Chapter 11: Input/Output Organisation

Lesson 17:

Standard I/O buses– USB (Universal Serial Bus) and IEEE1394 FireWire Buses

Objective

- Familiarize with a standard I/O interface—synchronous serial buses USB and FireWire
- Learn the speed, polling, bus arbitration, tree-like topology, four data transfer modes, three type of pipes and other features of USB
- Learn about the FireWire functions and speed
- Learn that both bus powered as well as self powered and hot plugging and plug and play buses

USB

USB

- A bus between a host system and a number of interconnected peripherals
- A synchronous serial bus for interfacing the system and peripherals
- Uses a root hub. Nodes containing the devices can be organized into a tree structure

USB

- Provides a fast (up to 12 Mbps) and as well as a low speed (up to 1.5 Mbps) serial transmission and reception between host and serial devices such as scanner, keyboard, printer, pen drive and ISDN
- USB 1.1 allows a low speed 1.5 Mbps 3 meter channel along with a high speed 12 Mbps 25 meter channel) and
- USB 2.0 allows high speed 480 Mbps 25 meter channel

USB protocol

- A device can be attached, configured, and used; reset, reconfigured, and used to share the bandwidth with other devices
- Attaches and detaches a device from the network

Polling and arbitration

- A polled bus
- The host controller regularly polls the presence of a device as scheduled by the software

Handshaking by token packet

- 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

Error detection

- A CRC field in a data packet permits error detection

Plug and Play feature

- Hot-Plugging— USB devices can be detached (while others are in operation) and reattached
- The host schedules the sharing of bandwidth among the attached devices

Bus Powered and Self-Powered

- A device can be either bus-powered or self-powered
- Also the power management by software at host for the USB ports

Bus Lines

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

Host Controller

- The host connects to the devices or nodes using the USB port-driving software and host controller
- The 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

Tree-like topology

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

Signals

- Non Return to Zero (NRZI)
- The clock is encoded by inserting synchronous code (SYNC) field before each packet
- The receiver synchronizes its bit-recovery clock continuously

Data transfer four types

- Controlled data transfer
- Bulk data transfer
- Interrupt driven data transfer
- Isosynchronous transfer

Message Transfer Control

- Three types of pipes

1. *Stream* with no USB-defined protocol. It is used when the connection is already established and the data flow starts.
2. *Default Control* for providing access.
3. *Message* for the control functions of the device.

Pipe

- The host configures each pipe with the data bandwidth to be used, transfer service type, and buffer-sizes

IEEE1394 FireWire

FireWire

- FireWire (IEEE 1394) is a standard bus
- A high-speed bus standard interface directly to a personal computer
- Used in Digital video cameras, digital camcorders, digital video disk (DVD), set-top boxes, and music systems multimedia peripherals, latest hard disk drives, and printers

Guaranteed Rate

- Since FireWire can transfer data at a guaranteed rate, it is also used in real-time, such as video devices

FireWire IEEE 1394 port

- Speed up to 400 Mbps
- FireWire ports that support 1394b and IEEE 1394b operate at speed up to 800 Mbps
- Supports isochronous data

1394 port

- Interface up to 63 external devices
- It supports both Plug-and-Play and hot plugging
- Also provides self-powered and bus-powered support on the bus

Summary

We learnt

- USB the serial synchronous bus, four type of data transfer modes and three types of pipes
- USB tree like topology
- USB 2.0 up to 480 Mbps for 25 meter channel
- FireWire bus IEEE 1394b operate at speed up to 800 Mbps for video
- USB and IEEE 1394 both bus powered as well as self powered and hot plugging and plug and play buses

End of Lesson 17 on

Standard I/O buses– USB (Universal Serial Bus) and IEEE1394 FireWire Buses