













© 2004-2007 Ed Lazowska, Hank Levy, Andrea and Remzi Arpaci-Dussea, Michael Swift



























## Polling I/O

- Each device controller typically has:
  - Data-in register (for host to receive input from device)
  - Data-out (for host to send output to device)
  - Status register (read by host to determine device state)
  - Control register (written by host to invoke command)

## Polling I/O handshaking: To write data to a device: Host repeatedly reads busy bit in status register until clear Host sets write bit in command register and writes output in data-out register Host sets command-ready bit in control register

•

- Controller notices command-ready bit, sets busy bit in status register
- Controller reads command register, notices write bit: reads data-out register and performs I/O (magic)
- Controller clears command-ready bit, clears the error bit (to indicate success) and clears the busy bit (to indicate it's finished)













## Finers How can the OS prevent runaway user programs from hogging the CPU (infinite loops?) use a hardware timer that generates a periodic interrupt before it transfers to a user program, the OS loads the timer with a time to interrupt "quantum": how big should it be set? when timer fires, an interrupt transfers control back to OS a twhich point OS must decide which program to schedule next very interesting policy question: we'll dedicate a class to it Should the timer be privileged? for reading or for writing?

© 2004-2007 Ed Lazowska, Hank Levy, Andrea and Remzi Arpaci-Dussea, Michael Swift



## "Concurrent programming"

- Management of concurrency and asynchronous events is biggest difference between "systems programming" and "traditional application programming"
  - modern "event-oriented" application programming is a middle ground
- Arises from the architecture
- Can be sugar-coated, but cannot be totally abstracted away
- · Huge intellectual challenge
  - Unlike vulnerabilities due to buffer overruns, which are just sloppy programming

© 2004-2007 Ed Lazowska, Hank Levy, Andrea and Remzi Arpaci-Dussea, Michael Swift

