DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK–

Lesson-20: SERIAL BUS COMMUNICATION PROTOCOLS – 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

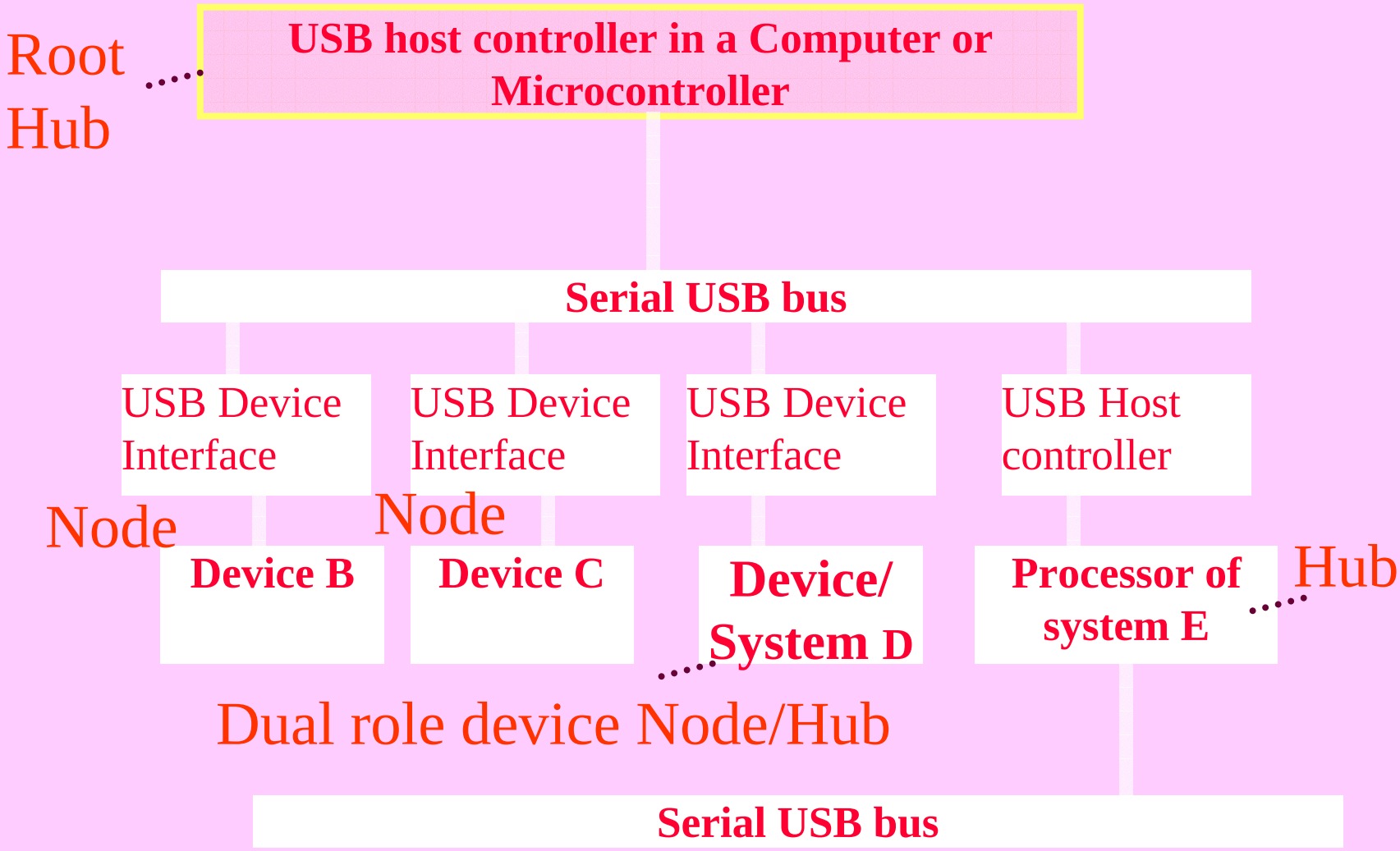
USB Protocol Features

- 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)

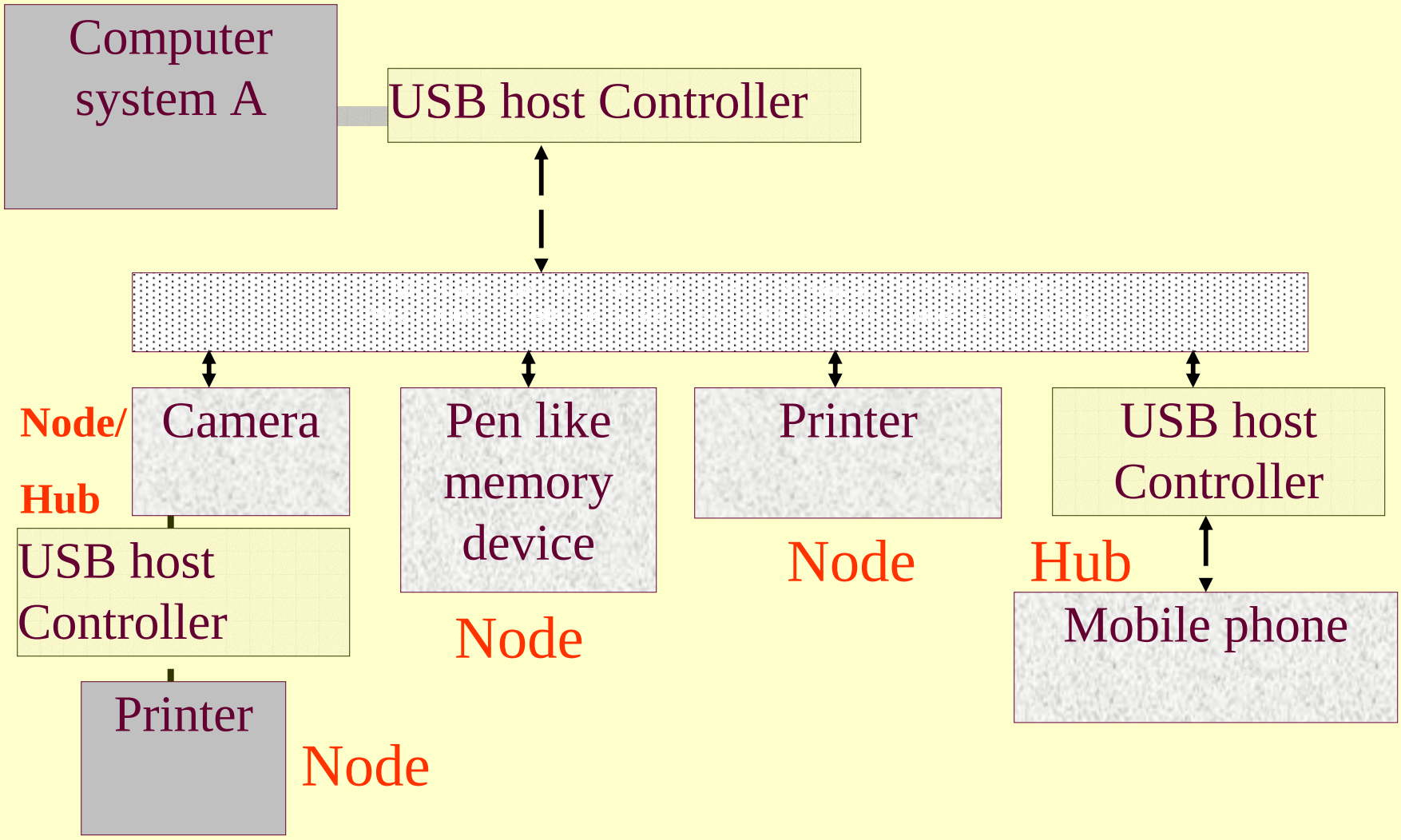
Host connection to the devices or nodes

- 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.
- 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 as follows:
- It has 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.

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 20 of Chapter 3