

UNIT-3

DATA TRANSFER TECHNIQUES

UNIVERSAL SERIAL BUS (USB)

Universal Serial bus

- The serial interface *USB* was introduced in 1998 by Microsoft, intel, and Compaq.
- Primarily, the USB system was proposed as the solution of the problem of multi-cable of periphery devices connected to the computer.
- The simplicity of the system and its efficiency results that today the system is widely used as a valuable interface system and many of the devices including measuring instruments as oscilloscopes and data acquisition boards, all are equipped with this interface.



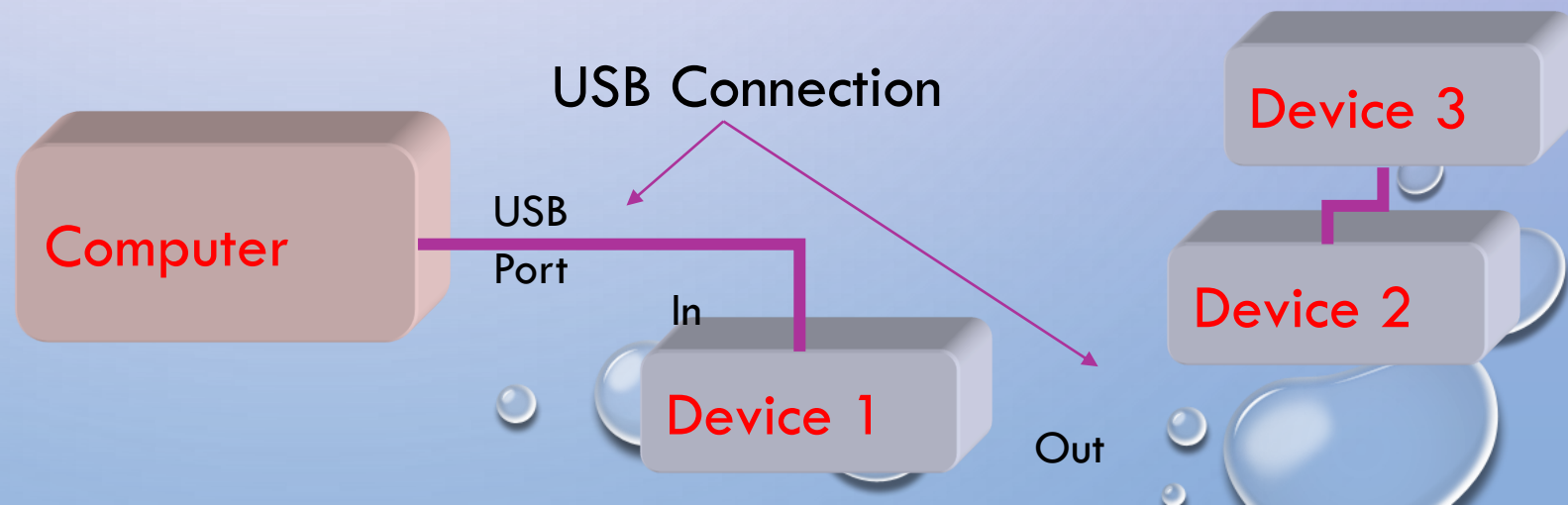
CONTD..

- The main advantage of the USB interface is high speed i.e. 12 Mbps in USB 1.0 and 480 Mbps in USB 2.0 and 5 Gbit/s in USB 3.0 and USB 3.1 10 Gbit/s.
- It is important that practically all computers are equipped with this interface.
- Another benefit of this system is also simple and inexpensive cable.
- The drawback is that the length of the cable is limited to 5 m, although on the market there are devices enabling increase of the cable length to 25 m with a special amplifier.



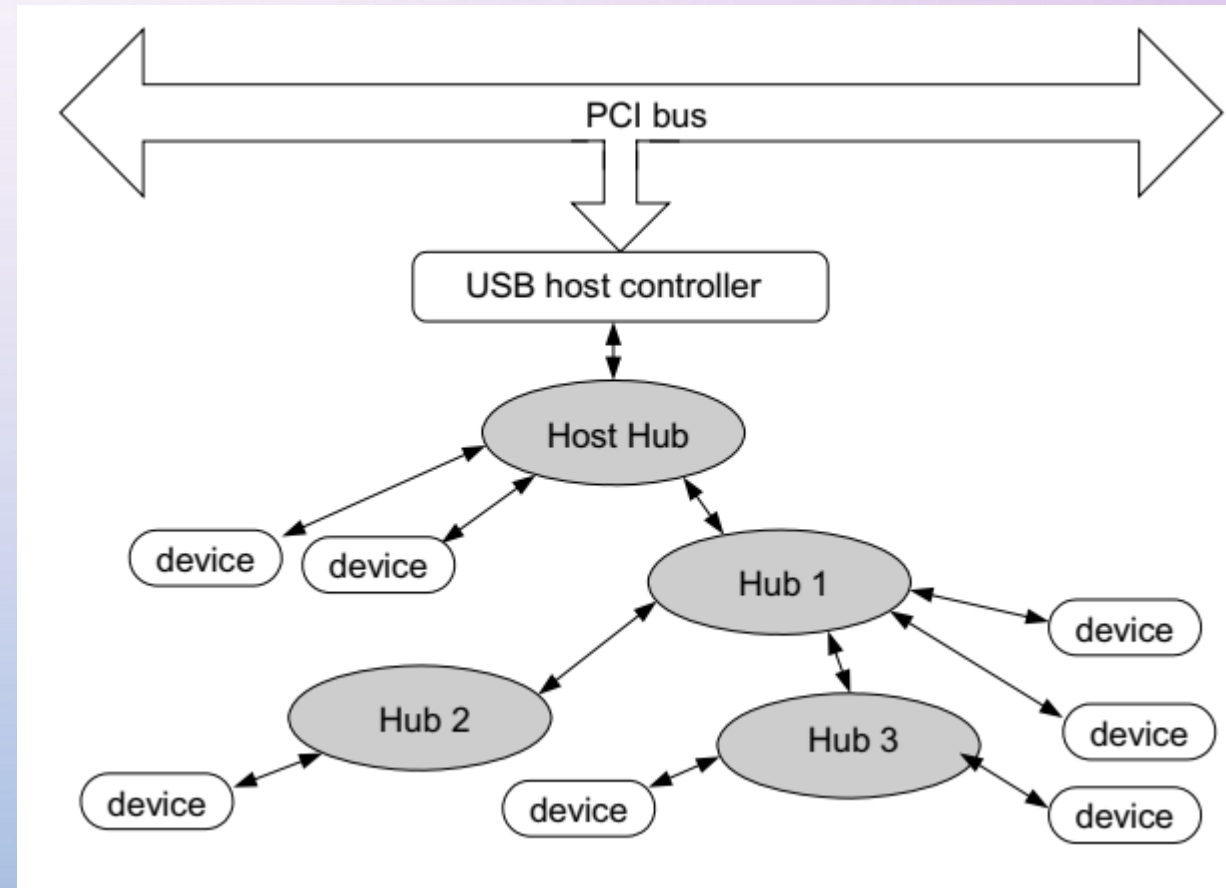
UNIVERSAL SERIAL BUS

- Being introduced as a high-speed replacement for the traditional RS-232 port
- USB has higher bandwidth
 - 1.5 Mbps, 12 Mbps and 480 Mbps
 - Faster than the RS-232 port that operates in the region of 115+ Kbps
- Devices can be daisy-chained



THE TOPOLOGY OF THE USB INTERFACE

- The USB is a master/slave, half-duplex interface designed to connect peripheral devices and extension hubs to the computer.
- It is organized in a pyramid shape topology where a host hub controls all USB ports.
- The host hub is usually inserted in the motherboard of computer.
- The USB network can be expanded by connecting successive hubs, this way it is possible to connect up to 127 devices.



CONTD..

- Every device after connection in “plug and play” mode obtains a description with information about required speed rate, data transfer mode, size of data packet, priority and address.
- The whole communication is organized and controlled by host hub that initializes and configures device port, enables or disables the port, recognizes if the device is connected, creates data packets and frames, sends the information to the bus, waits and recognizes response, tests the error.
- In regular time intervals the host hub controller sends *token packets*.
- There are four types of token packets: start of frame, in packets, out packets and setup packet.
- The *start packet* informs the device that it is the beginning of *1 ms* of frame.
- The *packet in* transfers the data from the device to the computer whilst the *packet out* transfers the data from the computer to the device.

DATA PACKET IN USB SYSTEM

- The data packet is formed as 1 ms frame – more than one device can send a packet inside one frame.
- It consists of a *synchronization* sequence, packet identification, data, CRC error test and EOP – end of packet.
- Cyclic redundancy check (CRC) is an error-detecting code commonly used in digital networks and storage devices to detect accidental changes to raw data.
- Personally identifiable information-Product Id

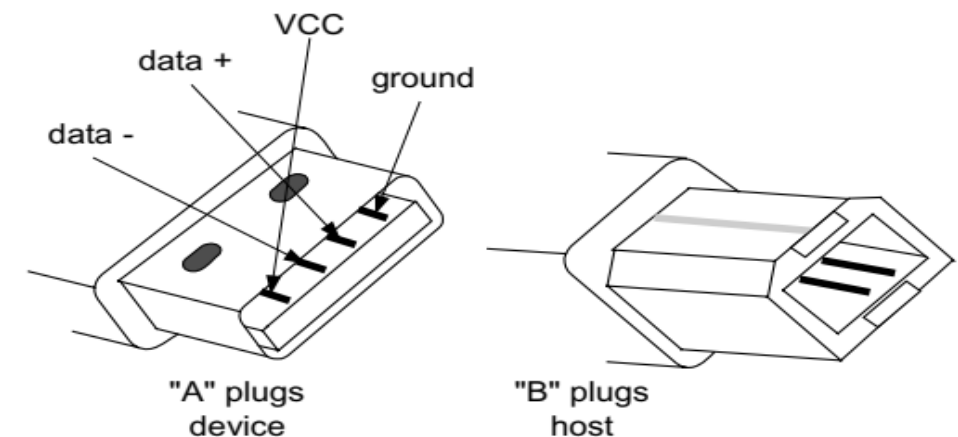
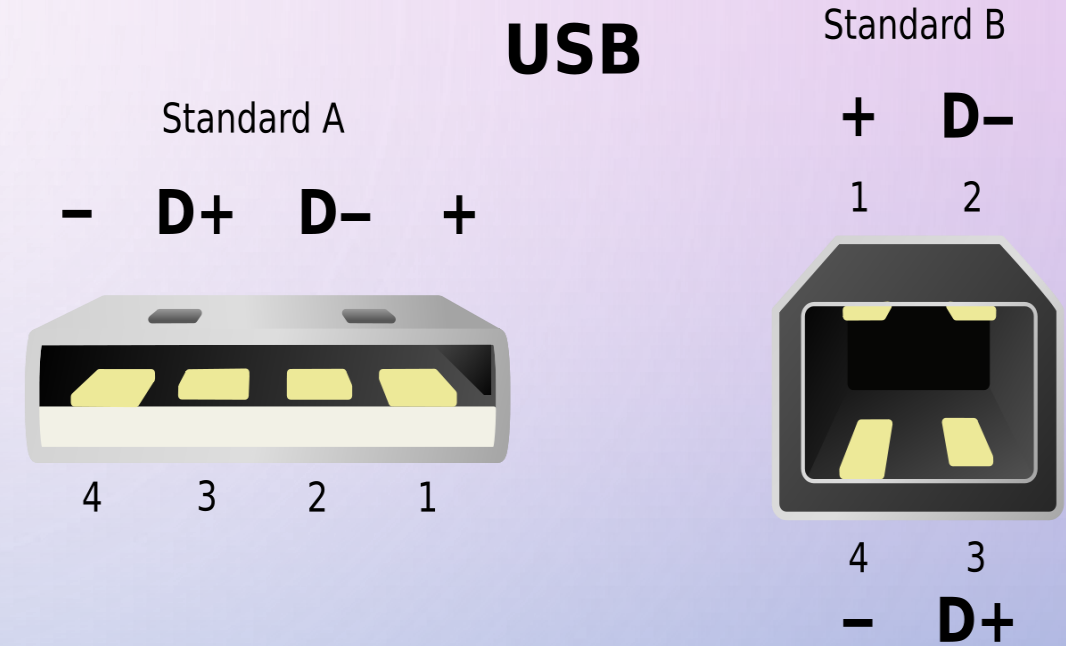
| | | | | |
|--|--|------------------------------|-----------------------|---------------------------------------|
| SYNC synchronisation 8 bits | PID identification 2 x 4 bits | DATA 0...1023 bits | CRC 16 bits | EOP end of packet 4 bits |
|--|--|------------------------------|-----------------------|---------------------------------------|

DATA TRANSMISSION MODES

- **Interrupt transfer**-This is used for the device that does not need continuous and frequent data sending (for example a keyboard).
- Because it is not possible to initiate the data transfer by the device the host hub initiates poll of a device if such device needs periodic attention.
- This requirement of polling is established during setup of the device. For example keyboard is polled every 100th frame.
- **Isochronous transfer** -The *bulk transfer* is used for the devices that are not time dependent but need to transfer large packets of data (for example a printer).
- The *isochronous transfer* is time dependent (for example the data from an audio CD).
- The data are sent in 1023 bit packets in synchronous or asynchronous mode, but with synchronization of transmitter and receiver.
- There is no limit of data packets.
- **Control transfer**-the *control transfer* is used for configuration and the requested device must respond back.
- **Bulk transfer**- this mode is used for transferring large chunk of data.

USB CONNECTORS

- **TYPE A**
 - UPSTREAM CONNECTORS
 - FROM THE SYSTEM
- **TYPE B**
 - DOWNSTREAM CONNECTORS
 - TO THE DEVICE
- **MINI A**
- **MINI B**
 - SMALLER CONNECTOR FOR PDAS, MOBILE PHONES AND DIGITAL CAMERAS
- **MINI-A AND MINI-B AND MINI-AB**
 - Small for factor connectors for USB OTG
 - The cable of a USB interface consists of two wires for data communication and two wires for power transmission.
 - It is possible to supply the external device via the USB cable.
 - There are two kind of connectors, type A and type B.
 - The power pins are slightly longer (7.41 mm) in comparison to the signal pins (6.41 mm), which means that the sequence of connection is established (supply voltage is connected first).



TYPES OF USB CONNECTORS



| Type | Year Released | Number of Loads | Power Per Load | Max Power |
|------------------|---------------|-----------------|----------------|-----------|
| USB 1 | 1998 | 1 | 100 mA | 100 mA |
| USB 2 | 2000 | 5 | 100 mA | 500 mA |
| USB 3 & 3.1 Gen1 | 2008 | 6 | 150 mA | 900 mA |
| USB 3.1 Gen 2 | 2013 | 6 | varies | 1.8A |

USB 3.2 PIN CONFIGURATION

High Speed Data Path (TX for USB, or for DP Alt Mode)

USB 2.0 Interface

High Speed Data Path (RX for USB, or TX for DP Alt Mode)

| A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 |
|-----|------|------|------|------|----|----|------|------|------|------|-----|
| GND | TX1+ | TX1- | VBUS | CC1 | D+ | D- | SBU1 | VBUS | RX2- | RX2+ | GND |
| GND | RX1+ | RX1- | VBUS | SBU2 | D- | D+ | CC2 | VBUS | TX2- | TX2+ | GND |
| B12 | B11 | B10 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 |

Cable Ground

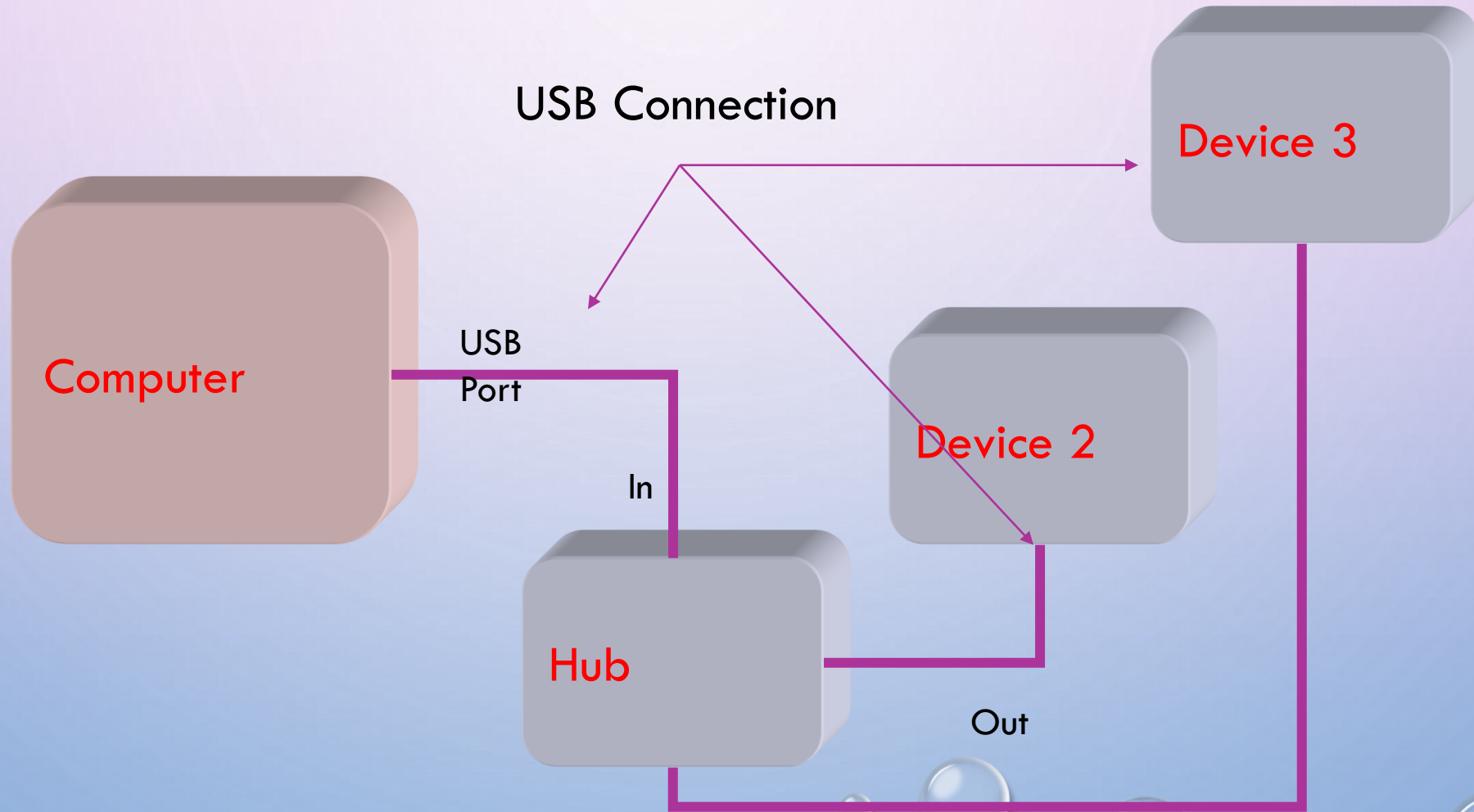
Cable Bus Power

Secondary Bus

Plug Configuration Detection

- One becomes Vconn, cable power
- CC is used for USB-PD communication

CONNECTING USB DEVICES USING A HUB



ADVANTAGES OF USB

- HIGHER SPEED
- ABILITY TO DAISY CHAIN DIFFERENT DEVICES
- SUPPORT FOR HOT PLUG-AND-PLAY



THANKS