Serial Interfaces
&
Network Interfaces

Course Teacher:

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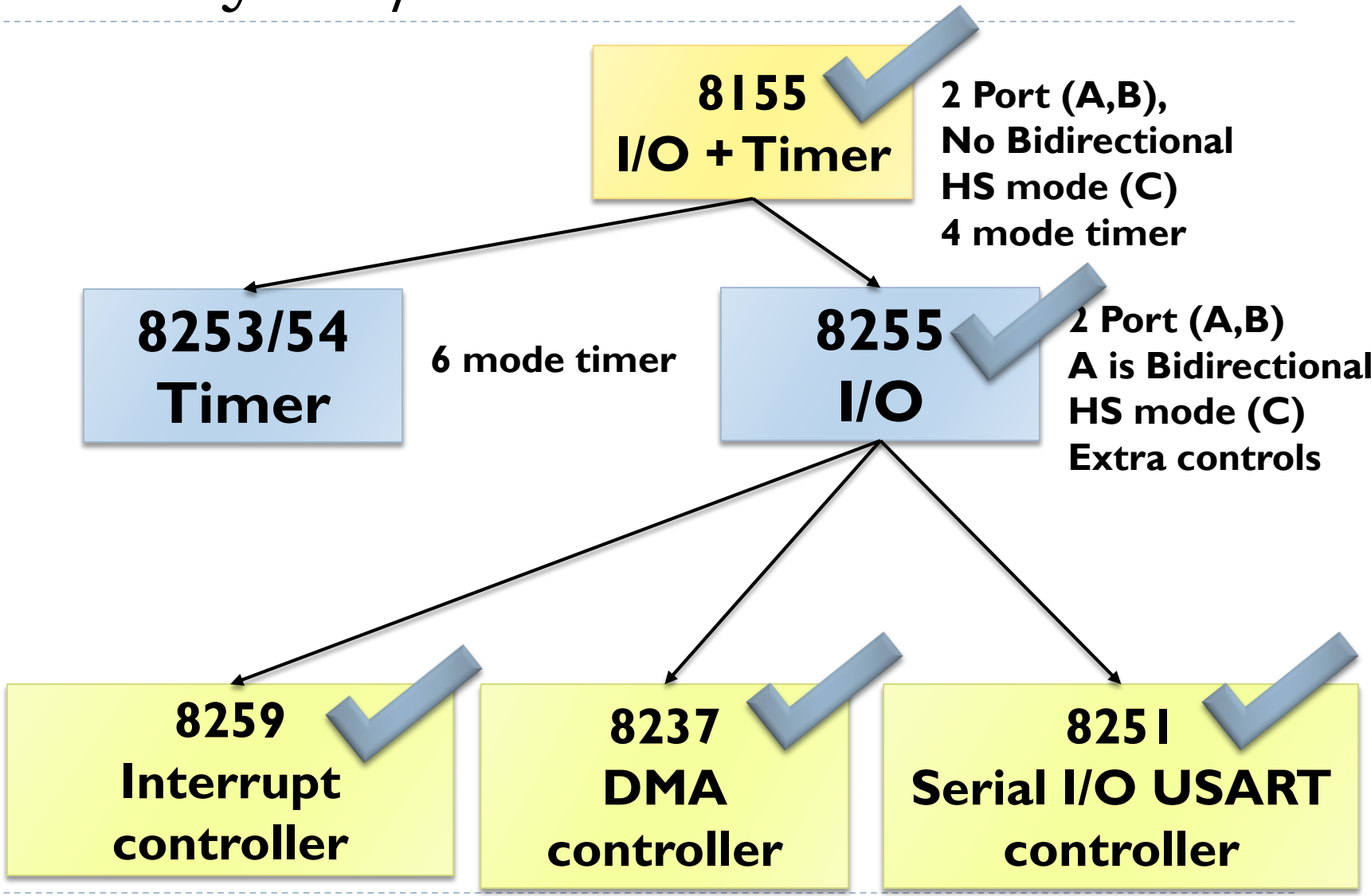
Lecture References:

- Book:
  - *Microprocessor Architecture, Programming and Applications with 8085 (Chapter-15)*, **Author:** Ramesh Gaonkor
  - *Microprocessors and Interfacing: Programming and Hardware*, **Author:** Douglas V. Hall

- Lecture Materials:
  - *I/O System Design*, Dr. Esam Al_Qaralleh, CE Department, Princess Sumaya University for Technology.

Hierarchy of I/O Control Devices



Connection Concepts

- Recalled: OSI model – level 1
  - Physical level, which requires peripheral devices to connect two different computers or devices together
  - Termed as "Interface"
- Two types of standards
  - **EIA-232F** (RS-232 Serial Interface/COM Port)
  - **USB** (Universal Serial Bus)
- Other peripheral interfacing standards that provide power, flexibility and ease-of-installation include:
  - **FireWire** (low cost device for digital)
  - **SCSI, iSCSC** (mainly for permanent storage, CD/DVD)
  - **InfiniBand**, **Fibre Channel** (high speed connection)

UART/USART IC

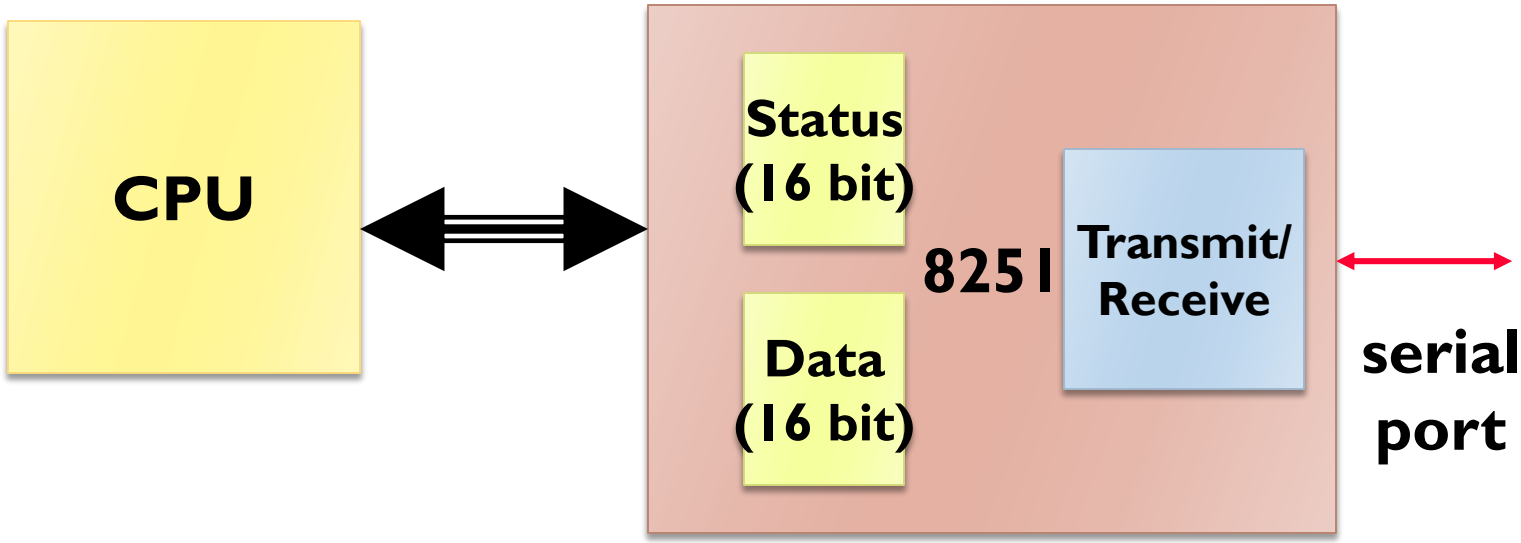
- Writing a program compatible with all different serial communication protocols is difficult and it is an inefficient use of microprocessor.
- **UART:** Universal Asynchronous Receiver/Transmitter chip.
- **USART:** Universal Synchronous/Asynchronous Receiver/Transmitter chip
- The microprocessor sends/receives the data to the UART/USART in parallel, while with I/O, the UART/USART transmits/receive data serially.

8251 UART/USART IC

- The 8251A is a programmable serial communication interface chip designed for synchronous and asynchronous serial data communication.
- It supports the serial transmission of data.
- It is packed in a 28 pin DIP.

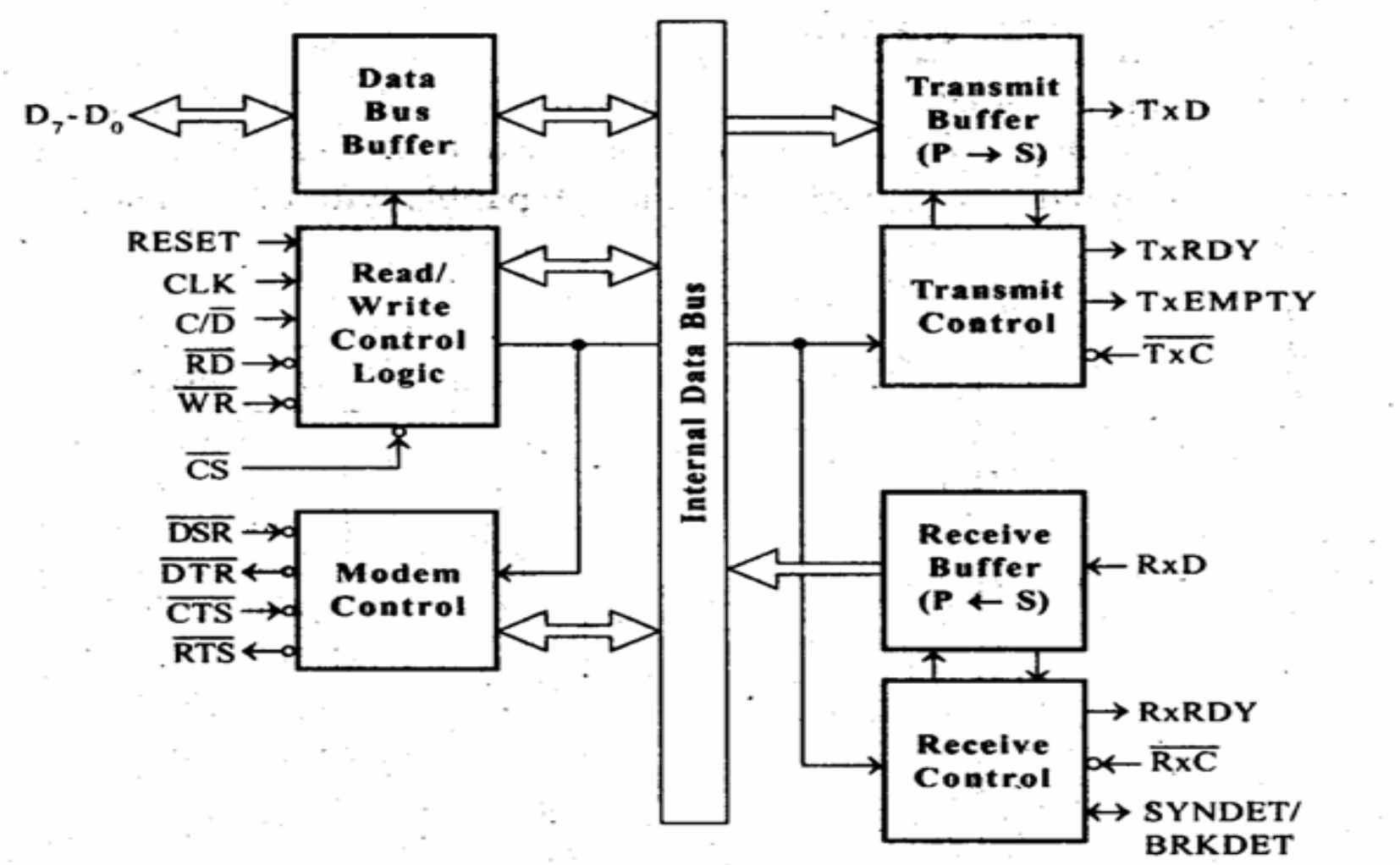
8251 UART/USART IC

- 8251 functions are integrated into standard PC interface chip.

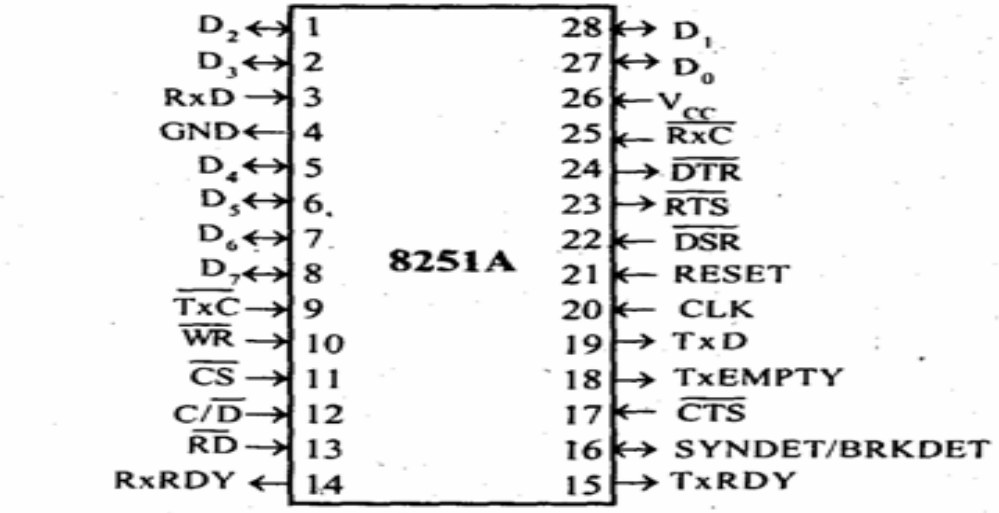


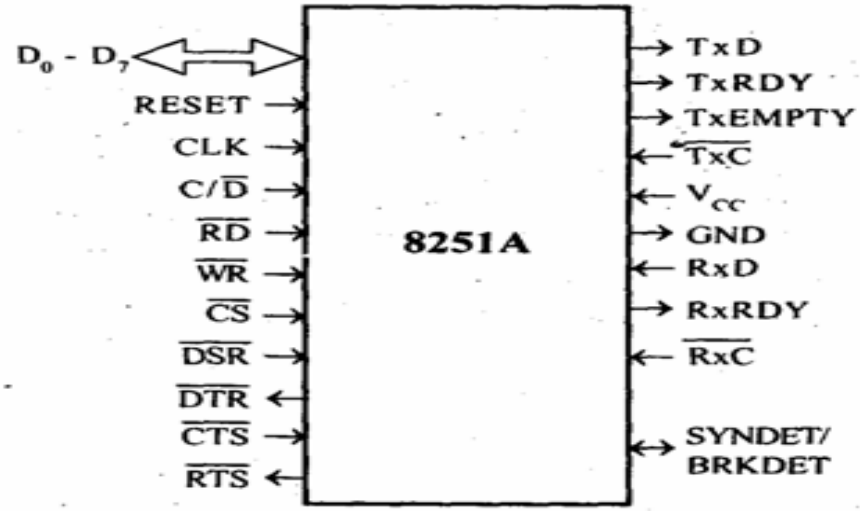
- UART/USART
  - 8251 USART
  - 8250/16450 UART is a newer version of 8251
  - 16550 is the latest version UART

8251 UART/USART IC (Block Diagram)



8251 UART/USART IC (Pin Diagram)





Pin	Description
D_0-D_7	Parallel data
C/$\overline{D}$	Control register or Data buffer select
$\overline{RD}$	Read control
$\overline{WR}$	Write control
$\overline{CS}$	Chip Select
CLK	Clock pulse (TTL)
RESET	Reset
$\overline{TxC}$	Transmitter Clock
TxD	Transmitter Data
$\overline{RxC}$	Receiver Clock
RxD	Receiver Data
RxRDY	Receiver Ready
TxRDY	Transmitter Ready
$\overline{DSR}$	Data Set Ready
$\overline{DTR}$	Data Terminal Ready
SYNDET/ BRKDET	Synchronous Detect / Break Detect
$\overline{RTS}$	Request To Send Data
$\overline{CTS}$	Clear To Send Data
TxEMPTY	Transmitter Empty
V_{CC}	Supply (+5V)
GND	Ground (0 V)

Universal Serial Bus (USB)

- A newer standard that is much more powerful than EIA-232F
- The USB interface is a modern standard for interconnecting a wide range of peripheral devices to computers
- Supports plug and play
- Can daisy-chain multiple devices
- USB 2.0 can support 480 Mbps or 60 MBps (USB 1.0 is only 12 Mbps);
- USB 3.0 ?? (5 Gbps or 640 MBps)

Universal Serial Bus (USB)

- This is now a very common interface for use with printers, scanners, digital cameras and it can also be used for keyboards and mice.
- It allows "hot swapping" which means that you can plug and unplug it while the computer is on.
- You can attach up to 128 USB devices at the same time using hubs in a "chain".
- The USB connection also provides power to the devices.

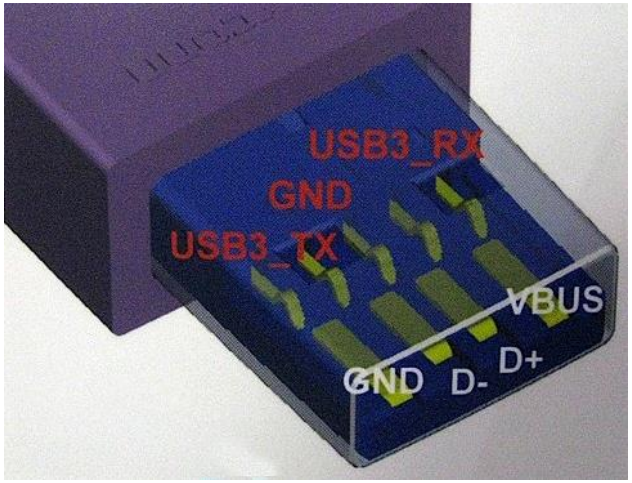
USB 1 transfer speed 12 megabits per second.

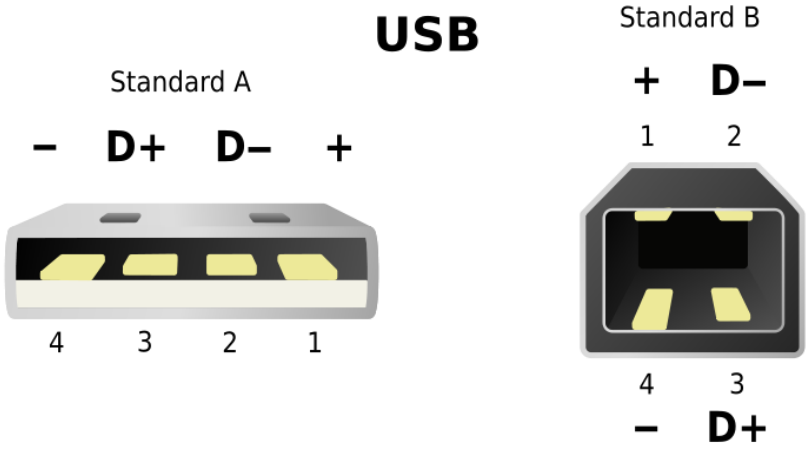
USB 2 transfer speed 480 megabits per second.

USB 3 transfer speed 5 gigabits per second.

Universal Serial Bus (USB)

- The USB interface defines all four components
  - The **electrical component** defines two wires VBUS and Ground to carry a 5-volt signal, while the D+ and D- wires carry the data to/from and signaling information.
  - The **mechanical component** precisely defines the size of four different connectors and uses only four wires (the metal shell counts as one more connector)

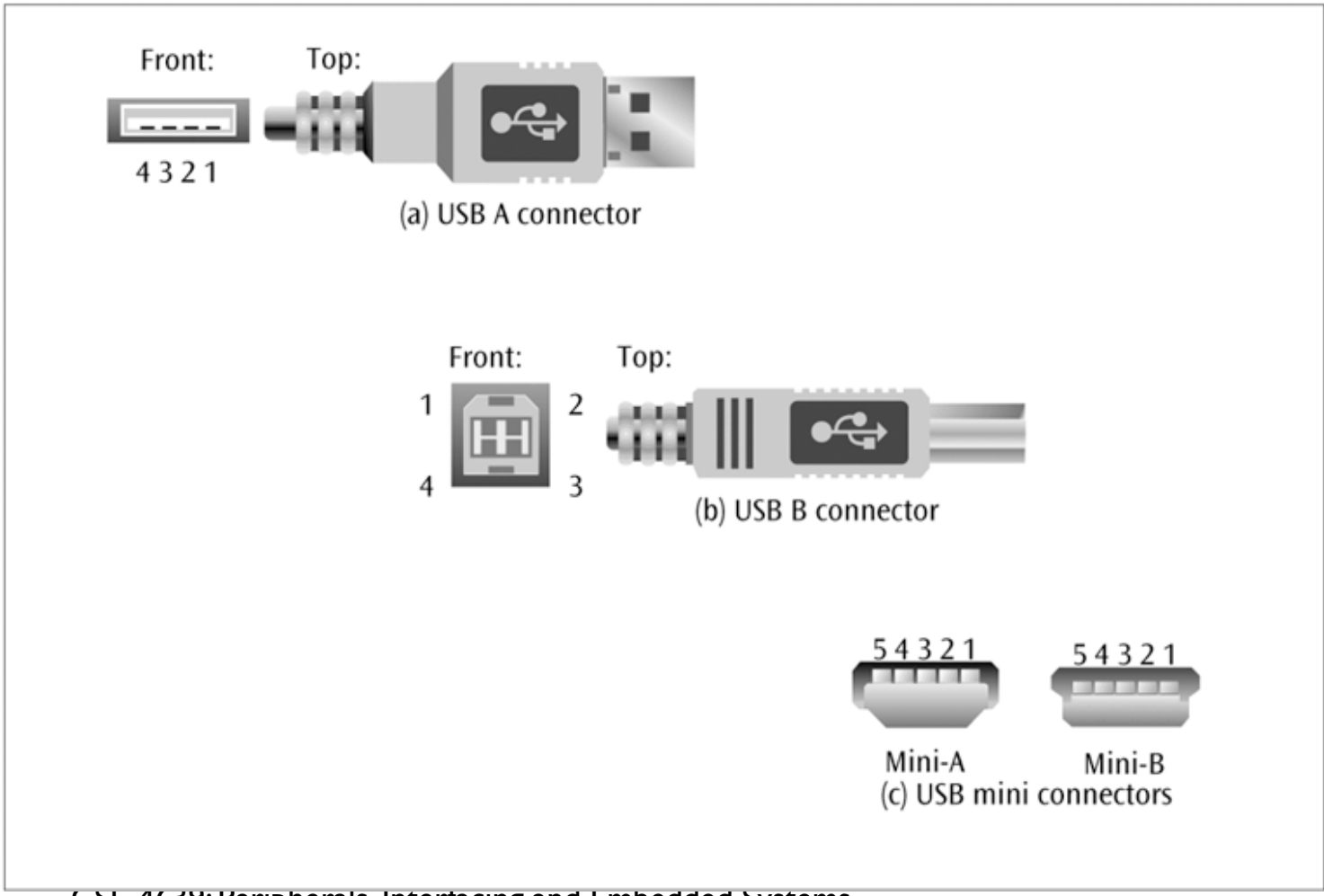




Universal Serial Bus (USB)

Four types of USB connectors

Figure 4-2
The four types of USB connectors



FireWire

- Low-cost digital interface (real time connection for PC)
- **A FireWire connection lets you send data to and from high-bandwidth digital devices such as digital camcorders, and it's faster than USB 1.0**
- Capable of supporting transfer speeds of up to 400 Mbps
- Hot pluggable
- Supports two types of data connections:
  - **Asynchronous** connection
  - **Isochronous** connection

FireWire

- FireWire (also called IEEE 1394 or i.LINK) was originally developed by Apple Computer for connecting peripheral devices to Macintosh computers.
- Companies such as Sony picked up on the technology and began incorporating FireWire into its camcorders and PCs, and FireWire grew from there.
- Some HDTV devices used FireWire connections for years, but FireWire appears to have all but gone away as a means of connecting HDTV devices.
- FireWire is becoming more common in the *audio* side of the home theater.

FireWire

- This is the standard interface for use with digital video camcorders, some storage devices and the first Apple Ipod.
- It allows hot swapping and up to 63 Firewire devices can be connected at the same time.
- It can supply modest power services to devices.

FireWire 400 transfer speed 400 megabits per second.

FireWire 800 transfer speed 800 megabits per second.

IEEE 1394b transfer speed 3.2 gigabits per second.

DVI (Digital Visual Interface)

- DVI was developed as a means of connecting computers to digital LCD screens and projectors.

- DVI picked up a strong copy protection system called HDCP (High-bandwidth Digital Content Protection) and became a favorite of the HDTV industry.

HDMI (High Definition Multimedia Interface)

- The latest and greatest in digital video (and audio) connections is the HDMI cable.

- HDMI is included in many devices, including HDTVs, DVD players, Blu-ray disc players, cable and satellite set-top boxes, Media Center Edition PCs, and gaming consoles.

New Trend: **Isochronous** Connections

- Apart from ***Synchronous*** and ***Asynchronous*** transmission a third type of connection defined at the data link layer used to support real-time applications
- Data must be delivered at just the right speed (real-time) – not too fast and not too slow
- Typically an ***Isochronous*** connection must allocate resources on both ends to maintain real-time communication
- USB and Firewire can both support isochronous connection
- Provide data transmission in a regular period of time

SCSI and iSCSI

- **SCSI (Small Computer System Interface)**
  - A technique for interfacing a computer to high-speed devices such as hard disk drives, tape drives, CDs, and DVDs
  - Designed to support devices of a more permanent nature
    - SCSI is a systems interface
  - Need SCSI adapter
- **iSCSI (Internet SCSI)**
  - A technique for interfacing disk storage to a computer via the Internet

InfiniBand and Fibre Channel

- **InfiniBand** – a serial connection or bus that can carry multiple channels of data at the same time
  - Can support data transfer speeds of 2.5 billion bits (2.5 gigabits) per second and address thousands of devices, using both copper wire and fiber-optic cables
  - A network of high-speed links and switches
- **Fibre Channel** – also a serial, high-speed network that connects a computer to multiple input/output devices
  - Supports data transfer rates up to billions of bits per second, but can support the interconnection of up to 126 devices only

Interfaces: Wireless Communication

- **IR**
  - Relatively cheap
  - Need line of sight
  - Diode emits infrared light to generate signal, Infrared transistor detects signal.
- **RF**
  - Line of sight not necessary
  - Longer distance communications
  - Frequency hopping, to communicate while constantly changing transmission frequency.

Interfaces: Wireless Protocols

- **IrDA** (Infrared Data Association)
  - IrDA is an international organization
  - Designed to support transmission between two devices over short-range point-to-point infrared.
  - Rate: 9.6 Kb/s – 4 Mb/s
  - Deployed in notebooks, printers, PDAs, cell phones,…
  - MS Windows CE 1.0 the first Windows OS support it
  - Available on several popular embedded OSs

Interfaces: Wireless Protocols

- **Bluetooth**
  - Bluetooth is a wireless technology which is used for computers, PDAs, mobile phones, headphones, mice and keyboards.
  - It transmits very weak signals on a 2.4 to 2.48 gigahertz or 5 gigahertz frequency (ISM Band) for communication over short distances, typically up to 10 metres.

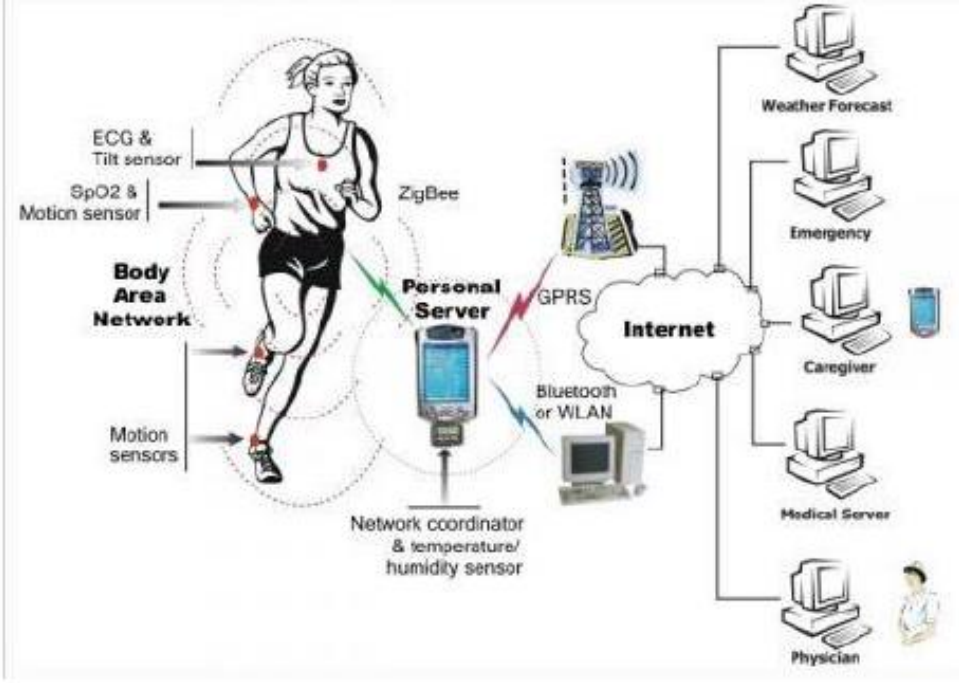
Bluetooth transfer speed up to 1 megabit per second.

Interfaces: Wireless Protocols

- **IEEE 802.11**
  - IEEE proposed standard for WLAN
  - Ad-hoc vs. infrastructure
  - PHY and MAC layers
  - Data rate: 1Mbps, 2Mbps, 11 Mbps, 54 Mbps, 600 Mbps
  - Calls: 2.4 – 2.4835 GHz frequency band (unlicensed band).
  - Use CSMA/CA
  - Signals for transmission: RTS, CTS, and ACK.

Interfaces: Wireless Protocols

- **IEEE 802.15.4**
  - IEEE proposed standard for WPAN
  - Basically for star-topology
  - PHY and MAC layers
  - Data rate: 250 Kbps
  - Calls: 2.4 – 2.4835 GHz frequency band (unlicensed band).
  - Use CSMA/CA and TDMA



Thank You !!