CSC 452 – I/O

Jonathan Misurda
jmisurda@cs.arizona.edu

1

Block Devices

A device that stores data in fixed-sized blocks, each uniquely addressed, and can be randomly accessed

2

Character Devices

Device that delivers or accepts a stream of characters

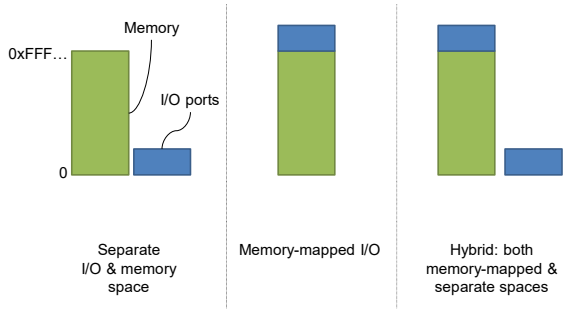
3

Device Controllers

The electronic component of an I/O unit, in contrast with the physical component.

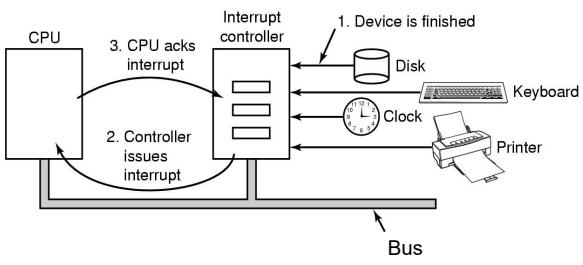
4

Memory-Mapped I/O



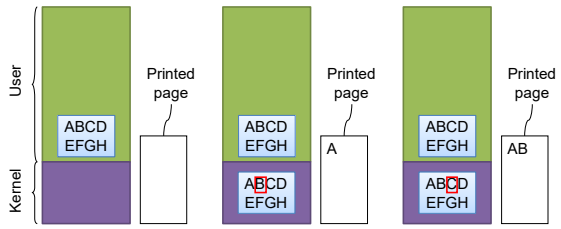
5

Interrupts



6

Programmed I/O



7

Polling

```
copy_from_user (buffer, p, count);  // copy into kernel buffer

for (j = 0; j < count; j++) {     // loop for each char
  while (*printer_status_reg != READY)
    ;                             // wait for printer to be ready
  *printer_data_reg = p[j];       // output a single character
}

return_to_user();
```

8

Interrupt-Driven I/O

System Call

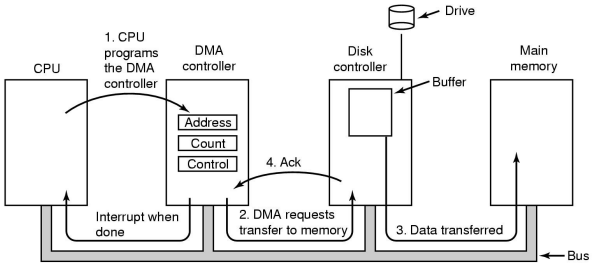
```
copy_from_user (buffer, p, count);
j = 0;
enable_interrupts();
while (*printer_status_reg != READY)
  ;
*printer_data_reg = p[0];
scheduler(); // and block user
```

Interrupt Handler

```
if (count == 0) {
  unblock_user();
} else {
  *printer_data_reg = p[j];
  count--;
  j++;
}
acknowledge_interrupt();
return_from_interrupt();
```

9

DMA



10

DMA

System Call

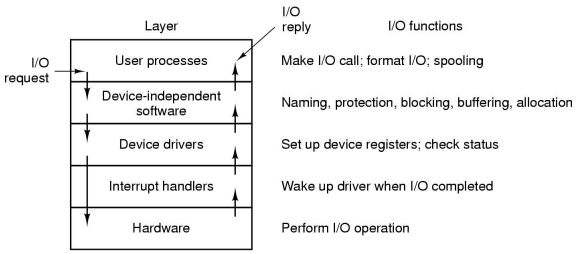
```
copy_from_user (buffer, p, count);
set_up_DMA_controller();
scheduler(); // and block user
```

Interrupt Handler

```
acknowledge_interrupt();
unblock_user();
return_from_interrupt();
```

11

I/O Request



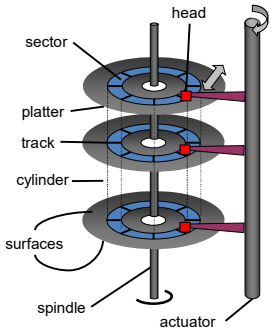
12

Soft Timers

Do we really need hardware timer interrupts for preemption?

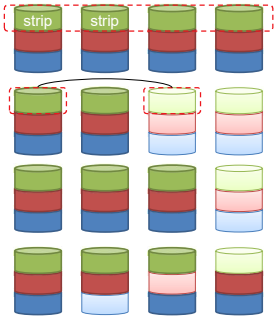
13

Disks



14

RAID



RAID 0
(Redundant Array of Inexpensive Disks

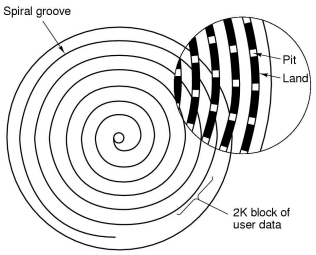
RAID 1
(Mirrored copies)

RAID 4
(Striped with parity)

RAID 5
(Parity rotates through disks)

15

CD-ROMs



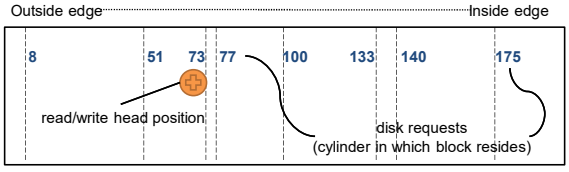
16

Disk Requests

- Seek time
- Rotational delay
- Actual transfer time

17

Disk Request Scheduling



Disk seek algorithm examples assume a request queue & head position (disk has 200 cylinders)

Queue = 100, 175, 51, 133, 8, 140, 73, 77
Head position = 63

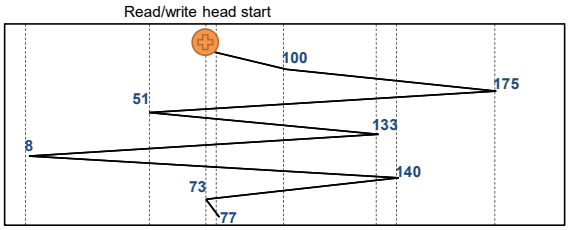
18

Seek Distance

Total distance travelled to service a set of disk requests

19

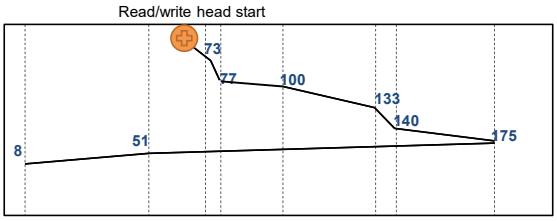
First-Come, First-Served (FCFS)



Seek distance = (100-63) + (175-100) + (175-51) + (133-51) + (133-8) + (140-8) + (140-73) + (77-73) = **646 cylinders**

20

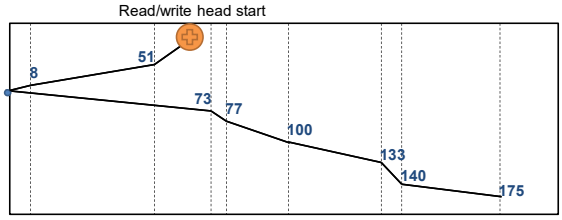
Shortest Seek Time First



Seek distance = 10 + 4 + 23 + 33 + 7 + 35 + 126 + 43 = **281 cylinders**

21

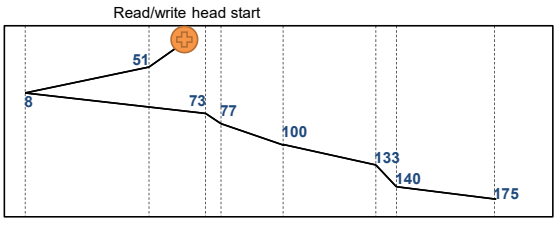
SCAN (Elevator Algorithm)



Seek distance = 12 + 43 + 8 + 73 + 4 + 23 + 33 + 7 + 35 = **238 cylinders**

22

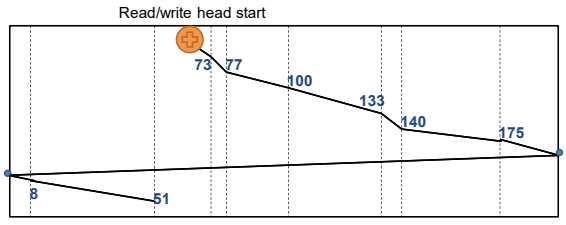
LOOK



Seek distance = 12 + 43 + 65 + 4 + 23 + 33 + 7 + 35 = **222 cylinders**

23

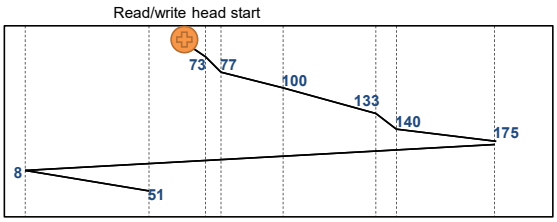
C-SCAN



Seek distance = 10 + 4 + 23 + 33 + 7 + 35 + 24 + 199 + 8 + 43 = **386 cylinders**

24

C-LOOK



Seek distance = 10 + 4 + 23 + 33 + 7 + 35 + 167 + 43 = **322 cylinders**

25