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INTERNAL REPORT No. 38

"SRL PDP-11 MAGNETIC TAPE OPERATING SYSTEM
SYSTEM GENERATION

by

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1. Introduction

The system is supplied as a set of paper tapes assembled for a 12K PDP-11. These may be loaded by the Paper Tape Software Absolute Loader into any PDP-11 having at least 12K words of read-write memory. If more memory is available, it will not be accessible to the system as supplied. The system may be expanded to fit a larger machine as described below (paragraph 4.).

2. Programs

The following programs comprise RELEASE 2 of the operating system:

IOXMTA	VØØ9A	Input/Output Executive
SRLSYS	VØØ3A	Monitor
SRLPIP	VØØ3A	File Transfer Program
ED-11M	VØØ3A	Text Editor
PAL-11M	VØØ4A	Absolute Assembler
PAL-11MR	VØØ2A	Relocateable Assembler
LINK-11M	VØØ3A	Linker
BOOT		System Bootstrap Loader
LOAD-11M	VØØ1A	Stand-alone Magtape Absolute Loader

3. Procedure for generating a 12K system.

3.1. The Loaders

a) Toggle the PTS Bootstrap Loader into locations 57744-57777 as specified in the PTS Programming Handbook (DEC-11-GGPB-D) page 6-2. An ROM

bootstrap may be used only if the machine has exactly 12K words of read-write memory.

b) Load the PTS Absolute Loader into locations 575ØØ-57743.

3.2. The Monitor Package

a) Use the PTS Absolute Loader to load IOXMTA first, then SRLSYS. SRLSYS will start itself and wait for a command.

b) Mount a write-enabled magnetic tape on any available drive, either 7- or 9-track. Position the tape to the load point and turn the unit ONLINE.

c) Type Zn , where n is the unit number of the tape to be initialized.

d) The monitor will type

.VERIFY:

Respond with a Y followed by a carriage-return. The monitor will write itself on the tape, followed by a double EOF. Each EOF causes MTS to be printed on the TTY in binary, e.g.:

```
MTS=Ø1ØØØØØØØ1ØØØØØØ
MTS=Ø1ØØØØØØØ1ØØØØØØ
```

3.3. Tape Identification

It is useful to have some information on the tape which will identify it. After becoming familiar with the monitor S command (SRL Internal Report #33), store a dummy program immediately following the monitor file, e.g.:

```
.Sn    ;n = unit #
TAPE ID FILE.  SYSTEM TAPE #ØØ1 -- 9 TRACK.
SYSTEM RELEASE 2:  SRLSYS VØØ3A AND IOXMTA VØØ9A.
INITIALIZED 3Ø-JUNE-1984/Ø-57;Ø!
```

Respond as above (Y<CR>) to the .VERIFY: message. Any other response will abort the command and allow you to try again.

3.4. System Programs

a) Before loading each program, clear memory using the monitor C command:

```
.C1000-37777
```

b) Put the binary tape for next program in the reader used for the PTS Absolute Loader.

c) Start the loader in the standard way, or by using the monitor A command. When the monitor types .SWITCHES? set bit 0 of the switch register to zero and type a <CR>.

d) When the program is loaded, restart the monitor at location 0.

e) Store the program on the initialized tape, e.g.:

```
.Sn    ;n = unit #
SRLPIP V003A 18-APR-72/50-57,1000-14177;50!
```

f) Other address limits are:

```
ED-11M V003A 19-APR-72/50-57,1000-10377;50!
PAL-11M V004A 19-APR-72/30-37,50-57,1000-36777;50!
PAL-11MR V002A 19-APR-72/30-37,50-57,1000-37377;50!
LINK-11M V003A 19-APR-72/30-37,50-57,23000--36377;50!
```

It is suggested that programs be stored in the order indicated above.

Do not attempt to store BOOT or LOAD-11M on the tape.

g) When all the programs have been stored, type

```
.In
```

to get an index of the tape. It should start with FILE 000002.

3.5. Coldstart Procedure

Normally the monitor and I/O package remain permanently resident in core. If they are destroyed either accidentally or intentionally, they may be restored quickly:

a) Load the Absolute Loader if it is not already in core.

b) Mount the initialized tape, select UNIT 1, turn it ONLINE.

c) Use the Absolute Loader to load the system BOOT loader. It will start itself, load the system, and jump to the system coldstart routine.

3.6. Power down/power up

To turn the machine off:

a) Loave the ENABLE/HALT switch in the ENABLE position.

b) Turn tape units off.

c) Turn console power off.

To restart:

a) Turn console power on.

b) Press CONT. If the monitor does not restart, do the coldstart procedure described above (3.5).

4. Procedure for generating a larger system

4.1. First generate a 12K system as described above. Become familiar with the use of ED-11M and PAL-11M. These are needed to expand the system.

4.2. Hardware requirements

4.2.1. Binary code for larger systems can be produced on a 12K machine. However, it cannot be loaded onto a formatted tape unless the required core is available.

4.2.2. In addition to the standard PDP-11 hardware, at least <u>two</u> TU-10 magtape drives are required. It is convenient if there are more than two drives available. A magtape containing the source code for all the system programs

is also required.

4.3. Size parameters

Each of the programs in the system is parametrized with respect to the memory size it is to be assembled for (except for LOAD-11M, which is size- and position-independent). Expansion to a larger memory size is done by changing one parameter in the source code and reassembling. In the assemblers, the parameter is N, which controls the size of the symbol tables. Values for N are:

SIZE	PAL-11M	PAL-11MR
12K	53.	41.
16K	99.	87.
20K	145.	133.
24K	191.	179.
28K	237.	225.

The number of user symbols available is 25N-70 for PAL-11M and 25N-82 for PAL-11MR. Thus the 12K assemblers are big enough for almost any conceivable assembly, and expansion is not likely to be necessary. If it is, N can be found at the beginning of the symbol table. If a listing is not available, use the ED-11M H command to find the string CHAR13: , then go to the beginning of the page in core and search for N= .

All the other programs, including BOOT, IOXMTA, and SRLSYS, are parametrized with respect to CORESIZE, which is set to the highest implemented memory address. Values are:

SIZE	CORESIZE
12K	57777
16K	77777
20K	117777
24K	137777
28K	157777

Do an H search for the string CORESIZE= , list the line, and make the appropriate changes.

4.3.1. NOTE: To save time at this stage, ED-11M and SRLPIP can be converted to a larger size by simple patches. Check the listings.

4.4. Editing procedure

The text to be edited has already been described. Since the programs are rather long, tape-to-tape editing is preferable, meaning two tape drives are needed. Load the 12K version of ED-11M from the tape produced in step 3.4 above. Start it using the monitor G command. If only two drives are available, demount the system tape. Mount the tape containing the source programs, and a blank write-enabled tape to receive the edited versions. Assume that units 1 and 2, respectively, have been selected:

For each program to be edited:

```
ED-11M  VØØ3A  19-APR-72
*I M1:nnn
*O M2:nnn/L    (L switch produces assembler-compatible tape)
*R
*8L    (check to see that it is the correct text)
*H
CORESIZE=
*L
*C
(new size)
*V             (verify change)
*999N          (copy rest of file)
MTS=Ø1ØØ...    (end of input file)
?
*2Z            (write EOF on output file)
MTS=Ø1ØØ...
*↑P            (restart ED)
```

4.5. Assembly

When all the programs have been edited, remount the system tape, load PAL-11M and assemble each program:

```
PAL-11M  VØØ4A  19-APR-72
*S  M2:nnn
*B  M3:nnn/2E
*L  <CR>            skip the listing
*T  <CR>            skip the symbol table
```

To save tape rewinding, the binary device file number nnn may be replaced by an asterisk (e.g. M3:*) if sequential files are to be used. Only the first assembly will require explicit file numbers.

4.6. Loading

4.6.1. LOAD-11M and the monitor package

Use the Absolute Loader to load LOAD-11M at location 1000_8. Set the switch register to 1001_8 before starting the Absolute Loader. LOAD-11M will read in, start, then halt at location 1600. Set the switch register to the number of the binary file containing IOXMTA. The binary output from the assembler should be mounted on UNIT 1. Press CONT. The tape should load, and LOAD-11M should halt at location 2074, with zero in the DATA lights. If not, an error occurred. When IOXMTA has been loaded, set the switch register to 1562, press LOAD ADDR and START. Set the file number for SRLSYS into the switch register and press CONT. SRLSYS should load in and start itself.

4.6.2. Generate a system tape in the manner described in paragraphs 3.2.-3.4., using the monitor An:mmm command instead of the Absolute Loader in steps 3.4b-3.4d.

5. Useful Documentation

In addition to this document and the program listings, the following Caltech Space Radiation Laboratory Internal Reports contain information regarding the use of the system programs:

SRL Internal Report #32 -- IOXMTA
SRL Internal Report #33 -- SRLSYS
SRL Internal Report #36 -- SRLPIP
SRL Internal Report #37 -- remaining programs

The PDP-11 Paper Tape Software Programming Handbook (DEC-11-GGPB-D) and PAL-11S Assembler and LINK-11S Linker Programmer's Manual (DEC-11-YRWA-D) are also essential references.

SYSGEN APPENDIX

MATERIALS REQUIRED

1. Hardware

   a) PDP-11 with at least 12K words of read-write memory

   b) ASR-33 Teletype

   c) TM11 Magnetic Tape Controller

   d) TU10 Magnetic Tape Transport (either 7 or 9 track)

      - at least one TU10 for 12K system

      - at least two TU10's to generate a larger system

   e) PC-11 High speed reader/punch is optional

2. Software - paper tapes

   a) PTS Absolute Loader (DEC-11-L2PC-PO)

   b) IOXMTA V00.9A Input/Output Executive

   c) SRLSYS V00.3A System Monitor

   d) SRLPIP V00.3A File Transfer Program

   e) ED-11M V00.3A Text Editor

   f) PAL-11M V00.4A Absolute Assembler

   g) PAL-11MR V00.2A Relocateable Assembler

   h) LINK-11M V00.3A Linker

   i) LOAD-11M V00.1A Magtape Absolute Loader

   j) BOOT System Bootstrap Loader

3. Software - magnetic tape

   a) Tape containing source code for programs 2b-2j above (needed only if expansion is desired).

b) Blank tape for generating 12K system

c) Blank tape for generating expanded system

4. Software - documentation

a) This document

b) Source tape contents list

c) Program listings

d) SRL Internal Report No. 32 -- IOXMTA

e) SRL Internal Report No. 33 -- SRLSYS

f) SRL Internal Report No. 36 -- SRLPIP

g) SRL Internal Report No. 37 -- other software

h) Paper Tape Software Programming Handbook (DEC-11-GGPB-D)

i) PAL-11S Assembler and LINK-11S Linker Programmer's Manual (DEC-11-YRWA-D)

ADDENDUM #1 to SRL Internal Report #38 FEB 1 1973

SYSGEN JWB

Operating System RELEASE 3

1.1 This addendum describes RELEASE 3 of the Caltech Space Radiation Laboratory Magnetic Tape Operating System, and briefly summarizes the differences between RELEASE 3 and RELEASE 2.

2.1 The following programs comprise RELEASE 3:

IOXMTA	VØ11C	Input/Output Executive (DECUS No. 11-63B)
SRLSYS	VØØ5A	Monitor (DECUS No. 11-63C)
SRLPIP	VØØ5A	File Transfer Program (DECUS No. 11-63D)
ED-11M	VØØ5A	Text Editor (DECUS No. 11-63E)
PAL-11M	VØØ4C	Absolute Assembler (DECUS No. 11-63F)
PAL-11MR	VØØ2B	Relocatable Assembler (DECUS No. 11-63G)
LINK-11M	VØØ3B	Linker (DECUS No. 11-63H)
BOOT	V4-V5	System Bootstrap Loader (DECUS No. 11-63C)
LOAD-11M	VØØ1A	Stand-Alone Magtape Absolute Loader (DECUS No. 11-63I)

3.4.e-f. Address Limits:

SRLPIP VØØ5A Ø1-FEB-73/5Ø-57,1ØØØ-13377;5Ø!
ED-11M VØØ5A Ø1-FEB-73/5Ø-57,1ØØØ-17Ø5;5Ø!
PAL-11M VØØ4C Ø1-FEB-73/3Ø-37,5Ø-57,1ØØØ-17777,2ØØØØ-36777;5Ø!
PAL-11MR VØØ2B Ø1-FEB-73/3Ø-37,5Ø-57,1ØØØ-17777,2ØØØØ-37377;5Ø!
LINK-11M VØØ3B Ø1-FEB-73/3Ø-37,5Ø-57,23ØØØ-36377;5Ø!

The above refer to a 12K system. For a 16K system, replace every occurrence of

1ØØØ-17777,2ØØØØ-3xxxx

by

1ØØØ-27777,3ØØØØ-5xxxx .

For LINK-11M, use 3Ø-37,5Ø-57,43ØØØ-56377;5Ø!

ADDENDUM #1 SYSGEN (cont.)

6. Errors Corrected.

6.1. IOXMTA VØØ9A to VØ11C

6.1.1. Internal errors sometimes caused location Ø or 2 to be modified, causing ↑C to fail. This was associated with the use of the FILE command.

6.1.2. Two time-dependent (non-reproducible) errors were corrected. One was associated with failure to detect a magtape EOF or other error when reading in a double-buffered mode. This had about a 40% probability of occurring, and was usually seen when using LINK-11M. The other was associated with a deadlock occurring when a magtape EOF or other error occurred while Teletype output was in progress. This had about a 10% probability, and was usually not seen with system programs.

6.1.3. The rewind logic in the FILE command handler was modified to return control immediately after the rewind is begun.

6.1.4. Some improvements were made in internal error handling.

6.2. SRLSYS VØØ3A to VØØ5A

The Mn:* construction is now handled correctly.

6.3. SRLPIP VØØ3A to VØØ5A

6.3.1. The error recovery procedure for magtape write errors was fixed.

6.3.2. The PUNCH READY? message is now issued correctly before output to the low speed punch begins.

ADDENDUM #1 SYSGEN (cont.)

6.3.3. Formatted binary decoding from PDP-10 format is now handled correctly.

6.3.4. Record counting has been improved.

6.4. ED-11M V00.3A to V00.5A

6.4.1. The retry procedure for magtape write errors was fixed.

6.4.2. Restart procedures were improved.

6.5. PAL-11M V00.4A to V00.4C

6.5.1. The symbol table is now reinitialized properly before each assembly.

6.5.2. The EOF?C option now works correctly.
This also applies to PAL-11MR V00.2B.

6.6. General

Restart procedures were modified to suppress the IOXMTA RESET during program restarts. This eliminates a good deal of tape rewinding, but requires that no manual operations be performed on tape drives used for subsequent operations. If manual intervention is required, the RESET can be performed by typing:

```
↑C
.GO
```

7. New Features

These are described more fully in addenda to the program writeups. They are summarized here for convenience.

ADDENDUM #1 SYSGEN (cont.)

7.1. IOXMTA

COREX command (code 17) has been added.

7.2. SRLSYS

7.2.1. .Un unload unit n - rewind and go offine.

7.2.2. .←aaaaa,d_1,d_2,... multiple deposit.

7.2.3. .$ any text... message buffer.

7.2.4. .?$ display message.

7.2.5. GET/PUT utility routine for magtape I/O with automatic error recovery.

7.3. SRLPIP

7.3.1. Default data mode changed to Unformatted Binary.

7.3.2. RETRY?X for write error recovery using extended record gap.

7.3.3. /H , /O , /W switches for hexadecimal and octal dumps.

7.3.4. /E switch for extra output EOF.

7.4. ED-11M

7.4.1. RETRY?X cf. para. 7.3.2.

7.4.2. U command. Redefine I/O units.

7.4.3. ±n? command. List ±n characters.

ADDENDUM #1 SYSGEN (cont.)

7.5. LINK-11M

Message "SYSTEM ERROR nn" changed to "LINKER ERROR nn".

7.6. BOOT

Changed to V4 (V5 is identical to V4) to accomodate lower start address of SRLSYS VØØ4A through VØØ5A.