CS241
I/O Revisited

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DMA, Polling, Disk Characteristics

Today

- Networking Quiz
- DMA vs Polling
- Disk Characteristics
- Announcements

DMA & I/O

- What is DMA?
- Why is useful?
- How does it work?
- Compare it Polling?

DMA

- Direct Memory Access
- DMA controls exchange of data between *main memory* and I/O module

- Processor issues a request for transfer of block data
- Process is interrupted when DMA request completes

Main Advantages?

Processor can perform useful work (does not need to wait for I/O device to be ready)

Optimal use of memory bus:

- Efficient block transfer
- Use main system bus once per word (In some architectures)

Cycle stealing

- DMA takes control of system bus to write to main memory
- CPU can not use bus at the same time
- DMA has stolen cycles from the CPU!

Compare to Polling

- CPU continually checks I/O device to see if it is ready
- Wastes CPU (and bus) cycles

- So when would Polling be useful?

Polling vs DMA

DMA overhead: Issuing commands to DMA

DMA shared resource: Requests are queued

DMA efficient for block reads to *memory.*

Interrupt overhead.

Reasons for polling

- Want small amount of data to be processed by CPU as soon as it is *available*.
- Interrupt-driven I/O not available.
- Not all devices, architectures support DMA transfer (or have a DMA)

Speed of I/O transfer

- Limitations of physical device
- Limitations of I/O bus
- Limitations of system bus
- Limitations of read/write speed of memory

Speed of I/O transfer

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In practice

- Physical device is a shared resource
- So is memory, I/O bus, system bus, memory & CPU

Physical device

- Rotation speed
- Seek time to correct track
  (move head to correct track)

To use these

- # Sectors per track
- # Bytes per sector

Rotation

- How long before first byte is under the head?
- How many milliseconds before all bytes are read from that track?

HW Problem

- rotational speed of 15,000 rpm,
- 512 bytes per sector,
- 400 sectors per track and
- 1000 tracks on the disk,
- average seek time is 4ms.

- What is the transfer time for this file?
- What is the average access time for this file?
- What is the rotational delay in this case?
- What is the total time to read 1 sector? What is the total time to read 1 track?

rpm=revolutions per minute

- Transfer rate= Bytes per 360 degrees x Rotational speed (60 x rpm)

- Avg Access Time for 1 sector= seek time + avg. rotational delay + transfer time for 1 sector

Examples

b=number of bytes to transfer, r=rotation speed, and N = number of bytes on a track

Tt=transfer time = b/(rN)

Ta=average access time of the whole file = Tseek+ 1/(2r)+T

Average Rotational delay = 0.5/r

Annoucements

- HW2 due Wednesday 05/02/2007
- Newsgroup request for review lecture