2009-03-15

**Block Devices, I/O, Drivers**

I/O devices
- Disk
- Network interface
- Graphics
- HID (mouse, keyboard, USB things)

Memory map:

```
<table>
<thead>
<tr>
<th>Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM</td>
</tr>
</tbody>
</table>
```

device has an register
address decoder checks if A: Aced
    if yes, register and data has interest
    physical address

kernel has virtual mapping to physical device addresses
5-10 giga-instructions/sec

CPU

4GB/s

100 ns

(500-1000 instructions)

Memory

north bridge

PCI bus

device controller

SCSI

SATA

2-4 GB/s

250-300 ns

1/2 GB/s

SATA

FC

Serial attached SCSI

Goal: hiding latency

DMA: device controller does burst writes to RAM

CPU

setup

write to register

start DMA transfer to address A

Data

interrupt

User

read()

Kernel

sleep

copy data to buffer

wake up

Hardware

read

interrupt

setup DMA interrupt

transfer
Only CPU sees virtual addresses

Transfers must be done with physical addresses

Key points

1. Latency
2. Bulk transfer (DMA) to achieve throughput despite latency
3. Buses:

   memory
   \longrightarrow
   \text{addressing}

   I/O (PCI, etc) \bigcup

   device (SCSI, SATA, ...)

4. Driver & DMA architecture

   read \rightarrow \text{sleep} \rightarrow \text{setup} \rightarrow \text{sleep} \rightarrow \text{return} \bigg| \text{DMA descriptor}

   op. DMA \rightarrow \text{in}