

# DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK—

## Lesson-16: SERIAL BUS COMMUNICATION PROTOCOL — USB

# USB Host Applications

## Connecting

- flash memory cards,
- pen-like memory devices,
- digital camera,
- printer,
- mouse-device,
- PocketPC,
- video games,
- Scanner

# Universal Serial Bus (USB)

- Serial transmission and reception between host and serial devices
- The data transfer is of four types: (a) Controlled data transfer, (b) Bulk data transfer, (c) Interrupt driven data transfer, (d) Iso-synchronous transfer
- A bus between the host system and interconnected number of peripheral devices

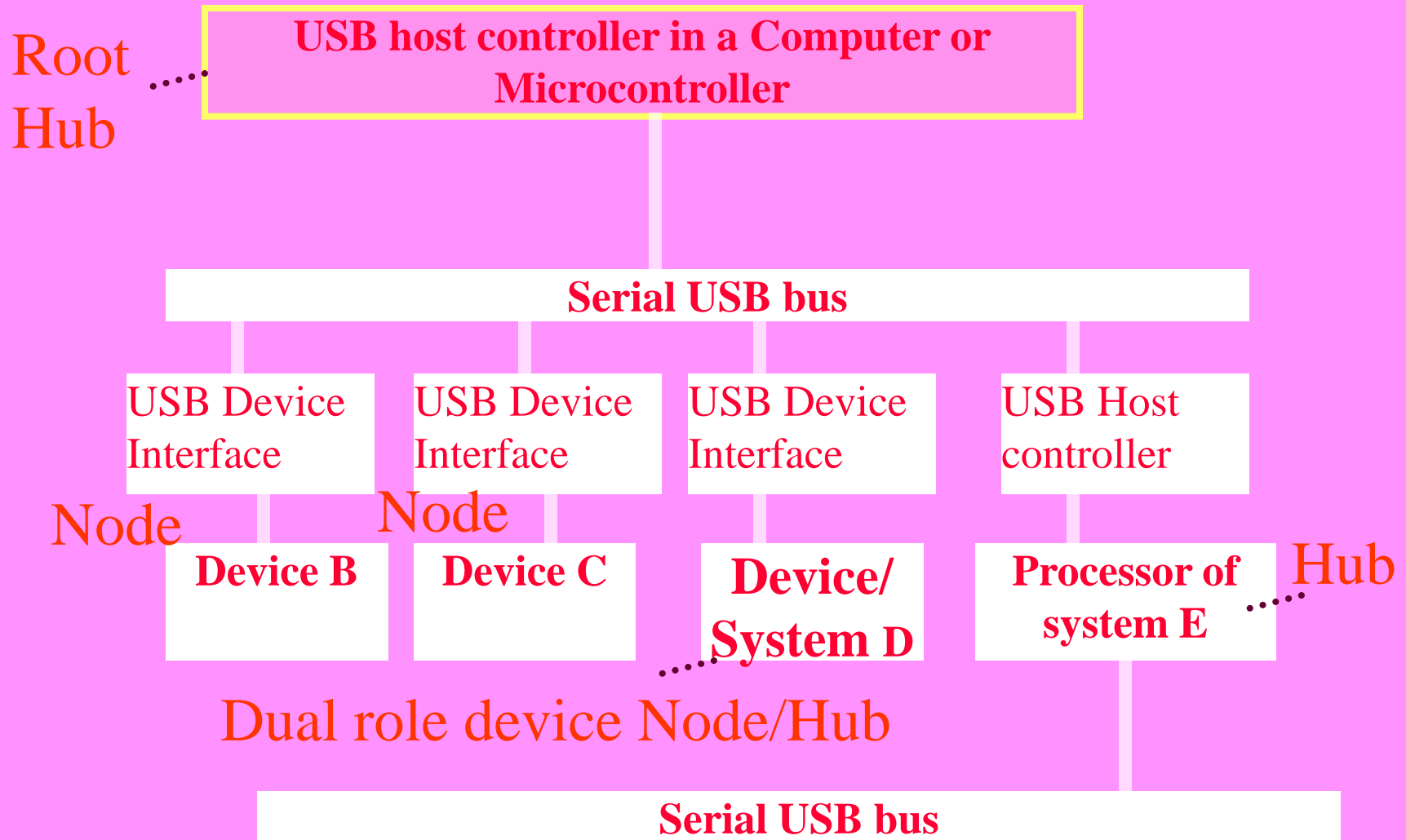
# USB Protocol Features

- Maximum 127 devices can connect a host.
- Three standards: USB 1.1 (a low speed 1.5 Mbps 3 meter channel along with a high speed 12 Mbps 25 meter channel), USB 2.0 (high speed 480 Mbps 25 meter channel), and wireless USB (high speed 480 Mbps 3 m)

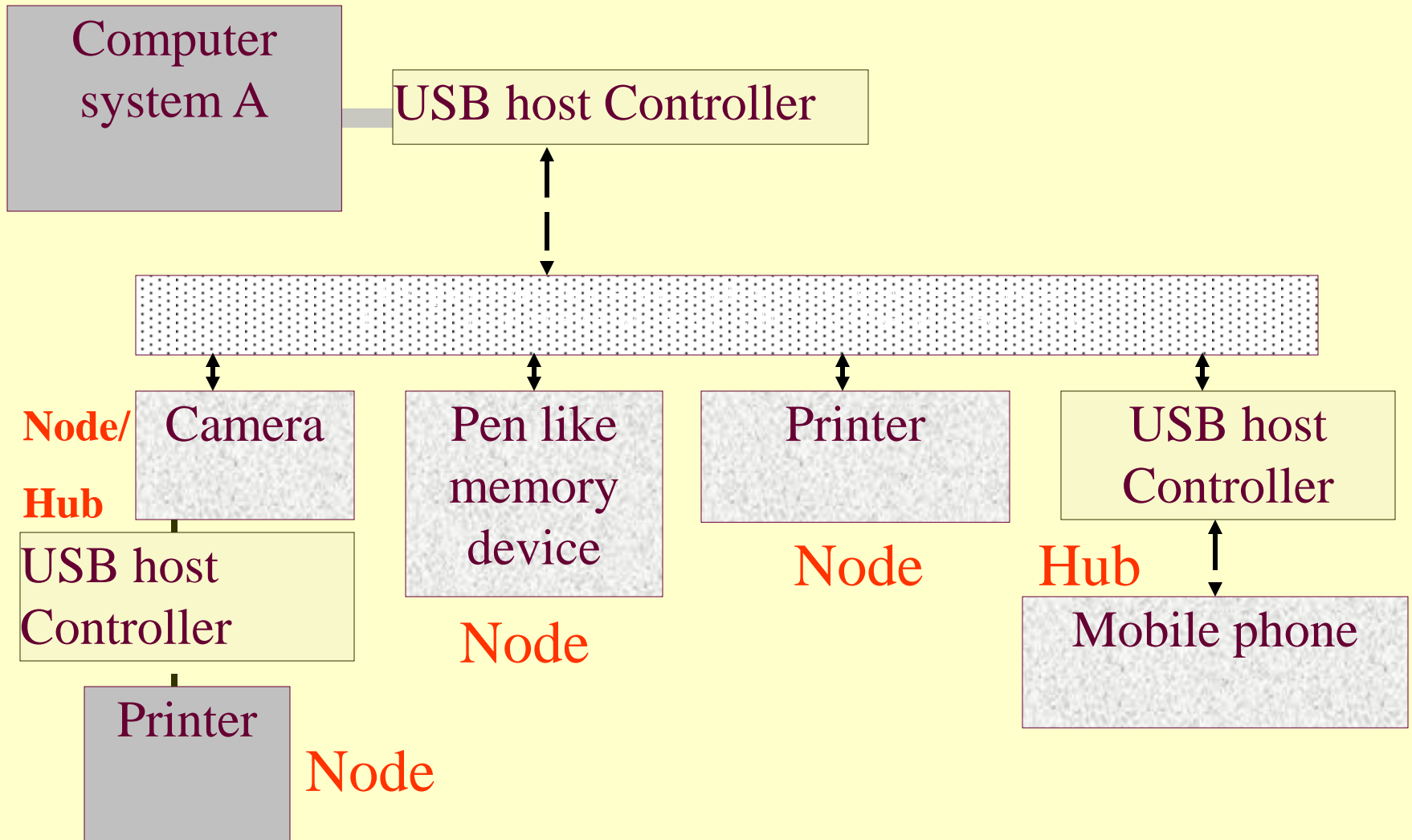
# Host connection to the devices or nodes

- Using USB port driving software and host controller,
- Host computer or system has a host-controller, which connects to a root hub.
- A hub is one that connects to other nodes or hubs.
- A tree- like topology

# Serial USB bus



# Serial USB bus in a computer



## Dual Role Devices (DRDs).

- DRD device can be a USB device as well as limited capability host. For example, a wireless USB digital camera is USB host when connected to printer and is USB device when connected to personal computer.



## The root hub connection to the hub (s) and node (s)

- The root hub connects to the hub (s) and node (s) at level 1.
- A hub at level 1 connects to the hub (s) and node (s) at level 2 and so on.
- Root hub and each hub at a level have a star topology with the next level.
- Only the nodes are present at the last level.

# USB Device features

- Can be hot plugged (attached), configured and used, reset, reconfigured and used
- Bandwidth sharing with other devices
- Host schedules the sharing of bandwidth among the attached devices at an instance

# USB Device features

- Can be detached (while others are in operation) and reattached.
- Attaching and detaching USB device or host without rebooting

# USB device descriptor

- Has data structure hierarchy
- Device descriptor at the root, which has number of configuration descriptors, which has number of interface descriptor and which has number of end point descriptor.

# Powering USB device

- A device can be either bus-powered or self-powered.
- In addition, there is a power management by software at the host for USB ports

## USB protocol

- USB bus cable has four wires, one for +5V, two for twisted pairs and one for ground.
- Termination impedances at each end as per the device-speed.
- Electromagnetic Interference (EMI)-shielded cable for the 15 Mbps USB devices.

## USB protocol

- Serial signals NRZI (Non Return to Zero (NRZI))
- The synchronization clock encoded by inserting synchronous code (SYNC) field before each USB packet
- Receiver synchronizes its bits recovery clock continuously

## USB Protocol

- A polled bus
- Host controller regularly polls the presence of a device as scheduled by the software.
- It sends a token packet.
- The token consists of fields for type, direction, USB device address and device end-point number.
- The device does the handshaking through a handshake packet, indicating successful or unsuccessful transmission.



## USB Protocol:

- A CRC field in a data packet permits error detection

## USB supported three types of pipes

- 'Stream' with no USB\_ defined protocol. It is used when the connection is already established and the data flow starts
- 'Default Control' for providing access.
- 'Message' for the control functions for of the device.
- Host configures each pipe with the data bandwidth to be used, transfer service type and buffer sizes.

# Wireless USB

- Wireless extension of USB 2.0 and it operates at UWB (ultra wide band) 3.1 GHZ to 10.6 GHz frequencies.
- For short-range personal area network (high speed 480 Mbps 3 meter or 110 Mbps 10 meter channel)

# Wireless USB

- FCC has recommended a host wire adapter (HWA) and a device wire adapter (DWA), which provides wireless USB solution.
- Wireless USB also supports the dual-role devices (DRDs).
- DRD device can be a USB device as well as limited capability host. For example, a wireless USB digital camera is USB host when connected to printer and is USB device when connected to personal computer.

# USB Device features

- Can be hot plugged (attached), configured and used, reset, reconfigured and used
- Bandwidth sharing with other devices: Host schedules the sharing of bandwidth among the attached devices at an instance.
- Can be detached (while others are in operation) and reattached.
- Attaching and detaching USB device or host without rebooting

# Summary

## We learnt

- USB a serial bus for interconnecting a system.
- Used in networking the IO devices like camera, printer, pen-like memory device, mobile phone, scanner in a computer system.

## We learnt

- Three standards: USB 1.1 (a low speed 1.5 Mbps 3 meter channel along with a high speed 12 Mbps 25 meter channel), USB 2.0 (high speed 480 Mbps 25 meter channel), and wireless USB (high speed 480 Mbps 3 m)



## We learnt

- USB root hub or hub or node
- It hot plugs, plugged (attached), configured and used, reset, reconfigured and used and detached a device from the network.
- USB devices can be organized like a tree structure.

End of Lesson 16 of Chapter 5  
on  
Serial Bus Communication Protocol-  
USB