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Identification.

User/System Fault Breakdown
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Purpose.

The 32 fault conditions included in the GE-645 fault repertoire are divided into two categories, user faults and system faults, for Multics fault handling. This section contains a list of the faults in each category. The GE-645 processor reference manual should be consulted for information concerning the causes of the various faults.

Discussion.

We define four general classifications of faults; program generated, operating system generated, hardware generated, and manually generated. Each fault is placed in the classification that corresponds to the possible cause of the fault. If a fault could only be caused by a hardware malfunction, it is classified as hardware generated; if it could possibly be caused by the execution of a program, it is classified as program (or operating system) generated. All hardware and manually generated and certain operating system generated faults are called system faults. They may occur at any time, regardless of which user process has control of the processor. They may not, in general, be attributed to the running process. The remaining program generated and operating system generated faults are called user faults. Since Multics executes as part of the user process, all user faults may be attributed to the running process.

Certain of the user faults and certain of the system faults have special meanings to the Multics operating system when they occur in specified contexts. In addition, certain faults are reserved for future assignment. Faults which are either assigned or reserved for future assignment are called reserved faults.

User Faults.

The user faults are as follows;

1. Derail
2. Divide check
3. Fault tag 1
4. Fault tag 2
5. Fault tag 3
6. Illegal procedure (5 sub-conditions)
 - a. GE-645 privileged instruction in slave mode
 - b. GE-645 semi-privileged instruction in slave mode with locked base

- c. Illegal operation code
- d. Out-of-bounds (may occur simultaneously with access violation)
- e. Access violation (may occur simultaneously with out of bounds)
7. Operation not completed (See Section BC.3.06)
8. Overflow (3 sub-conditions)
 - a. Fixed overflow
 - b. Floating overflow
 - c. Floating underflow
9. Master mode entry 1
10. Master mode entry 2
11. Master mode entry 3
12. Master mode entry 4
13. 635 compatability
14. 635/645 compatability

Reserved User Faults.

User faults which are either assigned or reserved for future assignment are as follows:

1. Fault tag 2. Fault tag 2 is the standard Multics linkage fault when it occurs in the linkage section. (See Section BD.7.01 for a description of the linkage section and Section BD.7.04, Linker, for a discussion of how the linkage fault is handled.)
2. Fault tag 3. (reserved for future assignment)
3. Master mode entry 1. (reserved for future assignment)
4. Master mode entry 2. (reserved for future assignment)
5. Master mode entry 3. (reserved for future assignment)
6. Master mode entry 4. (reserved for future assignment)
7. Illegal procedure, illegal operation code sub-condition. From time to time, new instructions may be added to the processor. During the interim period, before the instructions are retrofitted onto the processor, the Multics fault handler will simulate the new instructions. One example of this is the STAC instruction (Section BB.3.01 and Section BC.3.05).
8. Illegal procedure, out of bounds sub-condition. This fault is used by the Basic File System (Section BG).
9. Illegal procedure, access violation (attempt to execute data) subcondition. This fault is used to intercept an attempted outward wall crossing. (See Section BD.9, Protection of the Supervisor.)

System Faults.

The system faults are as follows:

1. Startup
2. Shutdown
3. Execute
4. Memory parity
5. Trouble
6. Lockup
7. Illegal descriptor
8. Illegal memory command
9. Directed fault 0
10. Directed fault 1
11. Directed fault 2
12. Directed fault 3
13. Directed fault 4
14. Directed fault 5
15. Directed fault 6
16. Directed fault 7
17. Timer runout
18. Connect.

Reserved System Faults.

The reserved system faults are as follows:

1. Timer runout. The timer runout fault is transformed into an interrupt signal, the time-out interrupt, which competes with other interrupt signals on a priority basis for recognition by that processor.
2. Connect. The connect fault is reserved to mean "clear your associative memory."
3. Directed fault 0. Directed fault 0 is used to indicate page or segment not in core memory. The distinction between page and segment faults is made on the basis of information saved by the processor control unit.
4. Directed fault 1. Directed fault 1 is used as a tool for metering core storage usage.
5. Directed fault 2. Directed fault 2 is used to intercept attempted wall crossings.
6. Directed fault 3. Directed fault 3 is used to deny all access to pages and/or segments (even to master mode procedures).
7. Directed fault 4. Directed fault 4 is used for "unusual mode simulation."

8. Directed fault 5. (reserved for future assignment)
9. Directed fault 6. (reserved for future assignment)
10. Directed fault 7. (reserved for future assignment)