

USB Standards

- **Universal Serial Bus (USB) 1.1 comes in 1.5 Mbps and 12 Mbps;**
 USB 2.0 runs at 480 Mbps
- **USB 3.0 runs at 5 Gbps; USB 3.1 runs at 10 Gbps**
- **USB connectors often use colors to show versions**
- **USB connectors come in many types: Type-A, Type-B, Type-C,**
 standard, mini, and micro

USB (Universal Serial Bus) - speeds in Megabits per sec (Port Color)

USB 1.0 - 1.5Mbps

USB 1.1 - 12 Mbps (white)

USB 2.0 - 480Mbps (black) - MUCH faster

USB 3.0 - 5Gbps (blue) - Faster but has a lot of compatibility issues

USB 3.1 - Gen 1 (blue) - Fixed compatibility & is used on most systems today

USB 3.1 - Gen 2 - 10Gbps (teal)

Charging Ports (red or yellow)

These speeds are very important for the exam - memorize them!



USB micro-B
Android

USB mini-B
Cameras

USB Type-B
Scanners

USB Type-A
Plug into the Computer



USB Type-C
Can orientate either way
unlike with USB Type-A

USB 3.0 micro-B
Compatible with
USB micro-B

Understanding USB

- All USB devices connect to USB controllers built into the motherboard of the system;
USB controller is in charge of all connected USB devices
- USB Type-A connectors plug into downstream USB ports
- USB Type-B connectors plug into upstream USB ports

USB Device gets plugged into a USB Controller

Built into the Mobo is a “network” which we connect these USB Devices.

Mobo has a built in Controller that enables the devices to work

Any time you connect a USB Device,

you have a USB Upstream Connector, and a USB Downstream Connector

Downstream - when a USB Device is plugged into the system,

the Controller built into the Mobo sends commands Downstream to the Device

This is done through the **Type-A Connector** (can plug in/out of system)



This is a Type-B Connector

Upstream -

This is done through a **Type-B Connector** (All USB Devices have a Type-B Connector. For a USB Mouse, there is a Type-B, but it's just soldered on the inside of the mouse & not meant for unplugging)

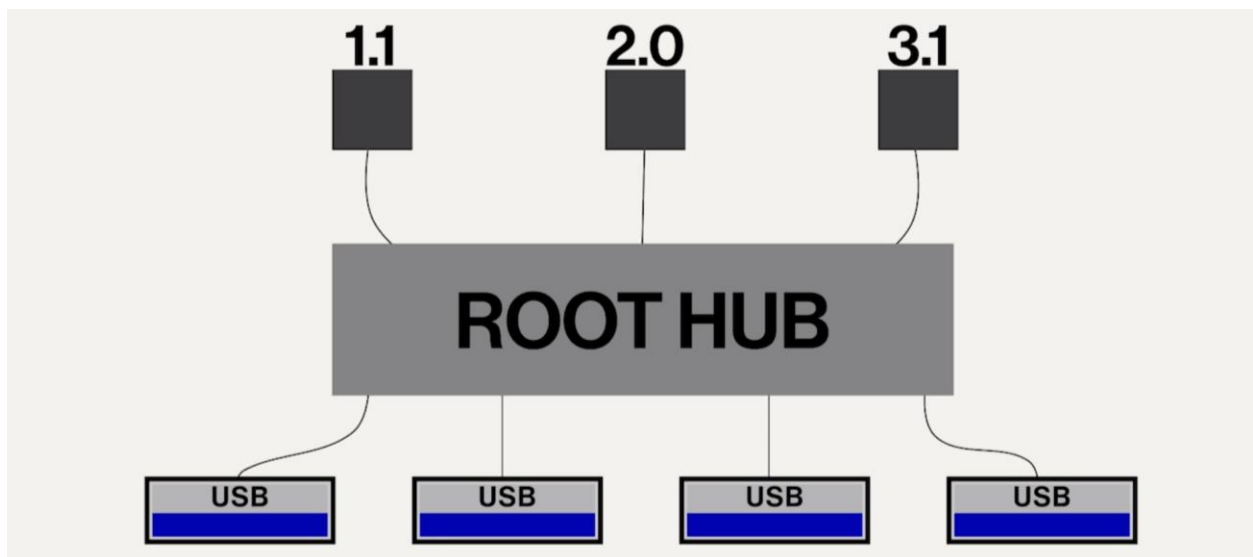
Type-B Connectors plug into a Device (with some exceptions)

Type-A Connectors plug into a System



This is another USB Type-B Connector

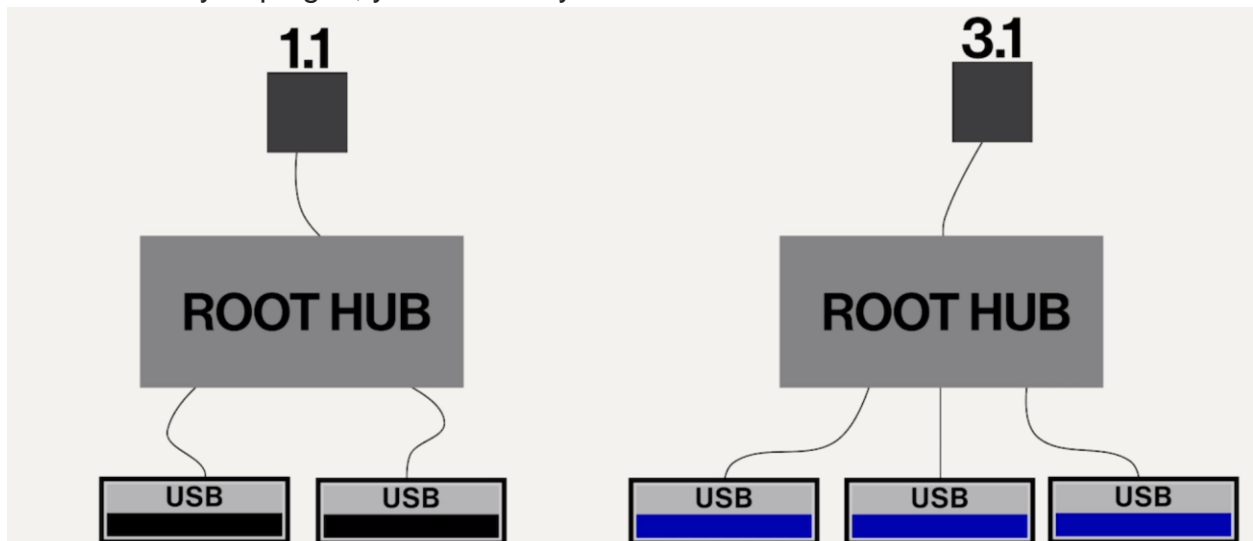
USB Type-C Connectors - can be plugged in either way where Upstream/Downstream directions don't matter. The devices will determine the direction.



Built into the Southbridge in a Mobo are separate USB Controllers, which are designed to support certain versions of USB (1.1; 2.0; 3.1)

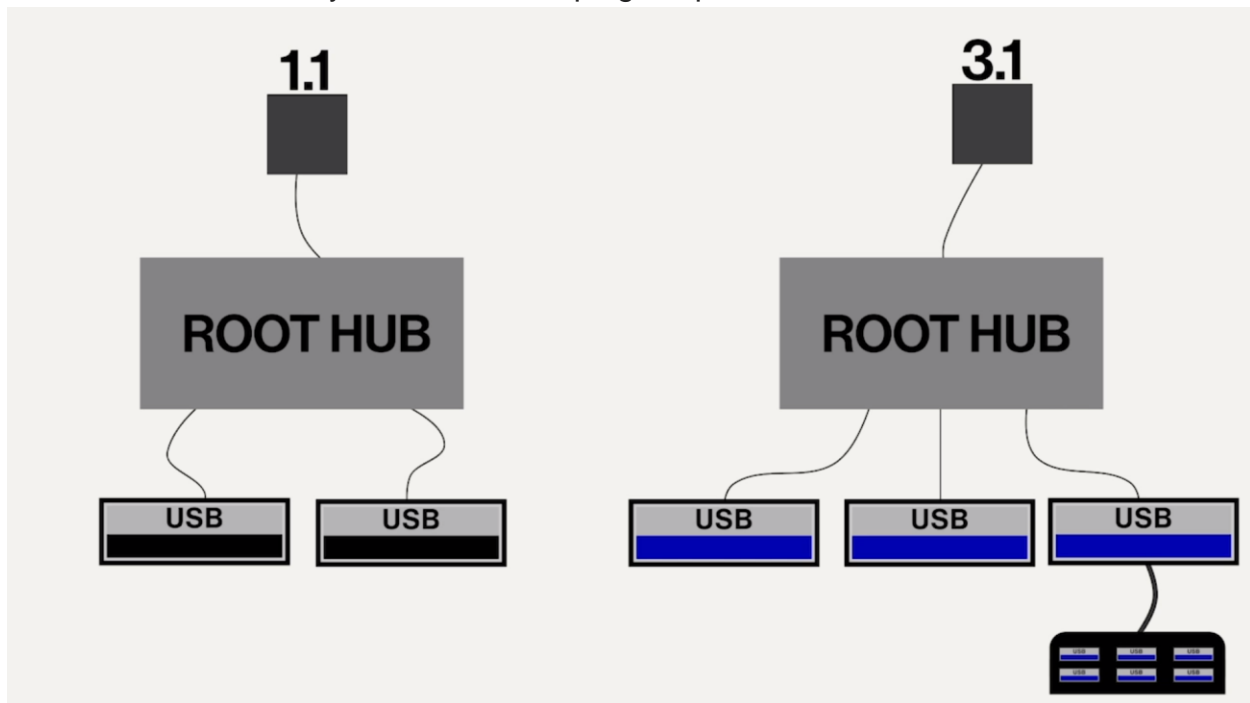
The USB Controllers are plugged into a Root Hub. From the Hub, all the USB Connectors on our Mobo are exposed for people to plug into them.

Most likely all the connections would be Blue, because no matter where you plug in, you can always connect to the 3.1 Controller



This setup is actually a little more common having separate Root Hubs in the system

The most amount of Devices we can plug into this system is 5,
but USB allows you to be able to plug in up to 127 Devices!



USB Hubs allow more USB Devices! -This is different than a Root Hub

USB provides Power, so having too many devices plugged into a USB Hub would be an issue, but these are USB AC Powered Hubs!



In Device Manager, you can see your USB Controllers (on the Mobo);
and the Root Hubs (the Composite Devices can also possibly be Root Hubs)

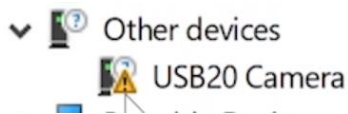
Configuring USB

- USB devices must have a device driver
- Operating systems come with thousands of built-in device drivers
- In some cases, you may need to download the correct driver for a USB device from the Internet

It used to be you'd have to setup the Device Driver first, then plug in the device to use it.

Windows10 has so many Device Drivers built into it already, we typically can now just plug in and start using the device.

If the OS doesn't have the Device Driver, it will go online automatically, download & install it.



This error tells us the OS recognizes the Device, but it doesn't have the Device Driver. Need to install it ourselves by either going online to find the Device Driver, or possibly installing it with a CD-ROM or Thumb Drive



HID (Human Interface Device) - Device Drivers that ensure the core Mice & Keyboard functions work

The extra features of the Keyboard or Mouse won't work without the right Device Driver

Disable USB Ports - (for Security) through System Setup selectively by Port, or turn them all off

USB Lock - Software designed to watch over USB Ports, which can prevent people from using the USB Port, perform Reporting, Whitelist (certain USB Devices work)

Good for preventing data being "leaked-out" through USB Ports (Security)

Thunder and Lightning

- Thunderbolt is a general purpose I/O port that runs at 10 Gbps up to 40 Gbps
- Thunderbolt uses a mini DisplayPort or a USB C connector
- The Lightning standard is exclusive to Apple products
- Lightning uses a proprietary lightning connector

Thunderbolt Connection - Combination of a PCIe and a DisplayPort
Monitors; Charging; Data Transfer; etc

Thunderbolt 1 - 10Gbits/s (2 channels)

Thunderbolt 2 - 20Gbits/s

Thunderbolt 3 - 40Gbits/s



Thunderbolt 3
(USB C)

Thunderbolt 2

Thunderbolt 1

Thunderbolt doesn't have it's own special connector - just uses Mini-DisplayPort



Notice the Thunderbolt Icon

MacOS is starting to use Thunderbolt 3 (USB C)



Lightning Connection - 5Gbits/s
Charging; Data Transfer

exclusive to Apple Products (iOS)

Optical Media

- **Compact discs (CDs) store 650-700 MB of data**
- **Digital video/versatile discs (DVDS) store from 4.37 GB to 15.9**
- **Blu-ray Discs (BDs) store 25 GB to 50 GB**
- **All optical media comes in read-only memory (ROM), write-once (R), and write-many (RW/RE) versions**

Optical Media - CD's, DVD's, Blu-Ray

CD (Compact Disc) - Originally just for Music
74 min & 80 min

disk - data storage media refers to magnetic storage

disc - refers to optical storage

CD-ROM (Compact Disc/Read-Only Memory) - Stores Data

CDFS (CD File System/ISO-9660) - File System for CD-ROM
Allows OS to see the folders/files

CD-R (CD-Recordable) - Allows us to "burn" (put whatever we wanted on there)
Can't erase this data.
Used for back up's

CD-RW (CD- Rewritable) - Burn & Replace data
Speed - 52x Capacity - 650-700MB & 74-80 min
(This is the capacity for CD-ROM; CD-R; CD-RW)

Optical Devices use SATA Data & SATA Power

Should be able to see the device in both the System Setup & Disk Management

DVD (Digital Video Disc) - Originally designed for playing Movies
(Today, DVD stands for “Digital Versatile Disc”)

DVD-ROM (DVD/Read-Only Memory) - Most common type of Optical Media
Motherboard will come with a DVD-ROM for installation & instruction

DL (Dual-Layer Format) - For DVD's, where on one side there are 2 layers.
Different lasers would hit different layers

DS (Double-Sided Format) - Silver on both sides

Original DVD was SS (Single-Sided) & SL (Single Layered)

DVD Version	Capacity
DVD-5 (12 cm, SS/SL)	4.37 GB, more than two hours of video
DVD-9 (12 cm, SS/DL)	7.95 GB, about four hours of video
DVD-10 (12 cm, DS/SL)	8.74 GB, about four and a half hours of video
DVD-18 (12 cm, DS/DL)	15.90 GB, more than eight hours of video

DVD+R - Burn Once

DVD+RW

DVD-RW

These all had their own standards that the player had to have,
which created a mess!

Today ANY Optical Media Device can read & write any of these formats!

Blu-Ray Disc - High Definition Movies

Blu-Ray Type	Blu-Ray-ROM Size	Blu-Ray SS Capacity (single layer)	Blu-Ray DS and SL or DL Capacity (dual layer)
Standard disc	12 cm	25 GB	50 GB
Mini disc	8 cm	7.8 GB	15.6 GB

(Much Larger Capacities)

BD-R - Recordable

BD-RE - Recordable Erasable

Readers and Scanners

- Smart card/magnetic readers are used to read cards
- Flash memory readers read many types of flash memory
- SD cards are very popular flash memory
- Scanners read paper documents.

Automatic document feeders enable scanning multiple pages

- Barcode and OR code scanners read printed coded labels

Smart Card Reader - Store essential credentials

Can be a USB Device, or built into the computer/laptop

Used for Authentication

Stores have these for your Credit Card Purchases

High Security Situations for Laptops for Logging In

You need to Log In and Use your Smart Card (Extra Security)

Magnetic Reader - Swipe your Card

Square has this with their Smart Devices for Purchases



Flash Memory Reader - Read Flash Memory Cards



Olympus xD Picture Card

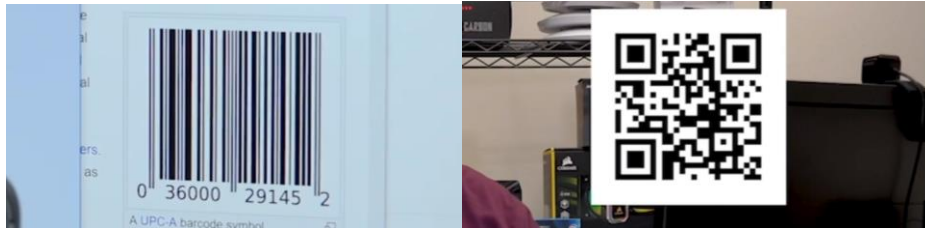
Micro-SD
Phones
Tablets

Mini-SD

SD Card
Cameras

Flatbed Scanner - Scans Paper Documents
Only allow 1 Page at a time

ADF (Automatic Document Feeder) - Very typical to have this in an Office Setting
with a Receptionist



Barcode/QR Code Scanners - Store either Numeric, or Alpha-Numeric Information
Great for Inventory

Scanner Gun Reader - Cashiers use these
Can also be read with a Smart Phone!

These codes are found in System Setup & in BIOS,
which will connect you to a website to help fix issues

Common Peripherals

- The most common modern peripherals are keyboards, mice, webcams, and external storage
- The term peripherals include both input & output devices
- You can personalize your sound settings in Windows

Types of Peripherals.....

Keyboard

Ten Keyless (TKL) Keyboard - smaller form factor keyboard

Wireless Keyboards connect through Unifying Dongles
using RF technology, not Bluetooth

USB Game Controller

Webcam

Joysticks

External/Hot-Swappable Storage Drives

Microphones

Speakers

USB Controller Resource Warning - too many devices connected on high-speed ports

- 1) Rearrange your USB devices to be on lower speed ports
- 2) Reboot your system

Webcams and Videoconferencing

- Webcams enable us to meet remotely using videoconferencing software
- Two common videoconferencing tools are Zoom and Microsoft Teams
- Many videoconferencing software options also allow screensharing

Videoconferencing Software (such as Zoom, and Microsoft Teams)

Allows you to.....

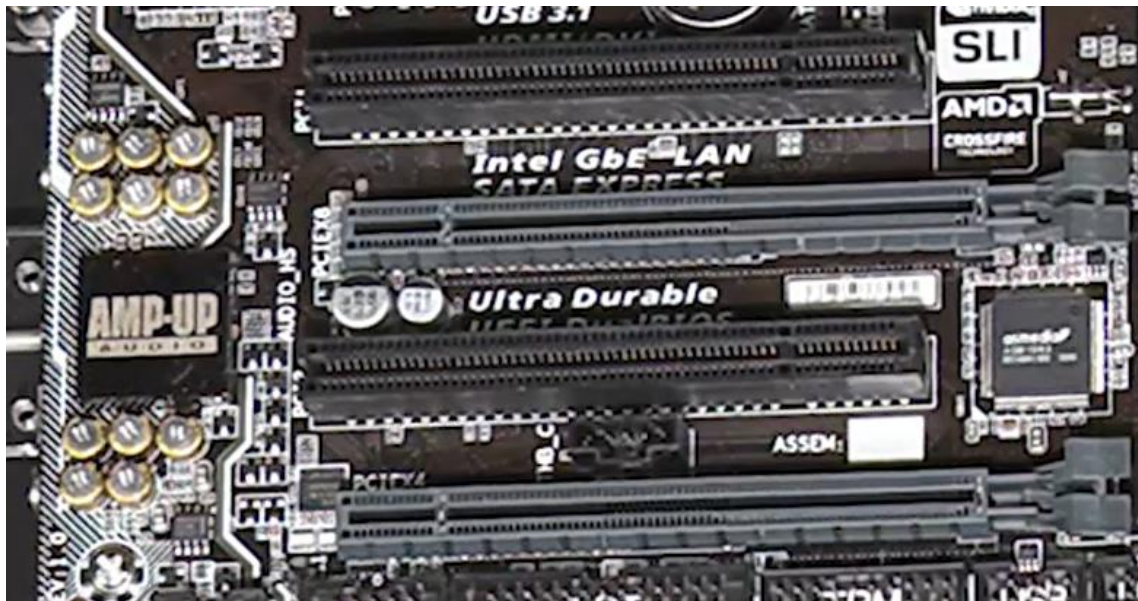
- enable/disable your webcam (so nobody can see you!)
- set different backgrounds (so nobody sees your messy bedroom)
- screen share (so you could show someone what's on your computer)

Installing and Troubleshooting Expansion Cards

- PCI cards were the first internal plug and play (PnP) components
- PCIe enables devices to keep up with higher bandwidth hardware like the CPU and RAM
- Common PCIe formats include x1, x4, x8, and x16
- Most modern GPUs utilize the PCIe standard

Expansion Card - uses a Peripheral Component Interconnect (PCI) or a PCIe (express)

PCI and PCIe Slots on the Mobo



PCIe – allows for really high bandwidth communication
between the device that's plugged into that slot
and the other components on the Mobo

Slots can be used for....

- GPUs (Graphics Processing Units)
- Sound Cards
- NICs (Network Interface Cards)
- RAID cards

PCIe Lanes – different formats

x1, x4, x8, x16

The more lanes you have, the more traffic you could get through!

x1



x16



Notice the clip on the x16

Keep in mind when installing a GPU/video card

You may need to disable on-board/integrated graphics in the BIOS