DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK

Lesson-2: Ports or Devices Communication and communication-protocols

Two Modes of communication between the devices and computer system

- Full Duplex – Both devices or device and computer system simultaneously communicate each other
- Half Duplex – Only one device can communicate with another at an instance

Three ways of communication between the ports or devices

- Synchronous
- Iso-synchronous
- Asynchronous

1. Synchronous and Iso-synchronous Communication in Serial Ports or Devices

Synchronous Communication

- When a byte (character) or a frame (a collection of bytes) in of the data is received or transmitted at the constant time intervals with uniform phase differences, the communication is called as ***synchronous***. Bits of a full frame are sent in a prefixed maximum time interval.

Iso-synchronous

- Synchronous communication special case– when bits of a full frame are sent in the maximum time interval, which can be variable.

Synchronous Communication

- Clock information is transmitted explicitly or implicitly in synchronous communication. The receiver clock continuously maintains constant phase difference with the transmitter clock. Bits of a data frame maintain uniform phase difference and are sent within a fixed maximum time interval

Example of synchronous serial communication

- Frames sent over a LAN. Frames of data communicate with the constant time intervals between each frame remaining constant.
- Another example is the inter-processor communication in a multiprocessor system

Optional Synchronous Code bits

- Optional Sync Code bits or bi-sync code bits or frame start and end signaling bits— During communication few bits (each separated by interval ΔT) sent as Sync code to enable the frame synchronization or frame start signaling.
- Code bits precede the data bits.
- May be inversion of code bits after each frame in certain protocols.
- Flag bits at start and end are also used in certain protocols.

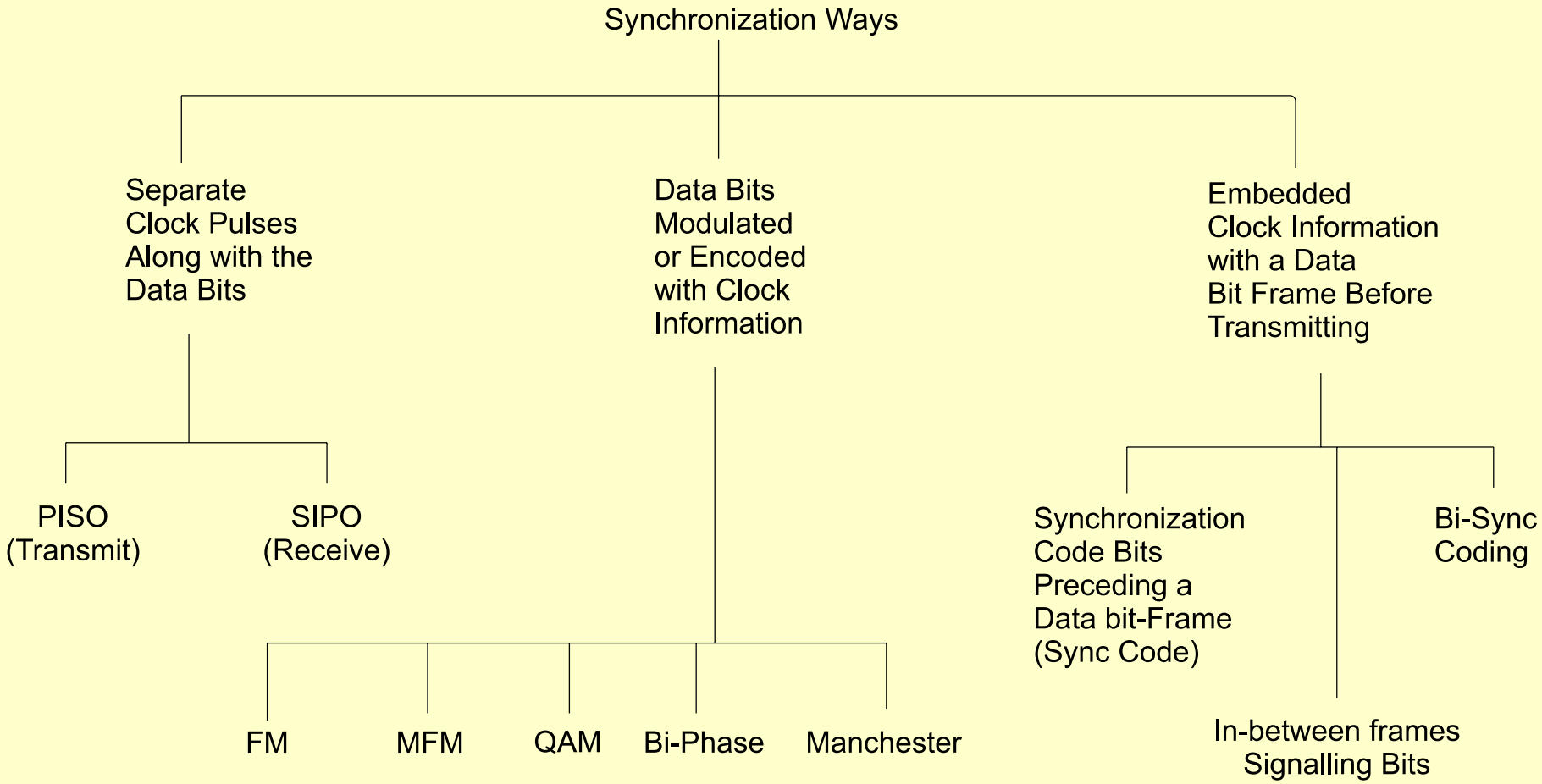
Always present Synchronous device port data bits

- Reciprocal of T is the bit per second (bps).
- Data bits— *m* frame bits or 8 bits transmit such that each bit is at the line for time ΔT or, each frame is at the line for time (*m*. T)
- *m* may be 8 or a large number. It depends on the protocol

Synchronous device clock bits

- Clock bits ─ Either on a separate clock line or on data line such that the clock information is also embedded with the data bits by an appropriate encoding or modulation
- Generally not optional

Ten ways of Transmitting Synchronous Serial bits



First characteristics of synchronous communication

1. Bytes (or frames) maintain a constant phase difference, which means they are synchronous, i.e. in synchronization. No permission of sending either the bytes or the frames at the random time intervals, this mode therefore does not provide for handshaking *during* the communication interval — *This facilitates fast data communication at pre-fixed bps.*

Second characteristics of synchronous communication

2. A clock ticking at a certain rate has always to be there for transmitting serially the bits of all the bytes (or frames) *serially*. *Mostly, the clock is* ***not*** *always* ***implicit*** to the synchronous data receiver. The transmitter *generally* transmits the clock rate information

2. Asynchronous Communication from Serial Ports or Devices

Asynchronous Communication

- Clocks of the receiver and transmitter independent, unsynchronized, but of same frequency and variable phase differences between bytes or bits of two data frames, which may not be sent within any prefixed time interval.

Example of asynchronous communication

- UART Serial, Telephone or modem communication.
- RS232C communication between the UART devices
- Each successive byte can have variable time-gap but have a minimum in-between interval and no maximum limit for full frame of many bytes

Two characteristics of asynchronous communication

1. Bytes (or frames) need not maintain a constant phase difference and are asynchronous, i.e., not in synchronization. There is permission to send either bytes or frames at variable time intervals— This *facilitates in-between handshaking* between the serial transmitter port and serial receiver port

Two characteristics of asynchronous communication

2. Though the *clock* must ticking at a certain rate always has to be there to transmit the bits of a single byte (or frame) serially, it is *always implicit* to the asynchronous data receiver and is independent of the transmitter

Clock Features

- The transmitter *does not transmit* (neither separately nor by encoding using modulation) along with the serial stream of bits any *clock rate information* in the asynchronous communication and *receiver clock thus is not able to maintain identical frequency and constant phase difference* with transmitter clock

Example: IBM personal computer has two COM ports (communication ports)

- COM1 and COM2 at IO addresses 0x2F8-0xFF and 0xx38-0x3FF
- Handshaking signals– RI, DCD, DSR, DTR, RTS, CTS, DTR
- Data Bits– RxD and TxD

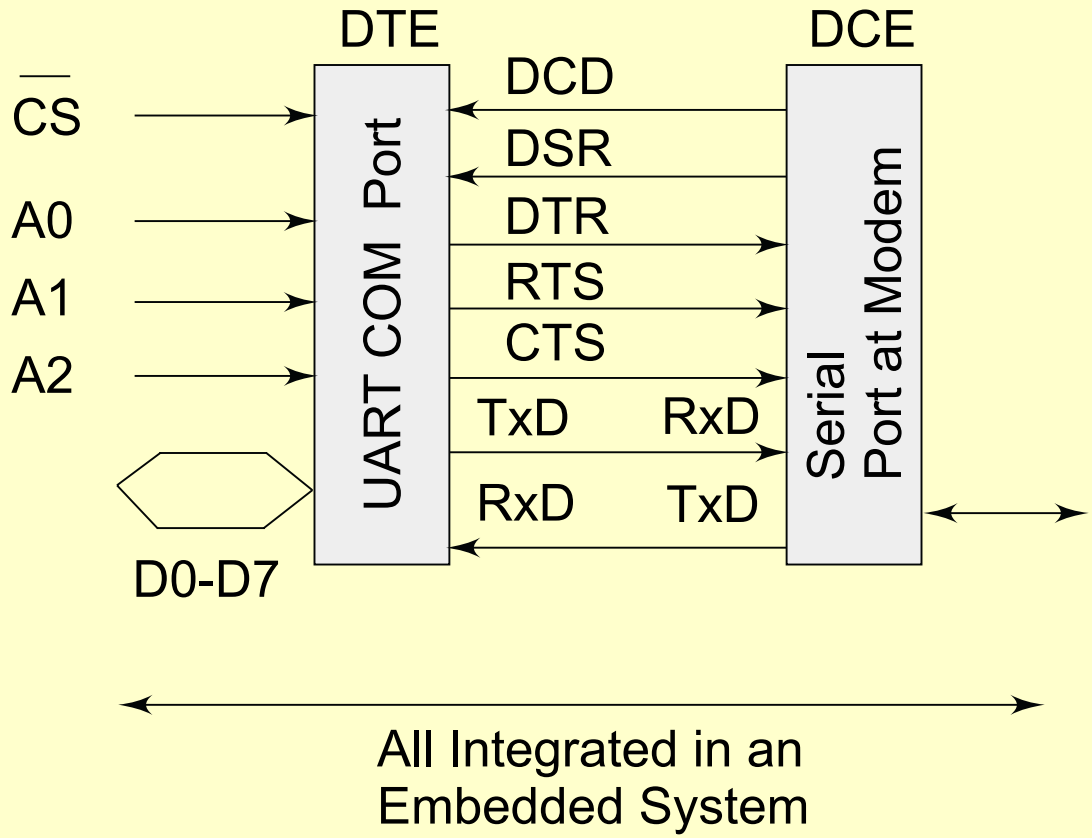
Example: COM port and Modem Handshaking signals

- When a modem connects, modem sends *data carrier detect* DCD signal at an instance t0.
- Communicates *data set ready* (DSR) signal at an instance t1 when it receives the bytes on the line.
- Receiving computer (terminal) responds at an instance t2 by data terminal ready (DTR) signal.

Example: COM port and Modem Handshaking signals

- After DTR, *request to send* (RTS) signal is sent at an instance t3
- Receiving end responds by *clear to send* (CTS) signal at an instance t4. After the response CTS, the data bits are transmitted by modem from an instance t5 to the receiver terminal.
- Between two sets of bytes sent in asynchronous mode, the handshaking signals RTS and CTS can again be exchanged. This explains why the bytes do not remain synchronized during asynchronous transmission.

COM port and Modem Signals



3. Communication Protocols

1. Protocol

- A protocol is a standard adopted, which tells the way in which the bits of a frame must be sent from a device (or controller or port or processor) to another device or system

[Even in personal communication we follow a protocol – we say Hello! then talk and then say good bye!]

A protocol defines how are the frame bits:

1) sent– synchronously or Iso-synchronously or asynchronously and at what rate(s)?
2) preceded by the header bits?

3) How the receiving device address communicated so that only destined device activates and receives the bits? [Needed when several devices addressed though a common line (bus)]

4) How can the transmitting device address defined so that receiving device comes to know the source when receiving data from several sources?

5) How the frame-length defined so that receiving device know the frame-size in advance?

6) Frame-content specifications –Are the sent frame bits specify the control or device configuring or commend or data?

7) Are there succeeding to frame the trailing bits so that receiving device can check the errors, if any in reception before it detects end of the frame ?

A protocol may also define:

8) Frame bits minimum and maximum length permitted per frame
9) Line supply and impedances and line-Connectors specifications

Specified protocol at an embedded system port or communication device

IO port bits sent after first formatted according to a specified protocol, which is to be followed when communicating with another device through an IO port or channel

Protocols

- HDLC, Frame Relay, for synchronous communication
- For asynchronous transmission from a device port– RS232C, UART, X.25, ATM, DSL and ADSL
- For networking the physical devices in telecommunication and computer networks – Ethernet and token ring protocols used in LAN networks

Protocols in embedded network devices

- For Bridges and routers
- Internet appliances application protocols and Web protocols ─HTTP (hyper text transfer protocol), HTTPS (hyper text transfer protocol Secure Socket Layer), SMTP (Simple Mail Transfer Protocol), POP3 (Post office Protocol version 3), ESMTP (Extended SMTP),

File transfer, Boot Protocols in embedded devices network

- TELNET (Tele network),
- FTP (file transfer protocol),
- DNS (domain network server),
- IMAP 4 (Internet Message Exchange Application Protocol) and
- Bootp (Bootstrap protocol).

Wireless Protocols in embedded devices network

- Embedded wireless appliances uses wireless protocols– WLAN 802.11, 802.16, Bluetooth, ZigBee, WiFi, WiMax,

Summary

We learnt

- Three communication types- synchronous, iso-synchronous and asynchronous
- Synchronous communication provides for sync code bits, data bits and clock bits at constant time intervals,
- Receiver (slave) synchronizes clock frequency and phase with the transmitter (master)
- Synchronous communication fast

We learnt

- Isosynchronous communication a special case of synchronous communication
- Asynchronous communication provides for handshaking bits and variable time intervals for bytes/frame communication
- Examples of IBM PC COM port and modem handshaking bits

We learnt

- Concept of Protocol and the format of bits in a protocol

(ii) Header bits format – Header bits precedes the data bits

(iii) Trailing bits – succeeds the data

- Various Protocols for the embedded device network

End of Lesson 2 of Chapter 3