. The schedule of the system resource for the COBOL program is depicted below:

  1. Process data (controller)
  2. Output transmission (controller to peripherals)
  3. Return to step 1

  The schedule of the system resources for all other users is depicted below:

  1. Wait on operation reaction (workstation)
  2. Operator key-in message (workstation)
  3. Input transmission (workstation to controller)
  4. Input processing (controller)

5. Input transmission (controller to host)

6. Processing (host)

7. Response transmission (host to controller)

8. Response processing (controller)

9. Response transmission (controller to workstation)

10. Display response (workstation)

11. Return to step 1

- Load Intensity: The maximum cluster controller environment load intensity is as follows:

For the UTS 4020 cluster controller:

- Eleven workstations performing interactive communication with the host processor, each workstation operating at 10 cps in buffered mode with combined input and output characters passed to or from all workstations not to exceed 1000 cps.

- Transmitting to or receiving from a host processor on a 19.2 kbps HDX communication line.

- One workstation running with a COBOL program which is reading or writing up to three 256-byte sectors per second on one 8-bit peripheral interface (without read-after-write), providing a combined I/O activity of 1200 cps on three other 8-bit peripheral interfaces.

For the UTS 4040 cluster controller:

- Twenty-nine workstations performing interactive communications with the host processor, each workstation operating at 10 cps in buffered mode with the combined input and output characters passed to or from all workstations not to exceed 1500 cps.

- Transmitting to or receiving from a host on a 19.2 kbps HDX communication line.

- One workstation running with a COBOL program which is reading or writing up to three 256-byte sectors per second on one 8-bit peripheral interface (without read-after-write), providing a combined I/O activity of up to 1500 characters per second on five other 8-bit peripheral interfaces. The workstation will be transmitting or receiving up to 500 characters per second.

7.4 PERFORMANCE GOALS RELATIVE TO UTS 400 PERFORMANCE

The UTS 4020 will execute a COBOL unit-of-work at 1.5 times the rate of a corresponding UTS 400 system having only one-half the number of workstations. The UTS 4040 will execute a COBOL program unit-of-work at 1.5 times the rate of a corresponding UTS 400 system having one-fourth the number of workstations.

8 STANDARDS

8.1 DOCUMENTATION STANDARD

This Product Software Description conforms to UNIVAC Standard S500 E 002, Level B.

Component Product Software Description (CPSD) comply with Univac Standard S500 E 002, Level B.

8.2 LANGUAGE PROCESSOR STANDARD

The American National Standard COBOL is specified in publication X3.23-1974, Programming Language for COBOL. Extensions supporting an interactive screen display are not currently covered by industry standards. A full description of UTS COBOL implementation is available in UP 8481, UTS COBOL Programmer's Reference Manual.

8.3 COMMUNICATION STANDARD

The communication standards for the UTS 4000 system are outlined in the following sections.

8.3.1 Uniscope Terminal Protocol

The UTS 4000 supports the UNISCOPE terminal protocol as defined in the UNISCOPE Display Terminal Programmers Reference Manual, UP-7807.

8.3.2 UTS 400 Protocol

The UTS 4000 supports the UTS 400 protocol as defined in the UTS 400 Programmer Reference Manual, UP-8359.

8.4 DATA SYSTEMS STANDARDS

The following data standards are used as described in UNIVAC Data Systems Standards, Volume 1. The internal UTS 4000 code is ASCII.

- ASCII -- S300 E 000
- Katakana -- S300 E 005

8.5 MASS STORAGE STANDARD

P720E015, Recording Formats for Flexible Diskettes (Single-Density)

P720E017, Recording Formats for Flexible Diskettes (Double-Density)

8.6 SYSTEM ERROR PERFORMANCE STANDARD

The UTS 4000 system control software complies with the System Error Performance Design Practice, P600 E 012, as it relates to a small-scale unit processor system.

9 STANDARDS DEVIATION

9.1 DATA STANDARD

The following data standards deviation will apply:

- Univac Standard P600E10, System Reliability Design Practice. Error correction codes are not provided for diskette data due to cost considerations and the requirements to be industry compatible. Diskette data is protected by error detection codes.
- Univac Standard P720E017, Recording Formats for Flexible Diskettes (Double-Density). The UTS 4000 system diskette recording format is compatible with the IBM single- and double-density format, except for ASCII.

9.2 UNISCOPE 100 AND 200 FEATURES NOT SUPPORTED

- The 7-bit auxiliary device capability of the UNISCOPE 100 and 200 Display Terminals will not be supported.
- The UTS 4000 as a follow-on to the UTS 400 supports the UNISCOPE 100 and 200 features in the same way as the UTS 400. Reference the UTS 4000 Product Family Product Description, number R-50223, Section 4.1.7.1 for detailed information of these differences.

9.3 UTS 400 FEATURES NOT SUPPORTED ON THE UTS 4000

- Reference the UTS 4000 Product Family Product Description number R-50223, Section 4.1.7.2 for detailed information on the feature differences.

10 USER DOCUMENTATION

Because of the new requirements of customer installability for the UTS 4000 system, there are now two categories of user documentation: standard user publications (that set of documents used to support previous product lines) and customer set-up (CSU) publications (those documents pertaining to customer ordering, unpacking, installation, and system verification).

10.1 STANDARD USER PUBLICATIONS

10.1.1 System Description

The system description is an overview of the system, describing how the various features fit together to produce certain applications. As such, configurations as well as the functional aspects of the system are discussed.

10.1.2 Operator's Guide

The operator's guide describes the operating procedures of the UTS 20W and UTS 40W workstations. It also provides a general picture of how the workstations fit into the cluster and how the cluster fits into the overall network.

10.1.3 System Reference Manual

The system reference manual contains information which must be considered for programming a UTS 4000 system. It provides detailed descriptions of the system structure, operational theory, and UTS 4000 programming techniques. Primarily, it is a manual of what to consider to fit the UTS 4000 into the host network of terminals.

10.1.4 UTS COBOL Programmer Reference

The UTS COBOL programmer reference manual provides the customer with all the UTS COBOL functions supported on the UTS 4000 and how to use these functions. This manual describes how to develop UTS COBOL prorgrams using features that are an extension of the standard COBOL. The manual covers compiling, collecting, and debugging COBOL programs for the UTS 4000 system.

10.1.5 Programmer Reference Manuals (Text Editor, Edit Processor, Interactive Program Generator and Loadable Character Set Generator)

These Programmer Reference Manuals provide the customer with a description of functions provided by the program products and how to use the functions. Program operation and user interfaces are explained along with operational considerations for product use.

10.2 CUSTOMER SET-UP PUBLICATIONS

10.2.1 System Ordering Guide

System ordering guides enable the customer to properly configure his own system and to develop an equipment order with little or no help from Sperry Univac personnel. (However, the customer will have the option of requesting assistance.) The content of this publication is formatted in such a way as to allow the customer to determine whether the equipment complement shipped agrees with the order.

10.2.2 Site Preparation Guide

Site preparation guides are used by the customer to prepare the site, or sites, for installation of the hardware. The content includes environmental and power considerations, size and weight information, cabling information, and so forth. As with the equipment ordering process, the customer is able to request assistance with this part.

10.2.3 Unpacking Guide

Unpacking guides allow the customer to safely remove the equipment from its shipping container and packing material. Additionally, the publication will aid the customer in determining whether the content of the shipping container is correct.

10.2.4 Installation Guide

Installation guides enable the customer to completely install all equipment declared customer installable without assistance from the Sperry Univac system analyst or customer engineer, although each customer will have the option of requesting such assistance. Each installation guide will include installation and cabling data, instructions for initial set-up and power turn-on as well as any related POC data.

10.2.5 System Verification Guide

System verification guides allows the customer to parameterize the system, load applicable software, and determine whether the system is operable. Each system verification guide contains data pertinent to applicable peripherals and auxiliary devices.

11 SOFTWARE SUPPORT

11.1 CATEGORY 1 SOFTWARE

The UTS 4000 system control software (including Univac-supplied terminal/cluster supervisors, device/communication handlers, host interfaces, COBOL user program interfaces and capabilities, and documentation for the above) is considered Category 1 software and is therefore supported by Sperry Univac. Software type numbers T6180-00 and T6180-01 are separately priced products and follow policies and procedures established for separately priced control and distribution.

11.2 DEVELOPMENT SOFTWARE

System software development aids are not Category 1; these include the following:

- PLUS compiler
- Assemblers
- System Debug monitor
- Performance drivers and monitors
- All software test routines

12 SOFTWARE DEVELOPMENT TOOLS

All software will be devloped using the 1100 Series computer system and associated OS-1100 System processors.

12.1 ASSEMBLERS

12.1.1 Terminal and Line Module Cross-Assembler (Z80)

A microcode cross-assembler is supplied for development of a terminal supervisor for the workstation. The cross-assembler uses a set of procedures written for the UNIVAC 1100 Meta Assembler (MASM).

12.1.2 Cluster Controller Cross-Assembler

A cluster controller cross-assembler is available to develop the cluster controller software. It allows code to be assembled in modular groups and use the Series 1100 collector to resolve relocatable addresses.

12.1.3 UTS 4000 "PLUS" Cross-Compiler

A "PLUS" cross-compiler operating on the series 1100 system is used to develop system software. It allows PLUS coding development on the Series 1100 which results in UTS 4000-generated assembly code that is subsequently loaded to the cluster controller.

12.1.4 Cluster Controller Microcode Cross-Assembler

A UTS 4000 microcode cross-assembler will be available for use on the 1100 Systems. This cross-assembler uses the standard 1100 MASM and converts microassembler code to object code for use by the microcontroller within the cluster controller.

12.2 DEBUG MONITOR

A debug monitor is provided for the cluster controller. This monitor is used for interactively controlling the execution of UTS 4000 software machine language code. Supported facilities include such functions as setting breakpoints, displaying and/or changing memory or register contents, and redirecting control flow.

12.3 DUMP ANALYSIS

To facilitate analysis of system failures and problems, memory dump utility programs are provided which run on a cluster controller.

12.4 LIBRARY MANAGEMENT

Development systems are organized into library files by level of development and release systems. Through this organization, changes and fixes can be traced through release system to insure that releases are made containing tested and operational features.

13 QUALITY ASSURANCE

The purpose of quality assurance is to guarantee a high-quality product for the marketplace. To achieve this goal, software and hardware works collectively towards specific goals and uses whatever testing and performance monitoring is necessary to assure these goals.

13.1 QUALITY GOALS

The quality goals are outlined in Sections 6 and 7. The mean time between stops (MTBS) is accepted as described in P600 E 012 as it relates to small scale unit processor systems.

13.2 METHODOLOGY

To achieve the product quality desired, a system of development and testing for both hardware and software has been established.

13.2.1 Development Language

The UTS 4000 software is being designed using structured programming tools for development and implementation. The tools are primarily high-level languages which check logic, provide structured charts, and document the design. Implementation of the design for select system components will use assembly language.

13.2.2 Design Review

Individual software designs are reviewed during development by a review team to assure quality and functionality. This insures that portions of the system do not rely solely on the efforts or integrity of any single individual.

13.2.3 Code Review

Code is reviewed before system integration to insure that functionality, interfaces, and basic design are correct. The review allows any approved suggestions by the review team to be implemented in a timely manner before system testing.

13.2.4 Module Testing

Individual modules are tested and integrated in the system development. Testing will be performed in a "top down" order.

13.2.4.1 System Test

System testing begins when the entire system has been put together, testing the collective functionality and stability of the entire system. When reasonable stability has been achieved, Beta testing can begin.

13.2.4.2 Beta Test

A Beta test consists of configuring and testing the system at selected CUE or customer sites.

13.2.4.3 Quality Assurance Testing

Quality assurance testing will be performed by a separate department to assess system quality with respect to the goals established for the product.

13.2.4.4 Qualification Test

When the software and hardware conform to the established goals during Beta test, they are released to marketing for in-house, qualification testing and at marketing-selected customer sites for marketing-controlled tests.

13.2.5 Software Contol Mechanism

OS-1100 SSG-based utilities will be used to create and maintain a controlled environment for software modules.

14 BRIDGING

The UTS 4000 software bridges the operational aspects and functional applications from the UNISCOPE 100 and 200 display terminals through the UTS 400 system.

14.1 UTS 400 CUSTOMERS

The UTS 4000 supports the UTS 400 basic functionality while simultaneously allowing an upward compatibility with UTS 4000 concept. Additionally, an expansion path to distributed processing is available to the user. COBOL programs written for the UTS 400 will run on a UTS 4000 and are expandable to the native mode of operation. These programs require some minor changes and recompilation to support the identical hardware features, and modification to add additional UTS 4000 features.

14.2 UNISCOPE 100 AND 200

The UTS 4000 is limited on how closely it will support all the features and peripheral interfaces of the UNISCOPE 100 display terminal; these are explained in Section 9. Despite this, the UTS 4000 offers a cost-effective follow-on to the UNISCOPE display terminals.

GLOSSARY

ARM	Standards for Availability, Reliability, and Maintainability functions within Sperry Univac products. Where: (1) availability is the capability to operate for long periods of time and to be repaired and recover quickly from failures and errors, (2) reliability is the capability to operate correctly for long periods of time without having to stop for repairs, and (3) maintainability is the capability to be repaired and to recover quickly.
ASCII	American Standard Code for Information Interchange.
BDE	IBM Single-Density Basic Data Exchange format.
Beta tests	Initial system testing at selected customer and CUE sites before system release.
bps	Bits per second.
cluster controller	A programmable, intelligent, microprocessor-based device which controls the activities of the cluster. The workstations depend on the cluster controller for initial loading of the microcode and subsequently for their interface to peripheral devices as well as to the communications line to a host processor.
COPY	Transfer a designated file to another file or device.
CPSD	Component Product Software Description.
CRT	Cathode Ray Tube.
DCA	SPERRY UNIVAC Distributed Communications Architecture.
DDP	Distributed Data Processing.
DID	Device Identifier, the third level of communications line addressing.

downline	Communication from host processor to terminal (e.g., downline program load).
EBCDIC	Extended Binary-Coded Decimal Interchange Code.
exclusive-use	A device or file capable of being addressed, or used, by only one workstation at a time.
FCC	Field Control Character.
firmware	Microcode which has been stored in read-only memory.
FDX	Acronym for full duplex.
HDX	Acronym for half duplex.
ILD	Integral Load Device. (Specifically, a diskette built into and made an integral part of the cluster controller.)
kbps	Kilobits per second.
kilobyte	1,024 eight-bit bytes.
LPM	Lines Per Minute.
macrocode	A sequence of macroinstructions.
macoinstructions	A single computer instruction that stands for a sequence of micro-operations.
macromemory	Memory where macroinstructions are stored.
MASM	SPERRY UNIVAC Meta Assembler.
megabyte	1,048,576 eight-bit bytes.
microassembler	An assembler used on the 1100 series computer to assemble UTS 4000 microcode.
microcode	A sequence of microinstructions.
microinstruction	A computer instruction corresponding to a single machine operation.
microRAM	An area of random-access memory used to store microcode.
MTBS	Mean Time Between Stops.

offline	Activities not requiring communications interface with the host processor.
online	Activities requiring communications interface with the host processor.
PDN	Public Data Network.
PLUS	An acronym for Programming Language for Univac Systems.
POC	Power-On Confidence test.
PREP	To format a diskette for subsequent read or write activities.
program state	A subdivision of the processor which executes a single given program by accessing a unique register set, memory range, and I/O port. Each workstation functions through a unique program state.
PSD	Product Software Description.
RAM	Random-Access Memory.
reentrant	A program characteristic that allows multiple entry by using tables supplied to the program for the storage of variable parameters and data.
RID	Remote Identifier, the first level of communications line addressing.
ROM	Read-Only Memory.
RPDC	Request for Product Description Change.
SID	Station Identifier, the second level of communications line addressing.
SSG	Skeleton System Generator.
SUR	System User Report.
SVR	Supervisor Request.
TCS	Acronym for SPERRY UNIVAC Model 610 Tape Cassette System.

UTS	Universal Terminal System; as in UTS 400, UTS 700, and UTS 4020.
X.21	Circuit-switched Public Data Network standard.
X.25	Packet-switched Public Data Network standard.

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