

CSCE 351

Operating System Kernels

Clocks (a.k.a. timers)

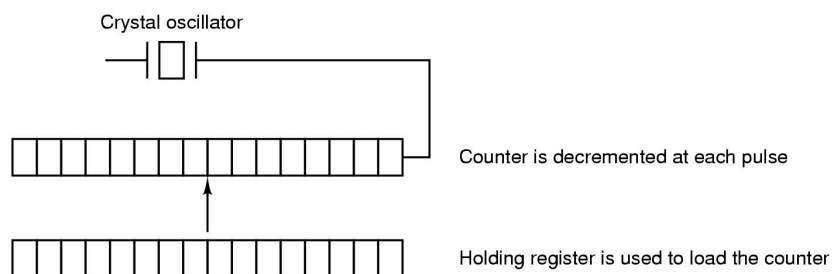
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Clock Hardware

- ◆ Two types of clocks
 - » Low-end clocks
 - ❖ Tied to the 110 or 220 volt power line
 - ❖ Generate an interrupt on every voltage cycle: 50 or 60 Hz
 - » Programmable Clocks
 - ❖ Crystal oscillator: 5-100+ MHz



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Programmable Clock Modes

- ◆ One-Shot Mode
 - » Must be restarted after counting down and generating an interrupt
- ◆ Periodic or Square-Wave Mode
 - » Holding register automatically copied in the counter and counter restarts on its own
 - » The periodic interrupts are called clock ticks

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Clock Software

- ◆ Primary Functions:
 - » Maintaining the time of day (a.k.a. real time)
 - ❖ See next slide
 - » Preventing processes from running longer than they are allowed to
 - ❖ Call the scheduler after a quantum has expired
 - » Accounting for CPU usage
 - ❖ Interrupt processing time is usually ignored
 - » Handling the ALARM system calls made by user processes
 - ❖ Interrupts, signals, or messages sent to caller when timer expires
 - » Providing watchdog timers for system software
 - ❖ When timer expires, a caller-specified procedure is called
 - » Doing profiling, monitoring, and statistics gathering
 - ❖ Increments the bin number (a range of addresses) that corresponds to the IP at each clock tick.

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Three ways to maintain the time of day

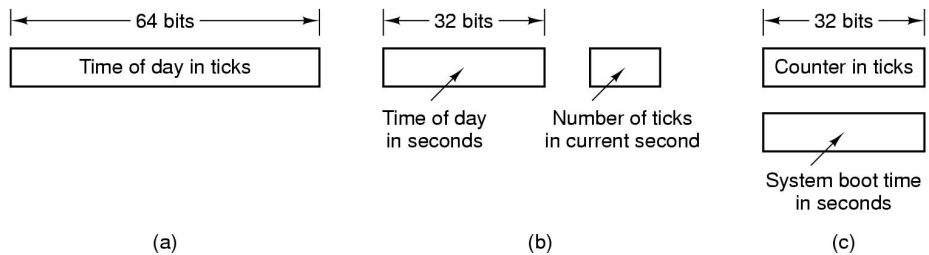
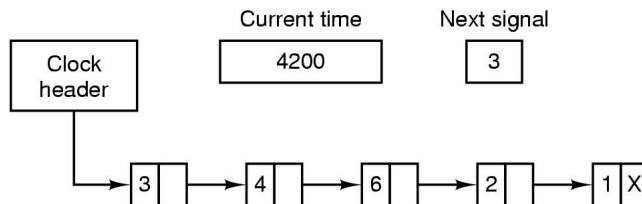


Figure 3-24 on page 225

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Supporting Multiple User Alarms

- ◆ Most clock chips support two or three separately programmable clocks.
- ◆ One is used to keep system time.
- ◆ The other is often used to support user or system specified ALARMS (or timers)
 - » Frequently multiple timers are implemented using a delta-list:



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Clock Driver in Minix

Overview

- ◆ Clock driver is in clock.c (of course ☺)
- ◆ Clock task accepts six message types
 1. HARD_INT
 - » Sent by clock interrupt when there is something to do
 2. GET_UPTIME
 3. GET_TIME
 - » Returns number of seconds elapsed since 12:00 AM, Jan 1, 1970
 4. SET_TIME(new time in seconds)
 5. SET_ALARM(proc number, procedure to call, delay)
 - » User processes set alarms via memory manager
 - » Kernel software sets watchdog timers with this function
 6. SET_SYN_AL(proc number, delay)
 - » A message is sent to the process rather than a signal
 - » Synchronous since the process blocks for a message
 - » Created for network server

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Clock Services in MINIX

Service	Access	Response	Clients
Gettime	System Call	Message	Any process
Uptime	System Call	Message	Any process
Uptime	Function Call	Function value	Kernel or task
Alarm	System Call	Signal	Any process
Alarm	System Call	Watchdog activation	Task
Synchronous alarm	System Call	Message	Server process
Milli_delay	Function Call	Busy wait	Kernel or task
Milli_elapsed	Function Call	Function value	Kernel or task

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