



OPERATING SYSTEMS

Storage Management - 1

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OPERATING SYSTEMS

Course Syllabus - Unit 4



Unit 4: Storage Management

Mass-Storage Structure - Mass-Storage overview, Disk Scheduling, Swap-Space Management, RAID structure. File System Interface - file organization/structure and access methods, directories, sharing. File System Implementation/Internals: File control Block (inode), partitions & mounting, Allocation methods.

Case Study: Linux/Windows File Systems

OPERATING SYSTEMS

Course Outline

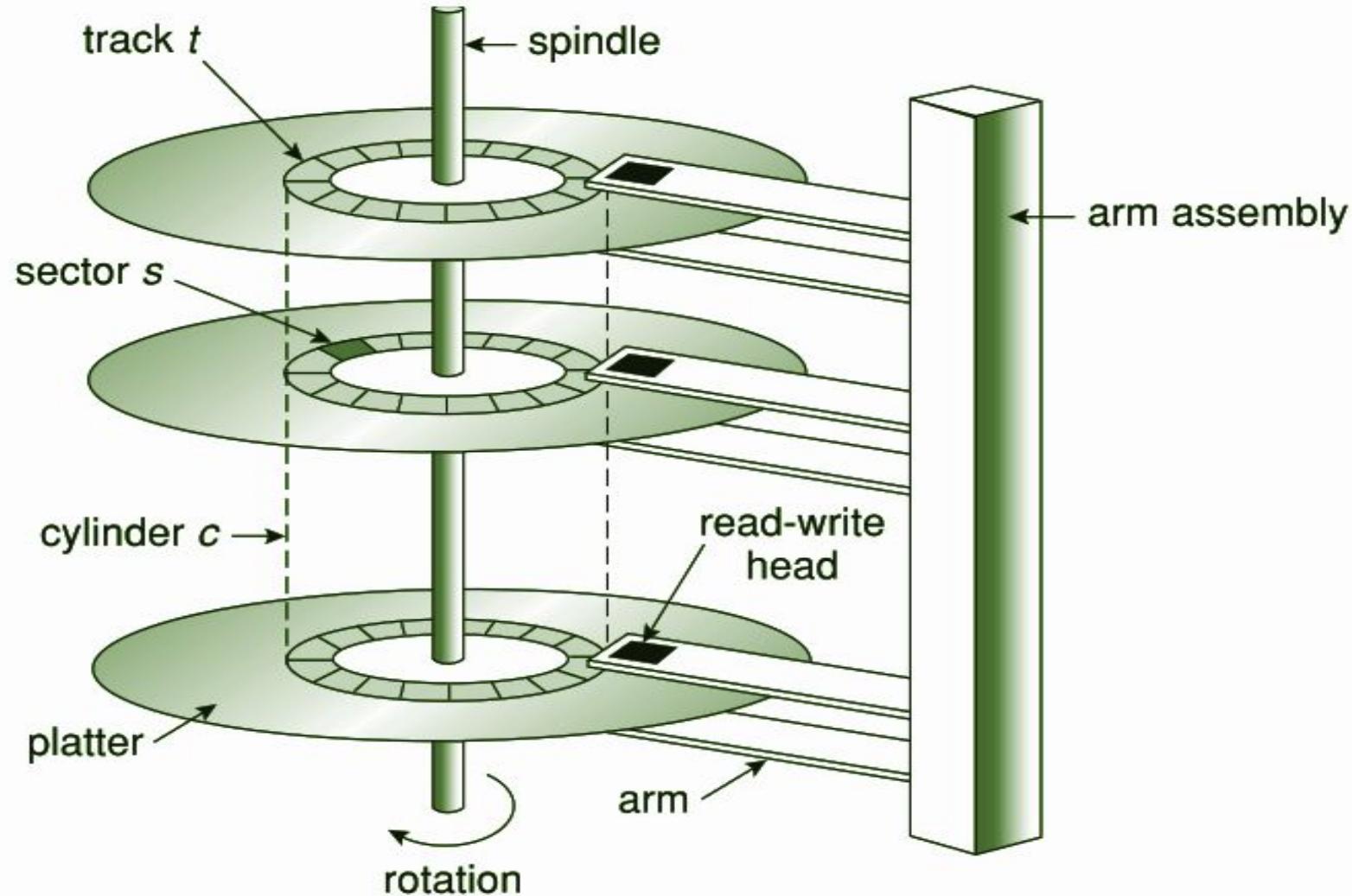
37	Mass-Storage Structure: Mass-Storage overview	12.1	82.1
38	Disk Scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK	12.4	
39	Swap-Space Management, RAID Structure	12.6,12.7	
40	File Concept, File Structure, Access Methods	10.1-10.2	
41	Directory and Disk Structure	10.3	
42	File-System Mounting, File Sharing, Protecting	10.4-10.6	
43	Implementing File-Systems: File control Block (inode), partitions & mounting	11.1,11.2	
44	Disk Space Allocation methods: Contiguous, Linked, Indexed	11.4	
45	Case Study: Unix/Linux File systems	11.8	
46	NFS	16.7	

- Overview of Mass Storage Structure

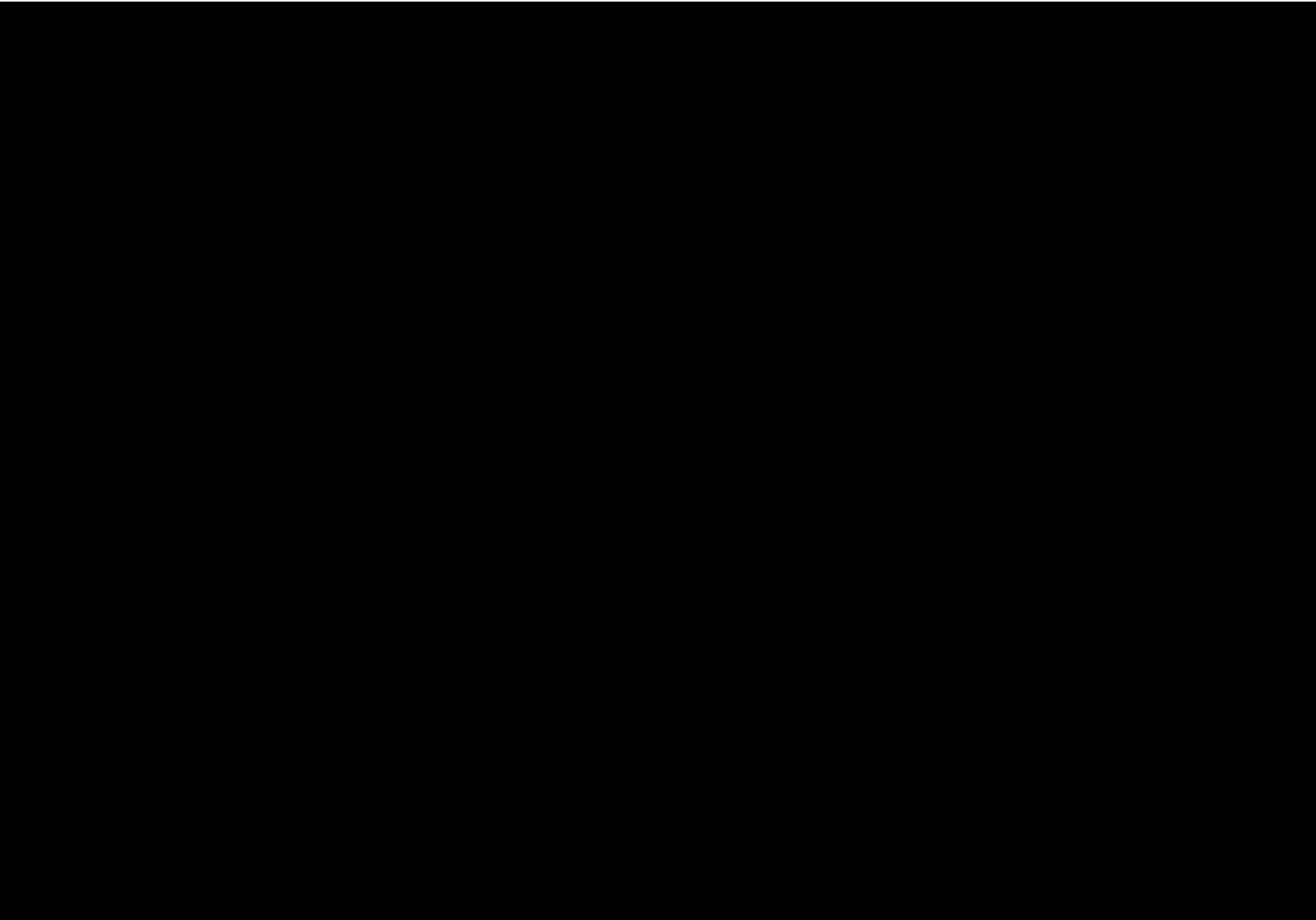
Overview of Mass Storage Structure

- Magnetic disks provide bulk of secondary storage of modern computers
- Drives rotate at 60 to 250 times per second i.e ranging from 3,600 RPM to 15,000 RPM
- Currently Hard drives have been engineered with spin rates as low as 1,200 RPM and as high as 15K RPM.
- Today's most common RPM rates, in both laptop and desktop PCs, are between 5,400 and 7,200 RPM
- Given two identically designed hard drives with the same **areal** densities, a 7,200 RPM drive will deliver data about 33% faster than the 5,400 RPM drive.
- Consequently, this specification is important when evaluating the expected performance of a hard drive or when comparing different HDD models.
- **The word “areal” refers to an area, which is an expanse of space or a region of land.**

Overview of Mass Storage Structure



Overview of Mass Storage Structure



Overview of Mass Storage Structure

- Magnetic disks provide bulk of secondary storage of modern computers
 - Drives rotate at 60 to 250 times per second
 - Transfer rate is rate at which data flow between drive and computer
 - Positioning time (**random-access time**) is time to move disk arm to desired cylinder (**seek time**) and time for desired sector to rotate under the disk head (**rotational latency**)
 - Head crash results from disk head making contact with the disk surface

Overview of Mass Storage Structure

- In general, higher RPM means equates to superior hard drive performance, but it also has a couple of drawbacks.
- In order to achieve higher rotational speeds, hard drives must draw more power to overcome increased wind resistance.
- This means higher RPM drives will put more strain on a power supply, which can add up when several high RPM drives are installed in one computer.
- Average disk drives rotate at 5400 or 7200 RPM.
- High-end drives which rotate at 10,000 or 15,000 RPM create so much wind resistance that disk memory capacity must often be compromised by shrinking the diameter of the platter in order to create a drive which runs effectively and does not draw too much power.
- Therefore, drives with very high RPM may not be economical as data storage

Overview of Mass Storage Structure

- The processing and multitasking speed of a computer is **more often limited by inadequate RAM or a slow processor, than hard drive RPM.**
- High-RPM hard drives are often used by hard core gamers and technologists that like to have computers which operate as fast as technology will allow
- For normal users a hard drive average RPM and high storage capacity should be satisfactory.

Overview of Mass Storage Structure

- Disks can be removable
- Drive attached to computer via I/O bus
- Host controller in computer uses bus to talk to disk controller built into drive or storage array
- Buses vary, including EIDE, ATA, SATA, USB, Fibre Channel, SCSI, SAS, Firewire

Overview of Mass Storage Structure

- **EIDE** : Enhanced Integrated Drive Electronics
- **ATA** : Advanced Technology Attachment
- **SATA** : Serial Advanced Technology Attachment
- **eSATA**: external Serial Advanced Technology Attachment
- **PATA** : Parallel Advanced Technology Attachment
- **USB** : Universal Serial Bus
- **Fibre Channel**
- **SCSI** : Small Computer System Interface
- **SAS** : Serial Attached SCSI
- **Firewire**

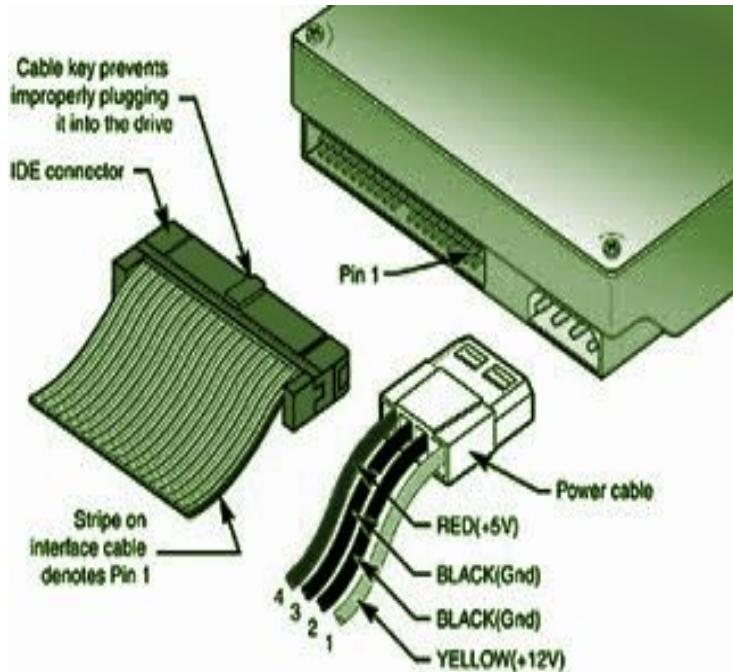
Overview of Mass Storage Structure - Additional Input

- More About **SATA**
- Serial ATA is able to move data up and down at the same time, instead of moving in the old parallel pattern. There's several versions available, with the newest 3.0 version theoretically able to move 6 Gigabytes per Second
- SATA allows hot-swapping of drives. This is handy in a server environment where machines have to be dependable
- SATA 1 came out in 2002, and 3.1 is currently being used on the new solid state drives.
 - **SATA1** was rated at about **150 MB/Sec.**
 - **SATA2** was rated at about **300 MB/sec**
 - **SATA3** was rated at about **600 MB/sec.**

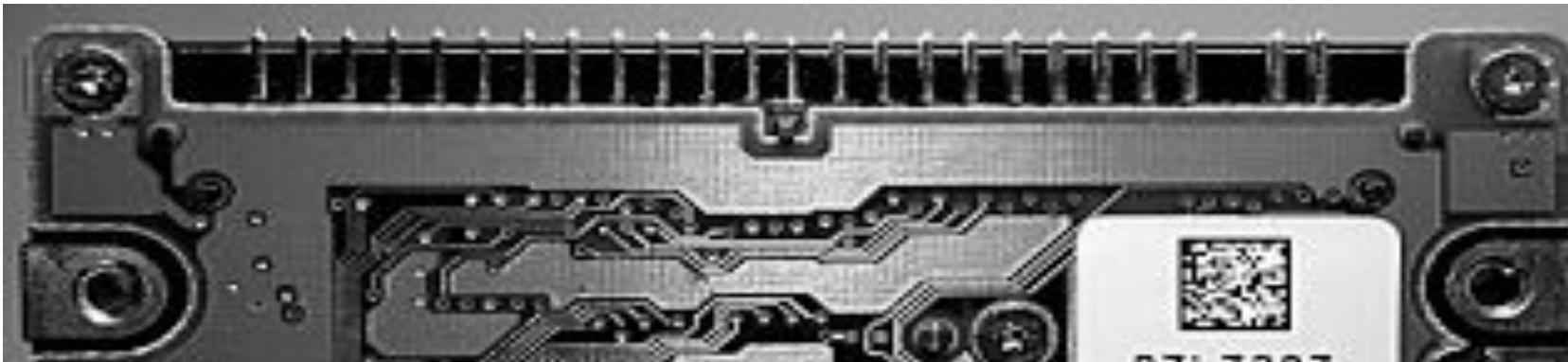
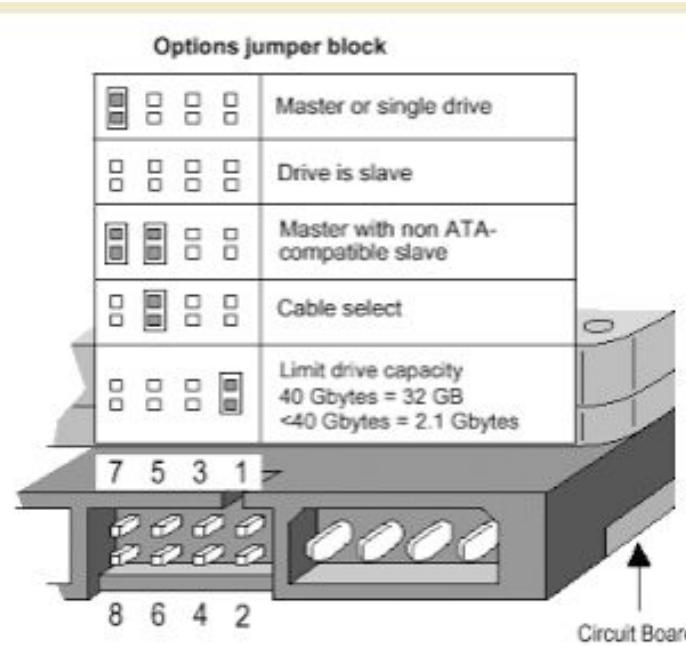
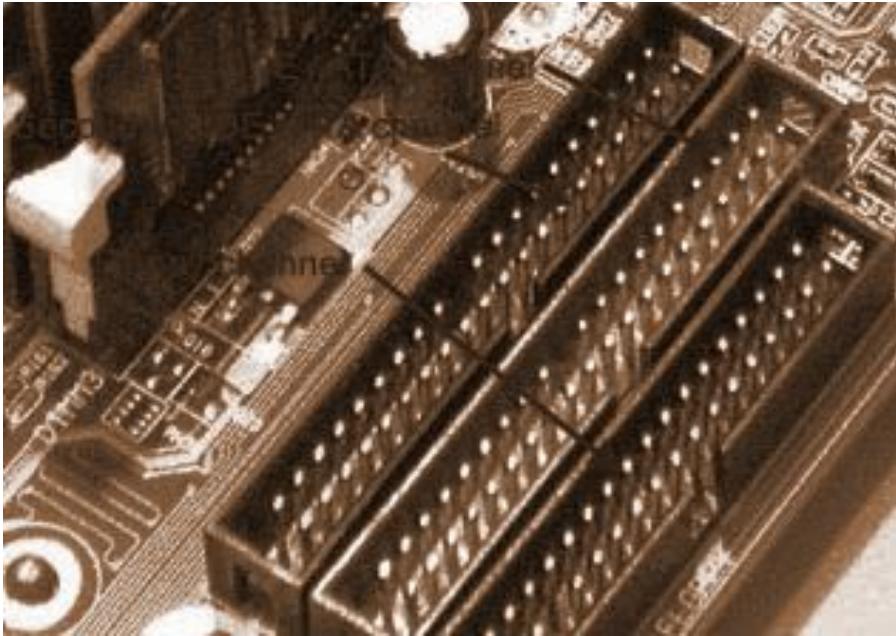
Overview of Mass Storage Structure

- Hard drives are rated by several important features.
- **Interface:** Serial or Parallel, internal and external. Data speeds vary.
- **Spindle Speed:** The rotation speed of magnetic drive platters
- **Storage Capacity:** Capacity available on new drives is constantly changing, but the price per unit of storage is dropping on magnetic drives. Solid state drives cost more per unit of capacity, but this is changing too.
- **Cache/Buffer size:** Buffers improve performance of drives by allowing a little leeway while data is being transferred. Cost goes up with buffer size. Some Hybrid drive setups use the Solid State portion as a large buffer to the magnetic drive.
- **Seek Time:** How fast is the data found and retrieved ? Cost goes up with performance. Solid State Drives have greatly improved seek time over magnetic drives.

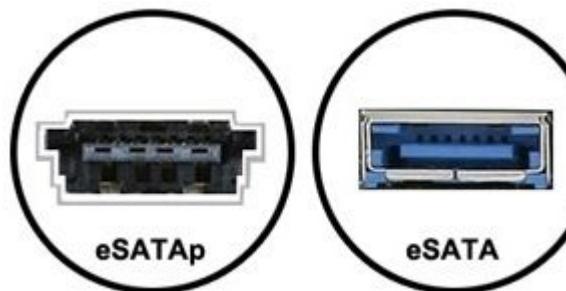
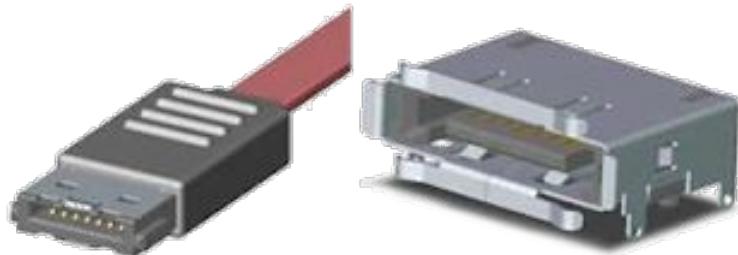
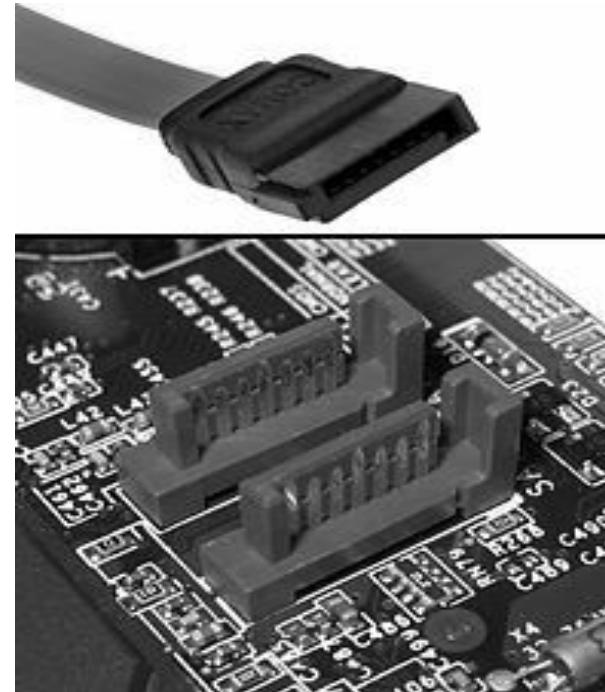
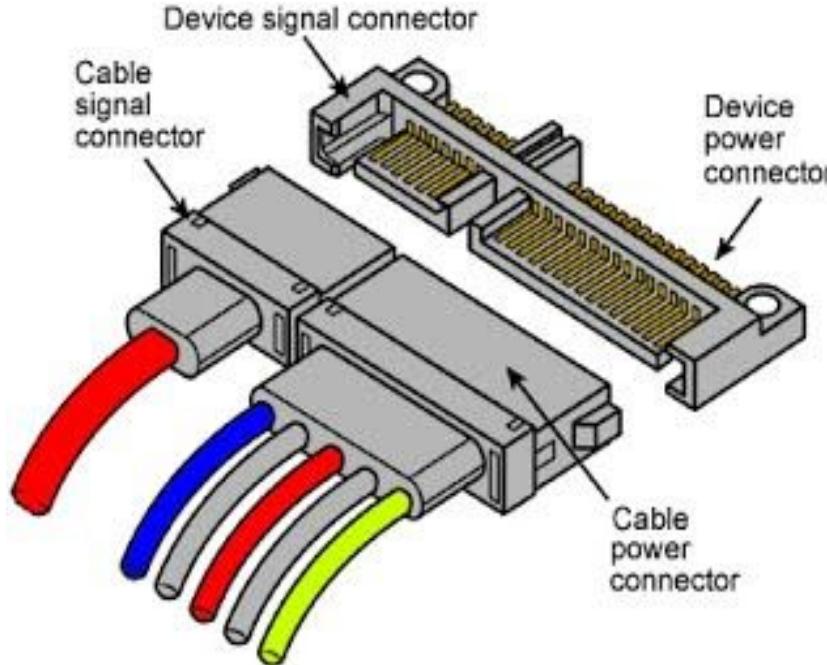
Overview of Storage Connectors - Additional Input



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Overview of Storage Connectors - Additional Input



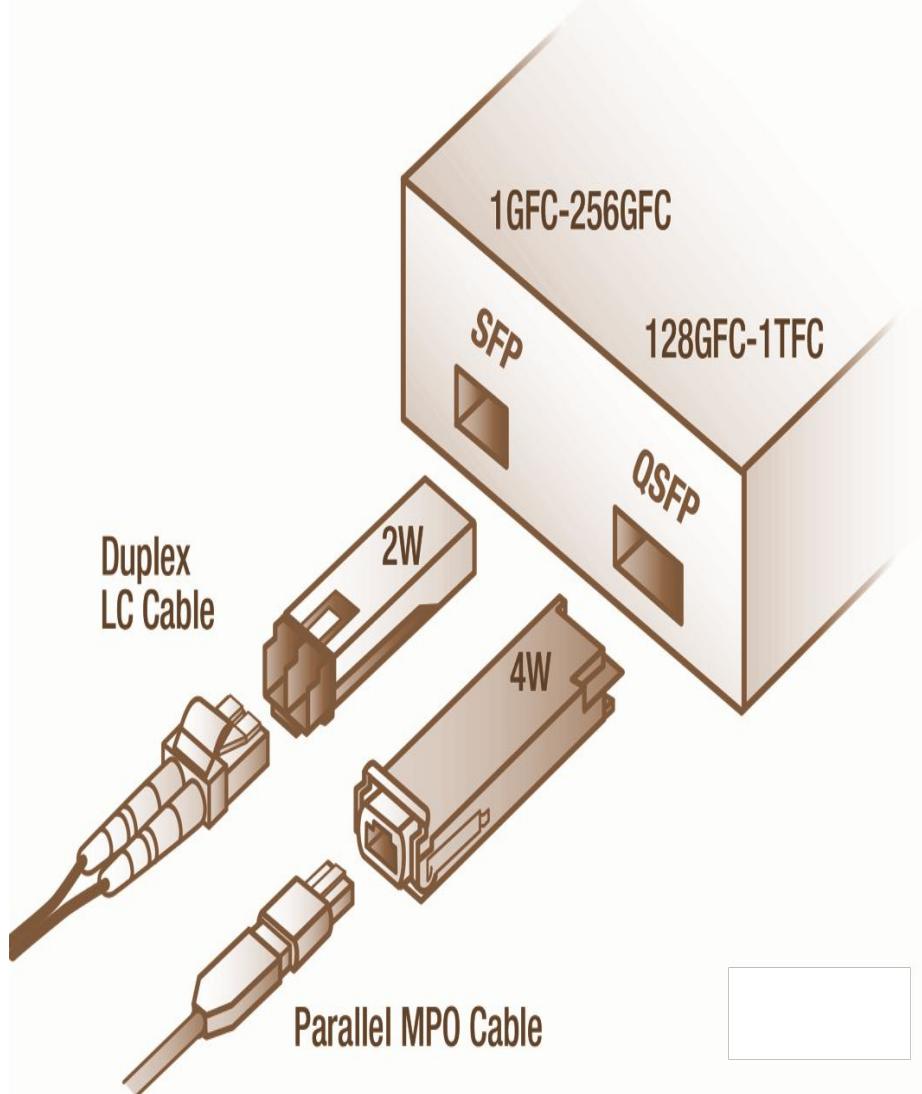
Overview of Storage Connectors - Additional Input

- **Fibre Channel** is a technology for transmitting data between computer devices at data rates of up to 4 Gbps (and 10 Gbps in the near future).
- **Fibre Channel** is especially suited for connecting computer servers to shared storage devices and for interconnecting storage controllers and drives.
- Since **Fibre Channel** is three times as fast, it has begun to replace the Small Computer System Interface (SCSI) as the transmission interface between servers and clustered storage devices.
- **Fibre Channel** is more flexible; devices can be as far as ten kilometers (about six miles) apart if optical fiber is used as the physical medium.
- Optical fiber is not required for shorter distances, however, because Fibre Channel also works using coaxial cable and ordinary telephone twisted pair.
- **Fibre Channel** technology is used with server storage networks

Overview of Storage Connectors - Additional Input

- **Fibre Channel** offers point-to-point, switched, and loop interfaces.
- It is designed to interoperate with SCSI, the Internet Protocol (IP) and other protocols, but has been criticized for its lack of compatibility - primarily because (like in the early days of SCSI technology) manufacturers sometimes interpret specifications differently and vary their implementations.
- Standards for **Fibre Channel** are specified by the Fibre Channel Physical and Signalling standard, and the ANSI X3.230-1994, which is also ISO 14165-1. (Rouse, 2005)
- **Why have the buffer ? Why not just go from the disk straight to the memory?**
- **Speed matching.** The disk supplies data at a fixed rate, which might exceed the rate the memory can accept it. In particular the memory might be busy servicing a request from the processor or from another DMA controller.

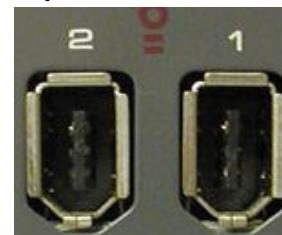
Overview of Storage Connectors - Additional Input



- **SFP:** The Small Form-factor Pluggable transceiver
- **QSFP:** The Qquad Small Form-factor Pluggable transceiver
- **LC :** Lucent Conector
- **GFC :** Generic Flow Control
- **TFC:** The Terabit FChannel
- **MPO:** Multi-fibre Push On

Overview of Storage Connectors - Additional Input

- **FireWire** is a method of transferring information between digital devices, especially audio and video equipment.
- Also known as IEEE 1394, **FireWire** is fast => the latest version achieves speeds up to 800 Mbps. At some time in the future, that number is expected to jump to an unbelievable 3.2 Gbps when manufacturers overhaul the current **FireWire** cables.
- You can connect up to **63 devices** to a **FireWire** bus. Windows operating systems (98 and later) and Mac OS (8.6 and later) both support it.



- Overview of Mass Storage Structure



THANK YOU

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