

Identification

Multics Bootloading Procedures

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Purpose

As testing of Multics continues, bootloads will be run more and more by persons who are not intimately familiar with either the 645 hardware or the Multics software. This document will explain the steps taken in a bootload and suggest dumping techniques to provide information for further analysis. See MSPM section BL for a complete description of the bootload sequence.

I Hardware Configuration

At present two processors, two GIOC's, five 64-k memories, eight tape drives, one Fire Hose drum, two clocks, and two card readers are available. Not all of these will be required for any given run. The 645 operators will know which modules are available.

- a) Processor - Two processors, labeled A and B, exist, and at least one will be on-line (available for use).
- b) GIOC - Two GIOC's, labeled A and B, exist. At the present stage of development only one will be on-line.
- c) Memory - Multics can support up to 8 memories and 4 memory controllers. At present the installation has five memories, and 4 controllers labeled E, F, G and H. The operators will know which memories and controllers are available.
- d) Tape Drives - Eight tape drives are attached to the 645. The collection tapes can be counted on any units which may be available.
- e) Fire Hose Drum - Only one Fire Hose Drum is at this installation, and it will always be required.

- f) Clocks - Two clocks are at this installation. The switch inside the door on each clock should be set to connect it to the on-line processor.
- g) Card Readers - The installation has two card readers. The operators will know which one is in use at any time.

II. Running a Bootload

- a) Determine which processor and GIOC are currently on-line. This information should be posted on the 645 configuration panel on the wall behind the printers. It can also be inferred from the placement of signs on the units themselves and on the Central Configuration Panel. Determine the memory configuration from the Central Configuration Panel. Ask the operators which card reader is in use. If it is not running, press the POWER ON switch. Mount the collection tapes on any available drives. The tapes will be read from units 3, 4, 5, 6, 3, 4, ... in that order.
 - b) Set the Bootload base on the switches behind the on-line GIOC to 61 (base 8).
 - c) Set the base switches on the Central Configuration Panel (located to the left of console B) to
 - 60 (base 8) on-line Processor
 - 100 (base 8) on-line GIOC
 - 140 (base 8) Drum
- See Appendix A for the layout of the Central Configuration Panel.
- d) Press INIT and RESET CONSOLE on the console associated with the on-line GIOC. The buttons are located under the flip-up cover.
 - e) Place the Multics Bootload deck, preceded by a clear card, and followed by a blank card, into the on-line card reader and press OPERATE on the reader.
 - f) Press BOOTLOAD on the operators console (located under the flip-up cover). One card will be read and all core cleared. Wait a few seconds and press BOOTLOAD again. The Multics Bootload deck will be read in.

- g) Collection 1 will be read from tape 0. Immediately after reading finishes the processor will display 000000000007 in the Q register. Enter the hardware configuration into bits 18-35 of the Data switches (see appendix B for the meaning of each switch). The switch settings will be indicated in the A register. Check to make sure the switches are correct, and flip switch 0 up and down. The switches can be set at any time, as they are not examined until switch 0 is flipped.
- h) Collection 2 will now be read from tape 1. After reading is completed the processor will display 000000000070 in the Q register. Enter the procedures to be invoked during initialization into bits 1 - 17 of the Data switches (see appendix), check the settings in A, and flip switch 0 up and down. These switches may be set when the hardware switches are set, although they are not examined until after this second pause.
- i) The teletype terminal must be dialed in. Determine to which data set the on-line GIOC is connected, and dial the appropriate number on the Teletype. The data sets are located in the gray cabinet behind and between the GIOC's.
- j) Wait for a message on the teletype indicating that Multics is in operation.

III. Trouble

Not every Bootload will be successful. This section covers the most likely problems and their probable causes, and suggests procedures for either recovery or termination.

| <u>Symptom</u> | <u>Cause</u> | <u>Action</u> |
|----------------------------|--|----------------------------|
| 1. Bootload cards not read | 1. Pressed button on wrong console | Check which GIOC is in use |
| | 2. Wrong card reader used | Try other card reader |
| | 3. Power off on card reader | Press POWER ON and re-Boot |
| | 4. Card reader not ready | Press OPERATE and re-Boot |
| | 5. Wrong Base Switch settings on GIOC or processor | Reset Base Switches |

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|--|--|--|
| 2. Halt on DIS instruction (op code 616) | 1. Error in BOOTSTRAP1 (PBR=4003) | Record address field of instruction, A, and Q. If A =11, record contents of X0, X1, X2, and X3. See BL.12 for description of errors. |
| | 2. PANIC was <u>called</u> (PBR = 14) | AQ will contain ITS pair to caller. Left half of A is segment number of caller. Using SUPERDUMP, dump this segment and any others of interest |
| | 3. Unexpected interrupt (address of DIS instruction is 777776) (PBR=14) | Dump Panic, etc. |
| | 4. Unexpected fault (address of DIS instruction is 777774) (PBR=14) | Fault code will be in A, bits 31-35. Subcondition will be in bits 26-30 (See chart on pillar next to CPU A). To recover from an op-not-complete fault (code35(base 8)), put EXECUTE SWITCHES switch down and press the EXECUTE button. Otherwise, get number of segment generating the fault from X2. Dump it, PANIC, and any other segments of interest |
| | 5. Master Mode procedure called MXERR (address of DIS instruction is 777770, PBR=14) | Dump PANIC, stacks, registers, and the offending procedure. Its segment number will be in the left half of A. |
| | 6. Tape read error (address of DIS instruction is 525252) | Remake collection tape |

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|----|---|---------------|--|
| 3. | Program loop- ing or running too long | Program Error | Put EXECUTE SWITCHES switch off (down) and push EXECUTE. PANIC will be entered as in 2.4 |
|----|---|---------------|--|

IV. Dumping Procedure

After a Bootload has terminated, either normally or abnormally, selective dumps can be taken with a program called SUPERDUMPER. See MSPM section BV.1 for a full description of the 645 segment dump program. Basically the procedure is as follows:

- a) Set Bootload base at back of GIOC to 1
- b) Set Control Configuration Panel switches to
 - 0 for Processor
 - 2 for GIOC
 - 4 for Drum (if needed)
- c) Press INIT on console
- d) Load SUPERDUMPER deck into card reader and press OPERATE
- e) Press BOOTLOAD on console

Note: Do not Power On or press OPERATE on card reader between bootload termination and step C. The interrupt which is generated would alter the machine state.

The dumper will be read from the card reader and will accept requests from cards or the operators console. To enter requests from the console, hit REQUEST. The keyboard should carriage return and unlock. Type the request, and press END OF MESSAGE. If the line is in error, hit OPERATOR ERROR and enter the line again. To dump from cards place the deck in the reader and press OPERATE. At present, all requests must be in octal; alphabetic characters are not allowed. A summary of requests is as follows. N refers to bits 0-17, or octal digits 0 - 5. Every request must consist of 12 octal digits.

| | |
|--------------|----------------------------|
| N000063 | Direct output to tape N |
| 000000000047 | Direct output to printer |
| nnnnnnnnn24 | Set dbr to value indicated |

| | |
|--------------|--|
| N000062 | Dump segment N |
| N000023 | Dump all <u>data</u> segments from N on |
| N000723 | Dump <u>all</u> segments from N on |
| 000000000000 | Dump registers, segments and stack Do not dump procedure segments |
| 000000000700 | Dump registers, segments, and stack <u>including</u> procedure segments |
| N000042 | Dump segment N as a stack |
| 000000000025 | If output is to tape, write EOF and unload, and switch to printer. If output is to printer, eject page |
| 000000000061 | Dump registers and descriptor segment |
| 000000000077 | Stop reading cards |

Dumper Problems

On rare occasions the dumper will fail to "take", that is, after the dumper deck has been read in requests cannot be made via the operator's console or the card reader. Recovery is made as follows:

Procedure I

- a) Put EXECUTE SWITCHES switch on processor panel in down position.
- b) Enter 000000000077 into data switches.
- c) Press EXECUTE button on processor panel.

In most cases this will reset the dumper and requests can be entered.

Procedure II

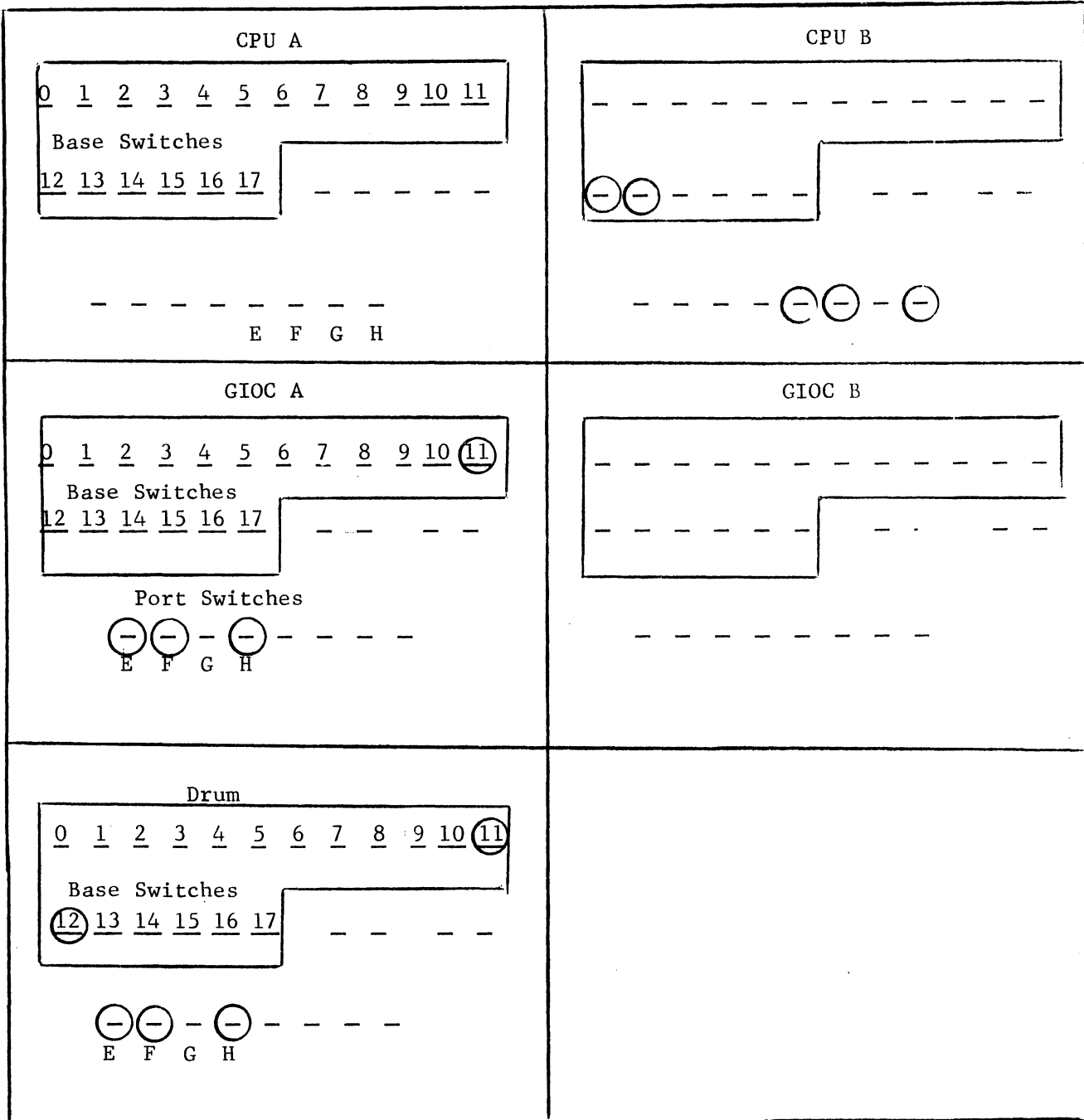
If this fails one more avenue is open. Remove any dump request cards from behind the dumper deck. Re-Boot the dumper (Page 5, steps c, d, e) until at last the dumper is ready and requests can be entered. The first request must set the dbr (descriptor base register), as it has been destroyed by the second Bootload. The request is

000301077424

The request cards can now be placed in the card reader, and when OPERATE is pressed the dumper will read them.

APPENDIX A

Central Configuration Panel



If the configuration were CPU B, GIOC A, the drum, and memories E, F, and H, the circled switches should be up.

APPENDIX B

Setting of Processor Data Switches

Switches 18-35 are used to communicate the hardware configuration to the initialization procedures. The meaning of each switch is as follows: (up means the device is to be used, down means it is not).

| Switch No. | Hardware Device |
|------------|-----------------|
| 18 | Not Used |
| 19 | Not Used |
| 20 | Not Used |
| 21 | CPU A |
| 22 | CPU B |
| 23 | GIOC A |
| 24 | GIOC B |
| 25 | DRUM |
| 26 | CLOCK A |
| 27 | CLOCK B |
| 28 | Memory E |
| 29 | E External |
| 30 | Memory F |
| 31 | F External |
| 32 | Memory G |
| 33 | G External |
| 34 | Memory H |
| 35 | H External |

Note: If an External memory is used, the corresponding internal memory must be used also. For example, if switch 31 is up, switch 30 must be up also.

Switches 1 - 17 are used to indicate which of certain initialization procedures are to be called. Again up means the procedure is to be invoked, and down means the procedure will not be invoked.

| Switch No. | Label (under switch) | Procedure Name |
|------------|----------------------|-----------------------|
| 1 | FS-1 | fs_init_1 |
| 2 | SEGF-2 | seg_fault\$use_mode_2 |
| 3 | SL-3 | segment_loader |
| 4 | FS-3 | fs_init_3 |
| 5 | SEGF-3 | segfault\$use_mode_3 |
| 6 | FS-4 | fs_init_4 |
| 7 | II | interrupt_init |
| 8 | IO-1 | io_init\$one |
| 9 | IO-2 | io_init\$two |
| 10 | SMM | turn_on_smm |
| 11 | FI-2 | fault_init\$two |
| 12 | TC | tc_init |
| 13 | FS-W | fs_windup |
| 14 | Not Used | |
| 15 | Not Used | |
| 16 | Not Used | |
| 17 | Not Used | |