

	Device	Data rate]
ĸ	eyboard	10 bytes/sec	
M	ouse	100 bytes/sec	
56	6K modem	7 KB/sec	
T	elephone channel	8 KB/sec]
D	ual ISDN lines	16 KB/sec	
La	aser printer	100 KB/sec]
S	canner	400 KB/sec	1
С	lassic Ethernet	1.25 MB/sec]
U	SB (Universal Serial Bus)	1.5 MB/sec]
D	igital camcorder	4 MB/sec]
IC	DE disk	5 MB/sec	
40	Dx CD-ROM	6 MB/sec	
Fa	ast Ethernet	12.5 MB/sec	
IS	SA bus	16.7 MB/sec	
E	IDE (ATA-2) disk	16.7 MB/sec	
Fi	reWire (IEEE 1394)	50 MB/sec	
X	GA Monitor	60 MB/sec	
S	ONET OC-12 network	78 MB/sec	
S	CSI Ultra 2 disk	80 MB/sec	
G	igabit Ethernet	125 MB/sec	
U	ltrium tape	320 MB/sec	
P	CI bus	528 MB/sec	
S	un Gigaplane XB backplane	20 GB/sec	1



But how do we talk to the Controller?

- Each controller has one or more "ports".
- A port is an "address" that we can read from or write to.
- We read from the port (or write to it) by putting the port's address on the bus.
- Every device (including memory) can look at the bus. If you're a device controller and you see your address on the bus, then you respond to the corresponding command.













Interrupt Driven I/O

To print a string

- When device is ready:
 - Write a character to the output port.
 - Go do something else. Probably involving a context switch.
- Receive an interrupt because the printer finished printing.
- Repeat until all characters have been written.







Principles of I/O Software Issues

- Device independence
- Naming
- Error handling
- Synchronous vs. asynchronous transfers
- Buffering
- Sharable vs. dedicated devices









Uniform interfacing for device drivers

Buffering

Error reporting

Allocating and releasing dedicated devices

Providing a device-independent block size

Functions of the device-independent I/O software











Unix I/O Management

- I/O devices are made to look like files.
 - Provides uniform naming
 - Devices appear as files in the directory /dev
 - /dev/hda is the first drive on the IDE controller.
 - /dev/hda4 is partition 4 on the same device.
 - /dev/lp is the printer
 - Devices are categorized as either "block" or "character" special files.
 - Block files support random access to individual blocks, using the **seek** command.
 - Character files behave as a stream of characters. Not possible or even meaningful to "seek" on a keyboard.



Device	Open	Close	Read	Write	locti	Other
Null	null	null	null	null	null	
Memory	null	null	mem_read	mem_write	null	
Keyboard	k_open	k_close	k_read	error	k_ioctl	
Tty	tty_open	tty_close	tty_read	tty_write	tty_ioctl	
Printer	nego al	lp close	error	lp write	lp ioctl	

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Disks						
Doromotor	IRM 260 KB floppy dick	WD 18200 bard dick				
Number of cylinders		10601				
Tracks per cylinder	9	12				
Sectors per track	9	281 (avg)				
Sectors per disk	720	35742000				
Bytes per sector	512	512				
Disk capacity	360 KB	18.3 GB				
Seek time (adjacent cylinders)	6 msec	0.8 msec				
Seek time (average case)	77 msec	6.9 msec				
Rotation time	200 msec	8.33 msec				
Motor stop/start time	250 msec	20 sec				
Time to transfer 1 sector	22 msec	17 µsec				

Disk parameters for the original IBM PC floppy disk and a Western Digital WD 18300 hard disk





































