

# I/O (Ch 8)

# Interfacing I/O devices

- How does the CPU request I/O?
  - special instructions in the instruction set
  - memory mapped I/O
- How does the I/O device contact the CPU?
  - Interrupts
- How do we transfer data to/from device?
  - programmed transfer
  - DMA

# Buses

- how to connect I/O devices to CPU?
  - separate I/O bus
    - optimize each bus (I/O and memory) individually
    - separate I/O instr. in processor architecture
      - ION, IOF, READ, WRITE... (Intel 8080)
  - memory mapped I/O
    - this is the trend in state-of-the-art processors
    - device regs mapped to memory space
    - L/S in/out of these regs for I/O

# How to move data?

- programmed I/O
  - CPU moves data from I/O into CPU regs, and then out to memory
  - how does CPU know when to move data?
  - where is this transfer mode suitable?
- DMA
  - initiated by CPU
  - start address (virtual or real?), count specified to I/O
  - DMA devices and CPU compete for memory cycles, who should be given priority?

- I/O processor
  - synchronous high speed transfers from memory
  - “super DMA” device that evolves with the CPU-memory bus structure
  - functionality and speed similar to a CPU, as opposed to “slave” mode in DMA device
  - “channel program” in shared memory for IOP
  - multiplexor channel (character oriented)
    - shared among several slow speed devices (terminal)
  - block multiplexor (block oriented)
    - shared between block oriented devices (tapes)
  - selector channel (high speed block oriented)
    - dedicated to one high speed device (disk)

# Buses

- Components
  - address lines
  - data lines
  - control lines
- Synchronous control
- Asynchronous control
- Arbitration
  - daisy chain
  - centralized parallel arbitration
  - distributed arbitration by self selection
  - distributed arbitration by collision detection

# Mass Storage

- Disk
  - surfaces (2 per platter), tracks, sectors, head assembly, RPM
    - all tracks have same number of sectors
    - all sectors record same number of bits
    - logical cylinder
      - a set of corresponding tracks on all surfaces
    - characteristics
      - seek time, rotational latency, data transfer rate
  - typical numbers
    - 20 surfaces, 1000 tracks, 128 sectors
    - transfer rate: 20 MB/sec, avg. seek time: a few ms, avg. rotational latency: a few ms

# Other I/O devices

- Network
- Mouse
- Keyboard
- Display