A

Seminar report

On

Universal Serial Bus (USB)

Submitted in partial fulfillment of the requirement for the award of degree
of Bachelor of Technology in Computer Science

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Acknowledgement

I would like to thank respected Mr…….. and Mr. ……..for giving me such a wonderful opportunity to expand my knowledge for my own branch and giving me guidelines to present a seminar report. It helped me a lot to realize of what we study for.

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Last but clearly not the least, I would thank The Almighty for giving me strength to complete my report on time.

Preface

I have made this report file on the topic **Universal Serial Bus** (**USB**); I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to ……..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

CONTENTS

CHAPTER 1

INTRODUCTION

Universal Serial Bus (**USB**) is a serial bus standard to connect devices to a host computer. The USB 3.0 is the upcoming version of the USB. The USB 3.0 is also called super speed USB. Because the USB 3.0 support a raw throughput of 500MByte/s. As its previous versions it also supports the plug and play capability, hot swapping etc. USB was designed to allow many peripherals to be connected using a single standardized interface socket. . Other convenient features include providing power to low-consumption devices, eliminating the need for an external power supply; and allowing many devices to be used without requiring manufacturer-specific device drivers to be installed.

There are many new features included in the new Universal Serial Bus Specification. The most important one is the super speed data transfer itself. Then the USB 3.0 can support more devices than the currently using specification which is USB 2.0. The bus power spec has been increased so that a unit load is 150mA (+50% over minimum using USB 2.0). An unconfigured device can still draw only 1 unit load, but a configured device can draw up to 6 unit loads (900mA, an 80% increase over USB 2.0 at a registered maximum of 500mA). Minimum device operating voltage is dropped from 4.4V to 4V. When operating in SuperSpeed mode, full-duplex signaling occurs over 2 differential pairs separate from the non-SuperSpeed differential pair. This result in USB 3.0 cables containing 2 wires for power and ground, 2 wires for non-SuperSpeed data, and 4 wires for SuperSpeed data, and a shield (not required in previous specifications).

CHAPTER 2

HISTORY

2.1 PRERELEASES

·**USB 0.7:** Released in November 1994.

·**USB 0.8:** Released in December 1994**.**

·**USB 0.9:** Released in April 1995.

·**USB 0.99:** Released in August 1995.

·**USB 1.0:** Release Candidate: Released in November 1995.

2.2. USB 1.0

USB 1.0: Released in January 1996.Specified data rates of **1.5 Mbit/s** (***Low-Speed***) and **12 Mbit/s** (***Full-Speed***). Does not allow for extension cables or pass-through monitors (due to timing and power limitations). Few such devices actually made it to market.

USB 1.1: Released in September 1998.Fixed problems identified in 1.0, mostly relating to hubs. Earliest revision to be widely adopted.

2.3. USB 2.0: Released in April 2000.Added higher maximum speed of **480 Mbit/s** (now called ***Hi-Speed***). Further modifications to the USB specification have been done via Engineering Change Notices (ECN).

2.4. USB 3.0:

On September 18, 2007, Pat Gel singer demonstrated USB 3.0 at the Intel Developer Forum. The USB 3.0 Promoter Group announced on November 17, 2008, that version 1.0 of the specification has been completed and is transitioned to the USB Implementers Forum (USB-IF), the managing body of USB specifications. This move effectively opens the spec to hardware developers for implementation in future products.

CHAPTER 3

ARCHITECTURE

ARCHITECTURAL COMPONENTS

3.1. HUB

The hub provide electrical interface between the USB devices and the host. Hubs are directly responsible for supporting many of the attributes that make USB user friendly and hide its complexity from the user. Listed below the major aspects of USB functionality that hub support:

- Connectivity behavior
- Power management
- Device connect/disconnect detection
- Bus fault detection
- SuperSpeed and USB 2.0 (high-speed, full-speed, an low-speed) support

A USB 3.0 hub incorporates a USB 2.0 hub and a SuperSpeed hub consisting of two principal components: the SuperSpeed Hub Repeater/Forwarder and the SuperSpeed Hub controller. The hub repeater/forwarder is responsible for connectivity and setup and tear-down. It also support fault detection and recovery. The Hub controller provides the mechanism for host-hub communication. Hub-specific status and control commands permit the host to configure hub and to monitor and control its individual downstream port.

3.2. HOST

There are two hosts are incorporated in a USB 3.0 host. One is SuperSpeed host and the second one is Non-SuperSpeed host. This incorporation ensures the backward compatibility of the USB 3.0 hub. Here the SuperSpeed hub will be supporting the 500MB/sec data transfer rate with full duplex mode. Then the Non- SuperSpeed host will be supporting the old data rates such as High-Speed, Full-Speed, Low-Speed. The host here interacts with the devices by the help of a host controller. When the host is powered off, the hub does not provide power to its downstream unless the hub supports the charging application. When the host is powered on with SuperSpeed support enabled on its downstream port by default the following is the typical sequence of events.

- Hub detects VBUS SuperSpeed support and powers its down stream ports with SuperSpeed enabled.
    - Hub connects both as a SuperSpeed and as a High-Speed device.
- Device detects VBUS and SuperSpeed support and connects as a SuperSpeed device.
    - Host system begins hub enumeration at high-speed and SuperSpeed.
    - Host system begins device enumeration at SuperSpeed.

A SuperSpeed host is a source or sink of information. It implements the required host-end, SuperSpeed. Communications layer to accomplish information exchanges over the bus. It owns the SuperSpeed data activity schedule and management of the SuperSpeed bus and all devices connected to it. The host includes an implementation number of the root downstream ports for SuperSpeed and USB 2.0. Through these ports the host:

- Detect the attachment and removal of USB device.
- Manages control flow between the host and the USB device.
- Manages data flow between the host and the USB device.

- Collect the status activity statistics
- Provide power to the attached USB device

3.3. DEVICE

SuperSpeed devices are sources or sink of information exchanges. They implement the required device-end, SuperSpeed communication layers to accomplish information exchanges between a driver on the host and a logical function on the device. All SuperSpeed devices share their base architecture with USB 2.0.They are required to carry information for self-identification and generic configuration. They are also required to demonstrate behavior consistent with the defined SuperSpeed Device States.

All devices are assigned a USB address when enumerated by the host. Each device supports one or more pipes though which the host may communicate with the device. All devices must be support a designed pipe at endpoint zero to which the device's Default Control Pipe is attached. All devices support a common access mechanism for accessing information through this control pipe. SuperSpeed inherits the categories of information that are supported on the default pipe from the USB 2.0. The USB 3.0 connection model allows for the discovery and configuration of the USB device at the highest signaling speed supported by the device. The USB 3.0 supports an increased power supply for the devices operating at the SuperSpeed. USB 3.0 devices within a single physical package (i.e., a single peripheral) can consist of a number of functional topologies including single function , multiple functions on a single peripheral device (composite device), and permanently attached peripheral devices behind an integrated hub.

3.4 BLOCK DIAGRAM

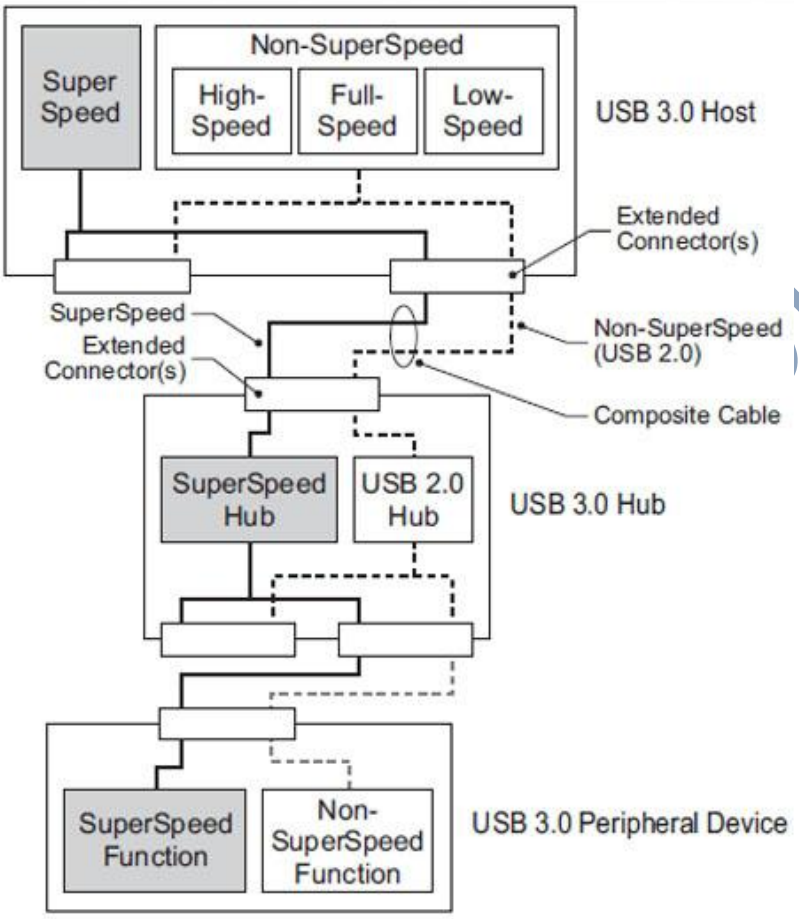

Figure 3.1. Architecture of USB 3.0

CHAPTER 4

PHYSICAL STRUCTURE

4.1. CABLE STRUCTURE

USB 3.0 cables have eight primary conductors: three twisted signal pairs for USB data paths and a power pair. In addition to the twisted signal pair for the USB 2.0 data path, two twisted signal pairs are used to provide the SuperSpeed data path, one for the transmit path and one for the receive path. USB 3.0 receptacles (both upstream and down stream) are backward compatible with USB 2.0 connector plug. USB 3.0 cables and plugs are not intended to be compatible with USB 2.0 upstream receptacles. As an aid to the user, USB 3.0 mandates standard coloring for plastic portions of USB 3.0 plugs and receptacles. Electrical (insertion loss, return loss, cross talk etc) performance for USB 3.0 is defined with regard to raw cables, mate connectors, and mated cable assemblies, with compliance requirements using industry test specification established for the later two categories.

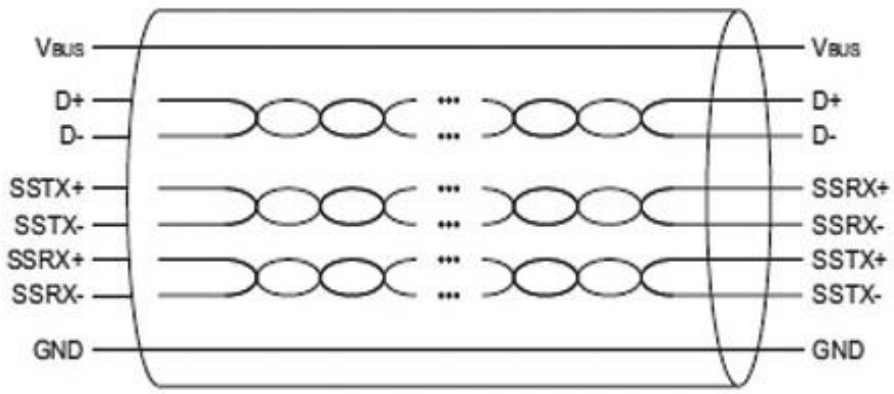

Figure 4.1. Architectural view of USB 3.0 bus

VBUS : This cable is used to carry power.

GND : It's the ground of the power cable.

D+ : It's the '+' data bus for the USB 3.0, which support backward compatibility with USB 2.0

D- : It's the '-' data bus for the USB 3.0, which support backward compatibility with 2.0

SSTX+ : It's the '+' data transmission bus of USB 3.0, which support SuperSpeed

SSTX- : It's the '-' data transmission bus of USB 3.0, which support SuperSpeed

SSRX+ : It's the '+' data reception bus of USB 3.0, which support SuperSpeed

SSRX- : It's the '-' data reception bus of USB 3.0, which support SuperSpeed

Here the USB is using a differential pair data cables. The differential pair data cables are used to reduce the transmission error. The data to be transmitted is passed through an OpAmp and the inverse of the data is produced. And then these two data are passed through the +, - lines provided. In USB 3.0 both shielded and unshielded differential pair lines are used. Shielded for the SuperSpeed transmission and the unshielded for the non-SuperSpeed.

4.2. CROSS SECTIONAL REVIEW

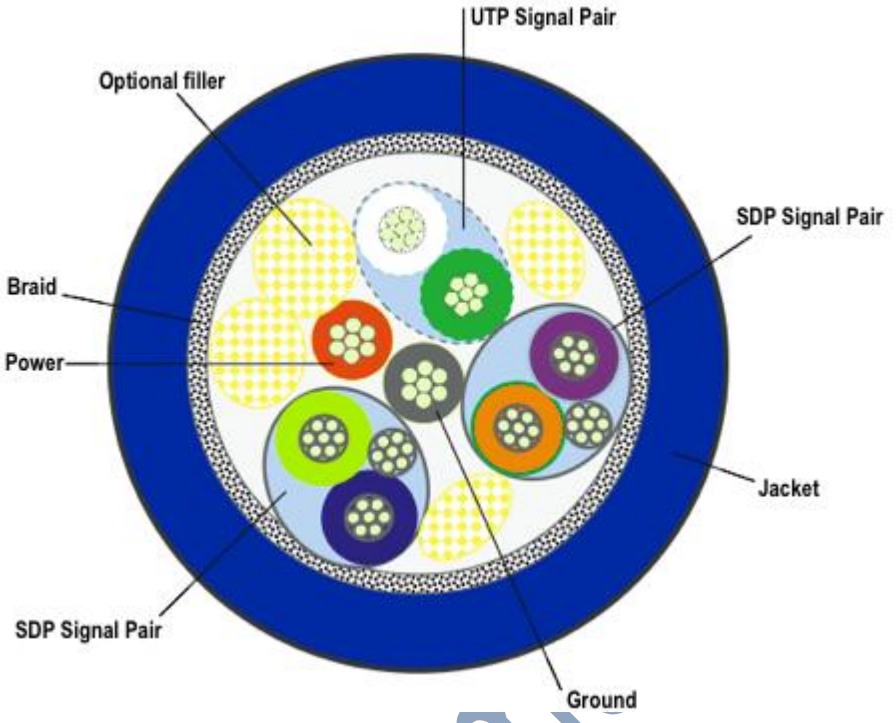

Figure 4.2. Cross sectional view of USB 3.0 cable

Cable Colours

PIN NO	COLOUR	DISCRIPTION
1	RED	POWER
2	GREEN	USB 3.0 DATA+
3	WHITE	USB 3.0 DATA -
4	BLACK	GROUND
5	ORANGE	SUPER SPEED RECEIVER-
6	VIOLET	SUPER SPEED RECEIVER +
7	BLACK	GROUND USB 3.0
8	GREEN	SUPER SPEED TRANSMITTER -
9	BLUE	SUPER SPEED TRANSMITTER +

Table 4.1

4.3. CONNECTORS

The USB 3.0 specification defines the following connectors:

- USB 3.0 standard-A plug and receptacle.
- USB 3.0 standard-B plug and receptacle.
- USB 3.0 powered-B plug and receptacle.
- USB 3.0 micro-B plug and receptacle.
- USB 3.0 micro-A plug.
- USB 3.0 micro-AB receptacle

4.4. STANDARD A TYPE CONNECTOR

USB3_RX : +/- data bus for reception USB 3.0

USB3_TX : +/- data bus for transmission

USB 3.0 -D/+D : +/- data bus for USB 2.0

BUS : Carry power

GND : Ground

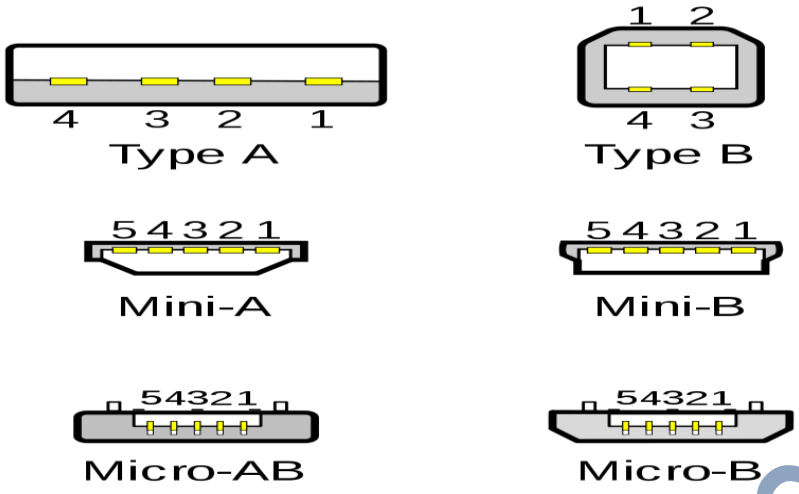

Figure 4.3. USB 2.0 Receptors

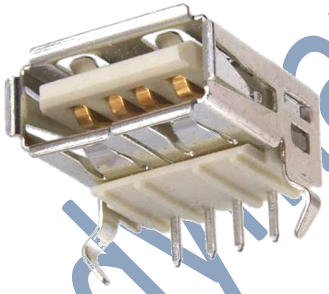

Figure 4.4. USB 2.0 Standard A Type Receptor

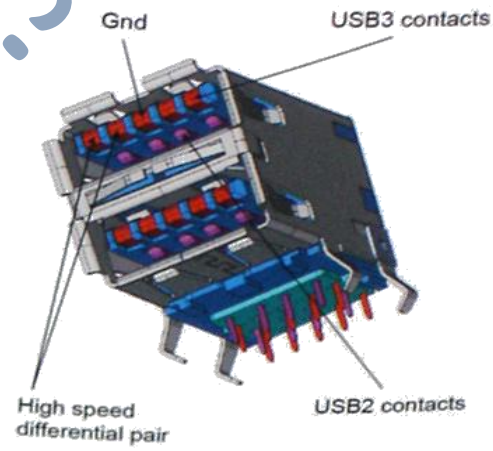

Figure 4.5. USB 3.0 Standard A Type Receptor

CHAPTER 5

FEATURES

5.1. TRANSFER RATES

A USB supports following data rates:

- A **low speed** rate of 1.5 Mbit/s (187.5 kB/s) is defined by USB 1.0. It is very similar to full speed operation except each bit takes 8 times as long to transmit. It is intended primarily to save cost in low-bandwidth human interface devices (HID) such as keyboards, mice, and joysticks.
- The **full speed** rate of 12 Mbit/s (1.5 MB/s) is the basic USB data rate defined by USB 1.1. All USB hubs support full speed.
- A **high-speed** (USB 2.0) rate of 480 Mbit/s (60 MB/s) was introduced in 2001. All high-speed devices are capable of falling back to full-speed operation if necessary.
- A **SuperSpeed** (USB 3.0) rate of 5.0 Gbit/s (625 MB/s). The USB 3.0 specification was released by Intel and its partners in August 2008

5.2. BACKWARD COMPATIBILITY

To accommodate the additional pins for SuperSpeed mode, the physical form factors for USB 3.0 plugs and receptacles have been modified from those used in previous versions. Standard-A cables have extended heads where the SuperSpeed connectors extend beyond and slightly above the legacy connectors. Similarly, the Standard-A receptacle is deeper to accept these new connectors. A legacy Standard-A cable will operate as intended and will never interact with the SuperSpeed connectors, ensuring backward compatibility. The Standard-B modifications could not be made as elegantly; the SuperSpeed connectors had to be placed on top of the existing form factor, making legacy Standard-B plugs workable on SuperSpeed Standard-B receptacles, but not vice versa.

5.3. POWER SPECIFICATIONS

The bus power spec has been increased so that a unit load is 150mA (+50% over minimum using USB 2.0). An unconfigured device can still draw only 1 unit load, but a configured device can draw up to 6 unit loads (900mA, an 80% increase over USB 2.0 at a registered maximum of 500mA). Minimum device operating voltage is dropped from 4.4V to 4V.

5.4. CABLE LENGTH

USB 3.0 does not define cable assembly lengths, except that it can be of any length as long as it meets all the requirements defined in the specification. However, electronicdesign.com estimates cables will be limited to 3 m at SuperSpeed.

5.5. TRANSFER MODE

When operating in SuperSpeed mode, full-duplex signaling occurs over 2 differential pairs separate from the non-SuperSpeed differential pair. Full-duplex means that the data can be transferred in two directions simultaneously.

5.6. OTHER FEATURES

- New power management features include support of idle, sleep and suspend states, as well as Link-, Device-, and Function-level power management.
- USB 3.0 extends the bulk transfer type in SuperSpeed with Streams. This extension allows a host and device to create and transfer multiple streams of data through a single bulk pipe
- SuperSpeed establishes a communications pipe between the host and each device, in a host-directed protocol. In contrast, USB 2.0 broadcasts packet traffic to all devices.
- As its ancestors USB 3.0 support hot swapping. That is the USB cables can be connected and operated without rebooting the computer.
- As its ancestors USB 3.0 networks use a tiered-star topology

- Unlike most other connector standards, the USB specification also defines limits to the size of a connecting device in the area around its plug. This was done to prevent a device from blocking adjacent ports due to its size. Compliant devices must either fit within the size restrictions or support a compliant extension cable which does.

- The connectors are designed to be robust. Many previous connector designs were fragile, with pins or other delicate components prone to bending or breaking, even with the application of only very modest force. The electrical contacts in a USB connector are protected by an adjacent plastic tongue, and the entire connecting assembly is usually further protected by an enclosing metal sheath. As a result USB connectors can safely be handled, inserted, and removed, even by a child.

- It is difficult to attach a USB connector incorrectly. Connectors cannot be plugged in upside down, and it is clear from the appearance and kinesthetic sensation of making a connection when the plug and socket are correctly mated. However, it is not obvious at a glance to the inexperienced user (or to a user without sight of the installation) which way around the connector goes, thus it is often necessary to try both ways. More often than not, however, the side of the connector with the *trident* logo should be on top or towards the user.

CHAPTER 6

COMPARISON WITH USB 2.0

As we know the USB 3.0 is the next version of the USB series. So we can't expect anything other than advantages from USB 3.0 over 2.0. Still we perform a comparison to find out what are advantages which we can expect from the new SuperSpeed USB (USB 3.0).

- The new spec will support data transfers at 4.8 gigabits per second, or Gbps, nearly 10 times faster than the current standard's 480 megabits per second and six times faster than FireWire 800. It's also 400 times faster than the 12 Mbps offered by the original spec, USB 1.0. ·USB 2.0 is also known as "Hi-Speed USB," while USB 3.0 will have the confusingly similar moniker "SuperSpeed USB."

- The new USB 3.0 connectors and devices will be compatible with older USB ports (on devices using USB 2.0 and 1.0) but they will be limited to the older ports' slower speeds. The latest SuperSpeed USB-enabled devices connecting to older PCs running USB 2.0 or lower will experience data transfer rates that are much slower.

- It also has better power output, 900 milliamps compared to 100 milliamps with USB 2.0. That means up to four devices can be charged from a single USB port and charged faster.

- When we look to the architecture of the USB 3.0, unlike the USB 2.0, USB 3.0 support 9 pins instead of 5 pins.

- The USB 3.0 support full-duplex data transfer. The full duplex means you can send data in either direction (bi-directionally) simultaneously. But USB 2.0 was supporting half-duplex transmission that you can transmit the data in either direction but not simultaneously.

- Since the USB 3.0 is supporting more cables than USB 2.0 the cable will be appeared a little much thick for the users.

CHAPTER 7
APPLICATIONS

The USB ports are used for a number of applications. The USB ports get the popularity because of its simplicity as well the easiness in use. The main application of USB 3.0 is listed below.

- USB implements connections to storage devices using a set of standards called the USB mass storage device class (referred to as MSC or UMS). This was initially intended for traditional magnetic and optical drives, but has been extended to support a wide variety of devices, particularly flash drives. This generality is because many systems can be controlled with the familiar idiom of file manipulation within directories (The process of making a novel device look like a familiar device is also known as extension)

- USB 3.0 can also support portable hard disk drives. The earlier versions of USBs were not supporting the 3.5 inch hard disk drives. Originally conceived and still used today for optical storage devices (CD-RW drives, DVD drives, etc.), a number of manufacturers offer external portable USB hard drives, or empty enclosures for drives, that offer performance comparable to internal drives [citation needed]. These external drives usually contain a translating device that interfaces a drive of conventional technology (IDE, ATA, SATA, ATAPI, or even SCSI) to a USB port. Functionally, the drive appears to the user just like an internal drive.

- These are used to provide power for low power consuming devises. These can be used for charging the mobile phones.

- Though most new computers are capable of booting off USB Mass Storage devices, USB is not intended to be a primary bus for a computer's internal storage: buses such as ATA (IDE), Serial ATA (SATA), and SCSI fulfill that role. However, USB has one important advantage in that it is possible to install and remove devices without opening the computer case, making it useful for external drives.

- Mice and keyboards are frequently fitted with USB connectors, but because most PC motherboards still retain PS/2 connectors for the keyboard and mouse as of 2007, they are often supplied with a small USB-to-PS/2 adaptor, allowing usage with either USB or PS/2 interface. There is no logic inside these adaptors: they make use of the fact that such HID interfaces are equipped with controllers that are capable of serving both the USB and the PS/2 protocol, and automatically detect which type of port they are plugged into. Joysticks, keypads, tablets and other human-interface devices are also progressively migrating from PC game port, and PS/2 connectors to USB.

- It can also support Ethernet adapter, modem, serial port adapter etc

- It can support Full speed hub, hi-speed hub, and SuperSpeed hub.

It can support USB smart card reader, USB compliance testing devices, Wi-Fi adapter, Bluetooth adapter, ActiveSync device, Force feedback joystick.

CHAPTER 8
CONCLUSION

The high-rate of SuperSpeed adoption illustrates that USB 3.0 is a thriving and advanced ecosystem. It is already driving and creating a new generation of devices and components. The new standard is allowing OEMs to manufacture a fresh wave of devices that take advantage of SuperSpeed's minimized wait time and optimized power efficiency. I would also like to note that USB 3.0 uses only 1/3 of the power compared to USB 2 - and of course, the standard is fully backwards compatible.

USB 3.0 SuperSpeed protocol is very promising high speed communication protocol. With success of earlier versions of USB and backward compatibility of USB 3.0 is going to be very useful for quick migration. High data rate of USB 3.0 is very tempting to adapt the technology for many high end video streaming applications.

Reference

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