

18 November

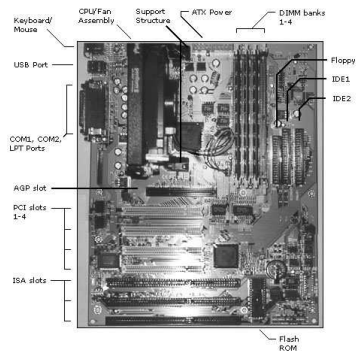
- 3 classes to go
- No class on Tuesday 23 November
- Last 2 classes will be survey and exam review
- Interconnect and IO

11/18/2004

Comp 120 Fall 2004

1

Interconnect: Busses

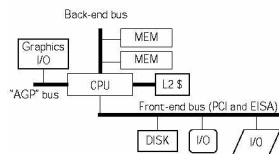


11/18/2004

2

Goals of Interconnect

1. Modularity
 - Everything doesn't fit on a single chip (yet)
 - Where to draw the lines?
 - Minimize communication?
 - Minimize cost?
 - Maximize expandability?
2. Expansion
 - More processors
 - More memory
 - More devices



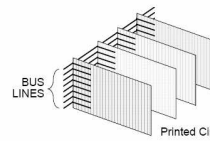
11/18/2004

Comp 120 Fall 2004

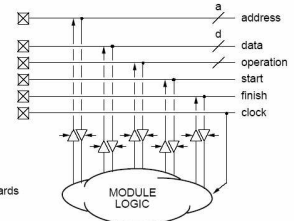
3

Backplane Bus

Modular cards that plug into a common backplane:
 CPUs
 Memories
 Bulk storage
 I/O devices
 S/W?



The backplane provides:
 Power
 Common system clock
 Wires for communication



11/18/2004

Comp 120 Fall 2004

4

Issues in Interconnect

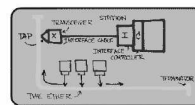
- Physical Interface
 - Single wire
 - Multiple wires
 - Radio
 - Light
- Protocol
 - Sync/Async
 - Master/Slave
 - Access Control
 - Time-Division Multiple Access
 - Frequency-Division Multiple Access
 - Code-Division Multiple Access

11/18/2004

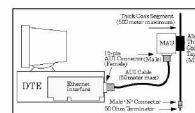
Comp 120 Fall 2004

5

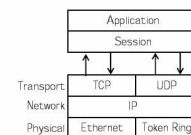
Ethernet



In the mid-70's Bob Metcalfe (at Xerox PARC) devised a bus for networking computers together.



KEY IDEA: Buses are about high-level protocols, not physical interfaces.



11/18/2004

Comp 120 Fall 2004

6

Magnetic Disk

Long term, nonvolatile storage
Large, inexpensive, and slow

Rotating platter(s) coated with magnetic material
Use a movable read/write head to access

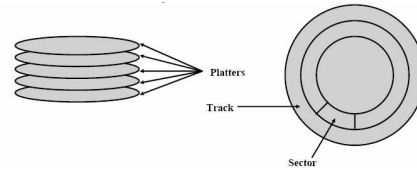


11/18/2004

Comp 120 Fall 2004

7

Magnetic Disk Organization



- Cylinder: All tracks under head with arm in a fixed position
- Read/Write time has 3 components
 - Seek time to move the arm
 - Rotational latency: wait for the desired sector to come by
 - Transfer time: transfer bits

11/18/2004

Comp 120 Fall 2004

8

Typical Disk Times

- Average Seek: 8ms to 12ms
 - Sum of all possible seek / number of possible seeks
 - Locality reduces this to maybe only 25% of average number
- Rotational Latency:
 - At 5400 RPM → 11 ms
 - At 7200 RPM → 8 ms
 - At 10000 RPM → 6ms
- Transfer time depends on:
 - Transfer size (typical 512 bytes)
 - Rotation speed
 - Recording density
 - Diameter
 - Typical values: 10 to 30MBytes per second

11/18/2004

Comp 120 Fall 2004

9

USB

- Universal Serial Bus
- Provides power and signal
- A single host connects to multiple devices
- Devices are given 7 bit addresses when plugged in
- Controller polls them round-robin
- 1.5Mbit/s for USB 1, up to 486Mbit/s for USB 2.
- Hot pluggable
- Plug and Play



11/18/2004

Comp 120 Fall 2004

10

Firewire

- IEEE 1394
- Serial bus plus power
- Multiple masters
- Up to 800Mbit/s
- Hot pluggable
- Plug and Play



11/18/2004

Comp 120 Fall 2004

11

Interrupts

- How does the CPU manage **SLOW** I/O devices?
 1. Programmed I/O
 2. Interrupt Driven I/O

11/18/2004

Comp 120 Fall 2004

12

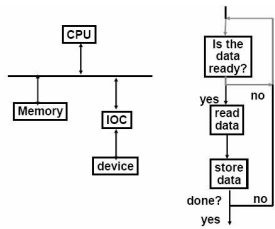
Polling

Advantages

- Simple
- No surprises
- Processor in full control

Disadvantages

- Polling can waste lots of time

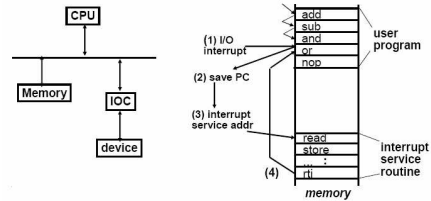


11/18/2004

Comp 120 Fall 2004

13

Interrupt Driven I/O



Advantage

- CPU only bothered when actually needed

Disadvantage

- Can occur at surprising or inconvenient times
- Have to save and restore state

11/18/2004

Comp 120 Fall 2004

14

MIPS Exceptions

- Reset
- Hardware Errors (Check, Bus Error, Cache Error)
- External Interrupt (6 inputs)
- Address Error
- Reserved Instruction
- TLB Miss
- System Call
- Breakpoint
- Trap
- Integer Overflow
- Floating Point Error
- Timer
- And a few more

11/18/2004

Comp 120 Fall 2004

15

Exception Processing

- EPC gets address of faulty instruction or of next instruction depending on type of exception
- Switch to kernel mode
- Jump to a new location based on type of exception
 - PC \leftarrow FFFF FFFF BFC0 0000 for Reset
 - PC \leftarrow FFFF FFFF BFC0 0300 for Hardware error
 - PC \leftarrow FFFF FFFF BFC0 0380 for external interrupts
 - PC \leftarrow FFFF FFFF BFC0 0400 for ...
- Save registers
- Examine the "cause" register to find out why you came here
- Branch to code to do the right thing

11/18/2004

Comp 120 Fall 2004

16

Classes to go

2

11/18/2004

Comp 120 Fall 2004

17