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Identification

Clock Services provided by the Supervisor
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Purpose

A fundamental function of the Multics supervisor is to provide co-ordination of use of the system hardware clocks. These hardware clocks are essential for supervisory functions including:

1. Resource accounting and allocation
2. Resource scheduling
3. Resource usage monitoring
4. Labeling data with instant of creation
5. Initiating periodic housekeeping functions
6. Triggering time-dependent strategy changes

In addition, many user programs have need for similar functions, and in addition:

1. Runaway loop control for undebugged programs
2. Triggering programs on occurance of specific time or date and time or passage of a time interval
3. Time and date computation in programs

This section discusses the range of clock services provided by the supervisor both for itself and for user programs. It also mentions briefly the hardware clocks on which these services are based. The following sections specify in detail the operation of the modules which provide the services.

Clocks

The clock services provided by the supervisor to a process are divided into two categories: real time clock services and processor execution meter services. The execution meter, by definition, counts only when the process is running, while the real-time clock marches on without pause even when the process is ready or blocked.

Real-Time Clock

The Real-time clock services are based on a hardware "Calendar Clock" accessible through a Memory Controller as a special register. This register contains a double-word integer which is incremented once per microsecond. The Calendar Clock is adjusted before system startup to contain the time since a fixed reference point: 0000 GMT, January 1, 1901. Section BD.10.02 describes a standard procedure for converting the double-word integer back and forth from a local date and time or a date and time in another time zone if the user desires.

Associated with the Calendar Clock is a calendar interrupt mechanism. A process may request that a wakeup occur when the calendar clock passes a specific value, or when a specific real time interval has passed. To provide this service, the supervisor uses a second register in a Memory Controller, which is program settable and is continuously compared with the Calendar Clock. Whenever the two registers are equal, a system interrupt is automatically generated. The supervisor module which co-ordinates usage of the calendar interrupt register is described in section BD.10.03.

Execution Meter

The fundamental purpose of the execution meter is to provide a measure of processor usage by a procedure. The supervisor uses a 24-bit hardware register in each processor to simulate a separate execution meter for each process as well as to enforce processor usage limits set by the scheduler. The hardware register counts down once for each memory reference made by the processor and will cause a processor fault as it passes zero. The Basic Execution Meter Module described in BD.10.04 uses this hardware register to provide for each process an execution meter which can be set, read, and used to generate a wakeup on runout.

A second module, the process execution meter co-ordinator, is described in section BD.10.05. This module permits any number of procedures within a process to "use" independently the single execution meter provided by the basic execution meter module.

Append to BD.10.01

Clock precision

Timer values

On 645 Multics/I, all calendar clock times, calendar clock intervals, and execution ~~times values~~ are expressed as integers of precision 71 bits (PL/I). They are stored as standard 645 double-word signed integers.