The following corrections are included in TSX-Plus version 6.0:

1. When a .CLOSE is performed to an I/O channel that is opened to a CL device, or a SET CL LINE=n command or EMT is executed, a check is made to see if any output is currently pending in the output ring buffer for the CL unit. If there is pending output, the job is suspended until the output is completed or until a maximum of 20 seconds of time have elapsed. This prevents truncation of CL output issued just prior to disconnecting the CL unit from a line.

2. TSX-Plus would lose the first character typed after initiating a logon after the terminal had been turned off or a break character was transmitted to the system. This problem only occurred on lines which were not generated with autobaud speed setting.

3. A job would lose the memory mapping to PLAS regions when a shared run-time system was disassociated from the job.

4. TSX-Plus would generate XON/XOFF flow control characters on lines connected to DHV11 multiplexers even if the line was in use as a CL line with the BININ/BINOUT flags set.

5. The .CSIGEN EMT has been corrected. Previously, if the command line was provided by the program (rather than being prompted for by .CSIGEN), and an error was detected such as a specified device or file not existing, the .CSIGEN EMT purged all channels before returning the error code. Now the .CSIGEN does not purge the channels, so you can tell which file was in error by checking the channel status. This change makes the TSX-Plus .CSIGEN processing comply with that done by RT-11.

6. The SET LOG CLEAN command now correctly resets the highest-block-written information for the log file.

7. The keyboard monitor information message "Device is still mounted by other users" was displayed inappropriately when dismounting a logical disk.

8. The highest-block-written value for a file was incorrectly set if an invalid block number was specified with a write operation and the word count was zero. A write with a word count of zero now performs no operation.

9. The open of the spool file used to fail during TSX-Plus startup if the RT-11 device handler was not loaded. Now the initialization code fetches the handler before trying to open the spool file.

10. Register 0 (R0) was destroyed if a BPT instruction was used in a program to cause the TSX-Plus debugger to be started. This problem only occurred when the BPT instruction was executed before the debugger had been initialized (i.e., it didn't occur when BPT was executed as a result of having set breakpoints with the debugger).

11. A system crash could occur if data caching was enabled for a device at the time that an I/O request for the device was waiting for a free UNIBUS map register. This problem could only occur on UNIBUS systems with more than 256 Kb of memory.

12. A .CHAIN EMT used to call the handler abort entry points, it no longer does.

13. A problem in TSAUTH has been corrected which prevented the KILL command from removing all selected accounts when a wildcard was specified.

14. The .SPCPS EMT did not work.

15. A user defined command of the form:

    XXX:==R DIR DK:\R DIR DK:

    used to only execute DIR one time (the second part of the command was ignored).

16. The EMT to send a message to another line did not correctly truncate the message if it was too long.

17. A system hang could occur if a terminal read timeout occurred at the same time that a character was received from the terminal.

18. The .CSISPC EMT to parse a file specification allowed two dots in the file name.

19. CCL version 3.00L corrects two problems. The /DELETE and /REMOVE library command switches now generate an output file (with the same name as the input file) when only one file is specified on the command line. Several command switches (/LIST, /MAP, /PRINT, etc.) no longer interfere with the positioning of other switches (/BEGIN, /PASS, etc.) in the expanded command line.

20. SYSMON changes.

20.1 SYSMON was altered to display all three digits of the job priority in the job execution status display. The PRIV flag was removed from the terminal status display, in accordance with the new privilege structure.

20.2 The SET SL SUBSTITUTE option was added to the terminal display screen.

20.3 A zero length message no longer causes a trap in the message display screen.

20.4 The message display screen now requires either OPER or SYSPRV privilege to run (in addition to MEMMAP). You may install SYSMON with OPER or SYSPRV in addition to MEMMAP to bypass this restriction if desired.

20.5 The CL line display has been modified to display up to 16 lines, CL0 - CL7 and C10 - C17.

20.6 The third terminal status line is now correctly cleared in the terminal status display.

21. A correction was made to prevent a log file from continuing to write onto the device when a USR error occurred during closing of the log file.

22. Read and write operations with word counts of 0 (zero) are now ignored (treated as NOP´s) rather than returning error codes.

23. The DL and DM handlers contain corrections for bad block replacement operations.

PRO/TSX-Plus is a multi-user, multi-tasking, real-time operating system for Digital Equipment Corporation Professional 300 series computers with up to 4Mb main memory.

PRO/TSX-Plus is fully compatible with TSX-Plus, S&H's multi-user, multi-tasking, real-time operating system for Digital's PDP-11 minicomputers. TSX-Plus is currently in use at over 4000 sites worldwide.

PRO/TSX-Plus provides the functionality of the Digital RT-11 operating system to multiple users on a time-sharing basis. With well over 80,000 licensees world-wide, RT-11 is Digital's most widely used operating system. Although RT-11 and PRO/TSX-Plus include many sophisticated features, they retain the emphasis on ease of use and human engineering pioneered by RT-11. Thus RT-11 and PRO/TSX-Plus are well suited for the novice as well as the experienced user.

PRO/TSX-Plus provides 3 time-sharing lines

PRO/TSX-Plus allows use of the console terminal and two auxiliary terminals connected through the printer and communication ports as time-sharing lines. The CL facility permits redefinition of the printer port or communications port for spooled printing, communications, or other I/O functions as defined by the user, thus providing maximal flexibility in use of system resources.

PRO/TSX-Plus includes: three time-sharing lines; three virtual lines; two detached lines; three extra CL units (one spooled); generalized data cache; 64Kb virtual job regions; virtual array and virtual overlay support (PLAS); shared file record locking; message channels; user defined commands; logical subset disks; single line editor; and the SYSMON utility.

RT-11 Compatibility

Most programs that run with RT-11 will run with PRO/TSX-Plus without modification. PRO/TSX-Plus interfaces with standard RT-11 device handlers (XM version) and supports RT-11 utility programs. PRO/TSX-Plus keyboard commands include those provided by RT-11, with significant extensions. PRO/TSX-Plus supports most system service calls (EMT's) provided by the RT-11XM monitor. (The RT-11 multi-terminal EMT's and the BATCH utility are not supported.) Devices supported by RT-11 are also supported by PRO/TSX-Plus.

Productivity

PRO/TSX-Plus allows the same machine to simultaneously support production use, program development and real-time control. Through the virtual line and detached job features, individual users have concurrent control over multiple jobs.

PRO/TSX-Plus allows dynamic redefinition of time-sharing lines for use as serial I/O devices. For example, the communication port may be used at times as a "dial-in" time-sharing line, and at other times may be taken over for use as a "dial-out" communication line to a remote computer. The printer port may be used either as a time-sharing line or to drive a printer or other output device.

High-Speed Execution

PRO/TSX-Plus addresses all installed memory on the Professional 300 series, up to 4Mb. Up to 64Kb is available to each job, and it is possible for jobs using virtual overlays or virtual arrays to utilize all the physical memory not reserved for the operating system. For the PRO 350, up to 8 jobs may be in memory at the same time, allowing rapid switching between executing jobs.

PRO/TSX-Plus caches recently used directory entries to eliminate directory searches for frequently accessed files. PRO/TSX-Plus also provides general purpose data caching for all mounted devices. Caches are used to keep copies of recently or frequently used disk information in memory. Then, when jobs need to read the cached data, the operating system automatically supplies it from the cache, eliminating unnecessary disk access, and thus speeding program execution.

Highly Productive Development

Compiling and linking programs under PRO/TSX-Plus can take a fraction of the time required under other multi-user operating

systems. As an example of the performance attainable under PRO/TSX-Plus, the following table contains performance figures for COBOL-Plus. The first compile rate and link time shown were measured with a 300 block data cache installed, the second measurements, shown in parenthesis, were made without data cache.

COBOL-Plus

Hardware		Compile Rate		Link Time	
CPU	Disk	lines/minute		sec/1000 lines	
11/44	RM02	3117	(2487)	4	(4)
11/73	RL02	1793	(1470)	4	(4)
PRO350	RD51	1225	(490)	8	(12)

Editors supported by PRO/TSX-Plus include KED, K52, TECO and others. Languages available for use with PRO/TSX-Plus include MACRO-11, C, PRO/COBOL-Plus™, FORTRAN, FORTRAN-77, Pascal-2, DBL and BASIC.

The program debugging facility allows a programmer to examine and modify the program and to set breakpoints. The debugger does not have to be linked with the program being debugged, and does not reduce the program's memory space.

Efficiency

Through the Adaptive Scheduling Algorithm™, PRO/TSX-Plus overlaps terminal interaction time, I/O wait time and CPU compute time for all jobs. The result is a tremendous increase in the productivity of the computer. Compute-bound jobs can soak up idle time while many users perform file editing, program development or data entry. Jobs are classified for execution as high, interactive or low priority tasks. Within the interactive group, job scheduling is optimized for terminal operations.

Real-time Concurrent with Time-sharing

PRO/TSX-Plus provides facilities for real-time jobs which may control their memory mapping, I/O page access, execution priority, and swapping. Real-time jobs may run concurrently with other time-sharing jobs, or disable time-sharing.

Many Compatible Software Products

S&H's Compatible Software Products list currently includes over 50 sources of vertical applications, 10 word-processing packages, 5 electronic mail packages, 9 networking and/or file transfer packages, 6 spreadsheet and financial modeling packages, graphics packages, 2 statistical analysis systems, 5 COBOL and/or DIBOL program and report generators, 6 editors, 4 sources of cross assemblers, 11 database management systems, and 37 sources of utilities, device handlers and miscellaneous packages; over 190 packages in all.

Digital's PDP-11 Software Source Book lists over 425 applications and 300 systems software products available under RT-11. Many of those products are compatible with PRO/TSX-Plus.

Simplicity and Flexibility

In order to time-share with PRO/TSX-Plus, the user boots to RT-11 FB and then types the command R TSX. In about 15 seconds, PRO/TSX-Plus completely replaces the RT-11 monitor and assumes control of the computer system.

PRO/TSX-Plus provides a dynamic system performance display utility and other tools to analyze and optimize system performance.

Security

The optional logon facility requires users to enter a user name or project/programmer number and password before they can access the system. Users may be locked to specific programs and limited to specific physical and/or logical disks (8 logical disks per account). System usage statistics are maintained for each account.

Convenience

PRO/TSX-Plus provides user defined commands, user-written command interfaces, an extended command file facility with up to 6 parameters, autobaud dial-in communications, support for RT-11's IND, a transparent print spooler, logical disk subsetting (up to 8 logical disks for each user), shared file record locking and inter-program messages.

PRO/TSX-Plus Technical Details

The Adaptive Scheduling Algorithm™

Jobs are scheduled in three priority categories: high, interactive, and low. The range of each category is: low, 0 to 19; interactive, 20 to 79; high, 80 to 127. Each job's priority number in the 0 to 127 range may be selected either with a keyboard command or a system service call.

Jobs in the high priority range execute strictly according to priority. That is, if there are two high priority jobs, the one with the higher priority will execute whenever it is active. The lower one will only execute when the higher priority job is not executable, i.e. suspended or in a wait state. Interactive jobs will only be executed when no high priority jobs need service. Jobs in the low priority range are also executed strictly according to priority. They execute only when no jobs of any higher priority need service.

Interactive jobs are scheduled according to a more flexible algorithm based on their activity. Within the interactive priority group, jobs are scheduled mainly according to their use and only secondarily according to their priority number. Some events which influence interactive job scheduling are: terminal input; I/O completion; terminal output; and duration of execution.

The Adaptive Scheduling Algorithm™, unique to PRO/TSX-Plus and TSX-Plus results in excellent system response to terminal operators while maintaining the flexibility to handle critical real-time jobs and fill system idle time with low priority tasks. Tools are provided to assist the system manager in optimizing PRO/TSX-Plus for the individual installation.

Command Files

Up to 6 parameters can be passed to a command file from a command line. These parameters may be substituted into the command file at arbitrary points. It is possible with PRO/TSX-Plus command files to have all program terminal input come from the command file, including input accepted by use of the .TTYIN EMT. Command files that have names which do not conflict with standard system commands may be placed on the system device and executed as system keyboard commands.

Communications Device Handler [CL]

A general purpose, three-line, full-duplex, serial device handler (CL) is included. This handler permits attachment of serial printers, plotters, and other communications devices to the system through the printer and communication interfaces. One of

these units is spooled. Additionally, individual communications units may dynamically take over inactive time-sharing lines for temporary use as I/O devices, and the time-sharing lines may be later restored.

Data and Directory Caching

Directory entries for files on mounted devices are maintained in a memory cache. When the cache is full, the least recently used entries are replaced as new directory entries are needed. This eliminates possible lengthy directory searches for recently or frequently accessed files.

General purpose data caching maintains whole blocks in memory using a least-recently-used algorithm like that for directory caching. Data caching eliminates disk I/O for read operations when the desired block is in the cache. PRO/TSX-Plus reserves 150 Kb of memory for caching data from mounted devices.

As an example of the data cache's effectiveness, COBOL-Plus will compile 1225 lines per minute on a PRO 350 with PRO/TSX-Plus and a 300 block data cache. Without the data cache, the compilation rate is 490 lines per minute.

Because PRO/TSX-Plus directory and data caches are "write-through", data integrity is maintained in the event of hardware failure.

Detached Jobs

Detached jobs operate like a "batch" facility and may either be initiated automatically upon PRO/TSX-Plus start-up or by the DETACH keyboard command. Once started, detached jobs are not associated with any terminal. All terminal input for a detached job must come from a command file and terminal output is discarded or may be sent to a log file. Communication with other jobs can be accomplished by use of the inter-job message communication facility.

Dynamic System Display Utility

SYSMON helps the system manager optimize system resource use and monitor system performance. It provides dynamic screen displays of CPU and I/O resource utilization, including bar graphs of system and user execution time, and information on cache usage, and message channel, job and terminal status.

Inter-Program Messages

Running programs can send messages to each other. Messages are queued through one or more named "message channels". Receiving programs can test for the presence of messages on a named channel and can suspend their execution until a message arrives.

Logon Access Control

Users may be required to "log on" with either a user name or project/programmer number and password before being granted system access. The logon facility also keeps track of system usage statistics including the number of logons, total connect time and total CPU usage of each account.

Using the logon system, users may have access restricted to certain devices, logical subset disks, or specific files. In addition, individual terminals or users may be "locked" to a particular program so that program is automatically executed at logon and the user is "logged off" on exit or abort from that program. Command files may also be specified for execution whenever a user logs off.

Start-up and log-off command files cannot be aborted by the user. They are used to restrict device and file access, grant certain types of privilege, and restrict maximum job priority.

Memory-management Implementation

PRO/TSX-Plus utilizes the memory management facilities of the Professional 300 series computer to access up to 4Mb of memory. The memory management facility protects the system by preventing user jobs from halting the machine or storing outside their program regions. Up to 64Kb of memory is directly available to each job. A "MEMORY" command can be used to control the memory space allocated to a job. Through the use of virtual overlays and/or FORTRAN virtual arrays, jobs may use all of free memory up to 300 Kb. Up to 8 jobs may be resident in memory at the same time.

When there are more jobs active on the system than total memory space, PRO/TSX-Plus uses a priority and time-slice scheduling system to determine which jobs to keep in memory and which to swap out to disk file. Jobs are never swapped unnecessarily.

Printer Spooling

When the spooled communication unit is attached to the printer port, it supports automatic spooling. The spooler supports forms, including form requests, alignment, and locking. All files needing the currently mounted form may be printed before form changes, or forms may be mounted in the order of requests in the output queue. The most recent portion of the current file may also be reprinted in case of paper jams, and individual entries in the spooler queue may be deleted.

Program Debugging

A program may be debugged by simply starting it with the RUN/DEBUG command. The debugger is implemented as a system overlay, so that the program need not be modified, the debugger need not be linked with the program, and it does not conflict with the job's memory space. The program may be executed and modified and break points may be set. Program execution may be dynamically interrupted from the keyboard as if a break point had been hit. Instructions may be decoded and displayed as their symbolic assembler mnemonics.

Real-time Program Support

Real-time programs can be run concurrently with normal time-sharing operations. Real-time programs may also change their virtual memory mapping, access the I/O page, convert virtual to physical addresses, influence job scheduling and execution priority, lock themselves in memory, and specify devices to be reset on program termination.

Shared Files and Record Locking

File access for several cooperating programs that wish to share a common file can be coordinated. A program may request exclusive access to one or more blocks within a file. If the blocks are not locked by another program, the access is permitted. Otherwise, at the program's option, an error code is returned or the program is suspended until the desired blocks are available.

Virtual Lines

Virtual lines allow each time-sharing user to control several simultaneously running programs from a single terminal. This is done by allowing the user to logically disconnect the terminal from the primary time-sharing line and reconnect it to a different virtual line. A virtual line may be used just like an additional terminal. When a program that is not currently connected to a time-

sharing line writes output to the terminal, the output is stored in a buffer area; when the buffer is filled, the program is suspended until the user reattaches to the program and accepts the queued output. Switching to a virtual line is accomplished by typing control-W followed by a digit that selects the line to which the user wishes to attach.

Hardware/software Required

CPU: Professional 300 Series
Minimum memory for time-sharing: 512 Kb
Minimum disk storage for time-sharing: 5 Mb Hard Disk
Operating system: RT-11 Version 5.01

Who is S&H?

S&H Computer Systems, Inc. was established in 1975 with the goal of providing efficient systems level software that would take full advantage of the Digital Equipment Corporation PDP-11 computer systems. The introduction of TSX in that year revolutionized the use of small PDP-11 systems by time sharing the RT-11 operating system.

Today, over 5,000 PDP-11 sites in the USA and 25 countries benefit from S&H's dedication to high performance: RTSORT (R), a fast and flexible disk sort; COBOL-Plus (R), a mainframe and micro Cobol compatible ANSI-74 Cobol; and TSX-Plus (R), a general purpose, multi-tasking, multi-user operating system supporting up to 4Mb of memory on the PDP-11. In 1984, S&H introduced two products designed for use with the Digital's Professional 300 series: PRO/TSX-Plus. PRO/COBOL-Plus, and PRO/RTSORT.

This brochure contains the latest information available at the time of its publication. To insure you have current information regarding the features in these products and their level of implementation, please contact S&H Computer Systems, Inc., Nashville, Tennessee, U.S.A.

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