Transmission Modes – PART 2

Transmission Direction:

- **Simplex:** Signals are transmitted in only one direction
- **Half-Duplex:** Both stations may transmit, but one at a time
- **Full-Duplex:** Both stations may transmit simultaneously

The designer of Communication System must deal with four factors:

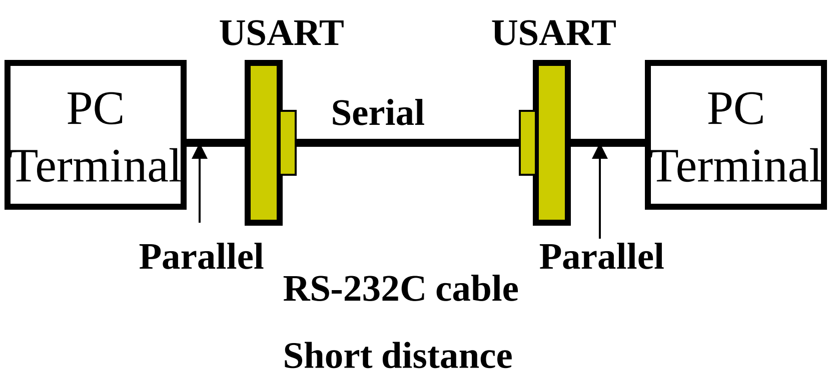
- Signal Bandwidth (Hz or bps) → Channel Capacity
- Data Rate of digital information (bps)
- Transmission Impairments (Noise, loss, attenuation, delay, …..etc.)
- Accepted error-rate level → **Bit Error Rate** (BER)

Transmission Modes: ● Serial Transmission ● Parallel Transmission

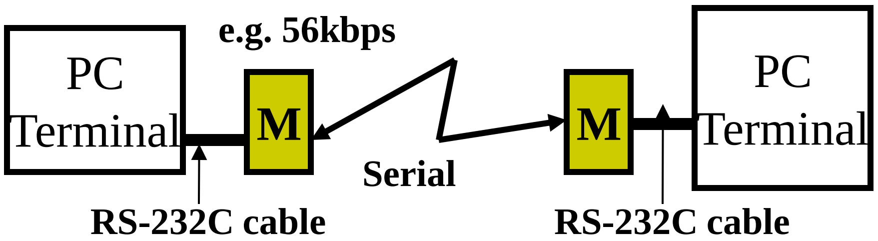
- **Serial Transmission (USART)**
  - Asynchronous Mode
  - Synchronous Mode

- USART 8250 → 8088 Intel 9600bps, 19200bps
- USART 16450→ 80286 PCAT 19200bps
- USART 16550→ 80386,80486, Pentium 115.2kbps
- USART= converts parallel data transmission to *serial transmission.* (The bits are sent in sequence over a line).

Ex (1): Direct Connection (Short distance)



Ex(2): MODEM (Long distance**)**

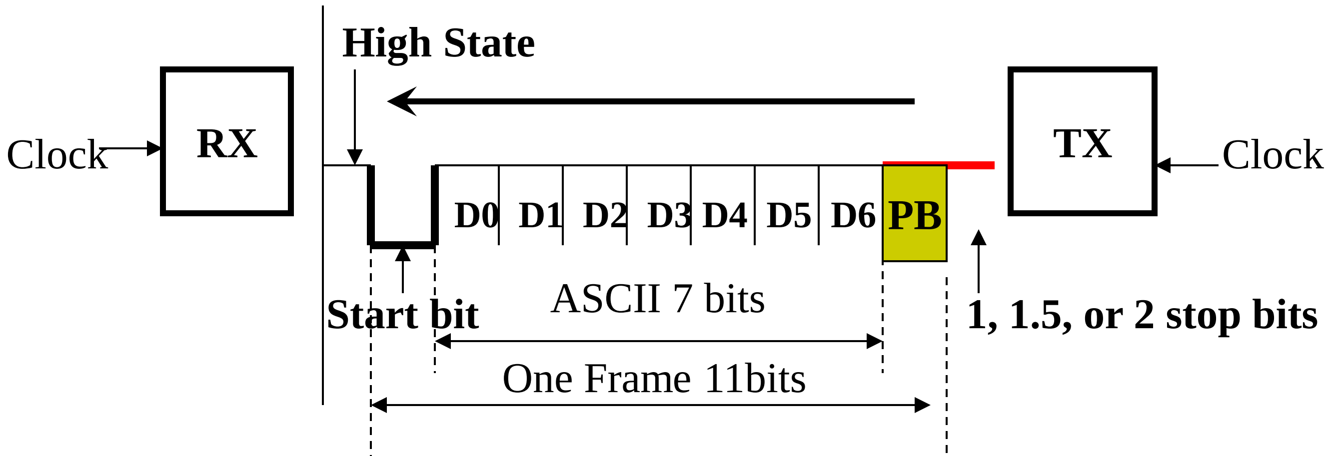


PSTN=Public Switched Telephone Network
ISDN=Integrated Services Digital Network

Asynchronous Mode:

- ❑ It can occur at any time for sending letters e.g. ASCII (7bits)
- ❑ Each character has **Start** and **Stop** bits
- ❑ When **no Data** are being transmitted a receiver stays in **High-State.**

Mark =logic 1 High State
Space=logic 0



-The transmission is called **Framing**. → Character-by-character

One Frame= 1 (Start bit) + 7 (or 8) Data bits (ASCII) + 2 Stop bits

= 11 bits

-It is used for low-speed transmission – e.g. RS-232C (15meters, 38kbps)

Example:

- Consider Character “I”=49Hex in ASCII is transmitted with 1200 baud with framing format 1 start bit, 2 stop bits and odd parity. Assume 15 meter distance (cable length) and propagation speed=$3x10^5$ m/s

Solution:

Baud Rate=Bit Rate = $R \quad bps$

0 100 1001 = 49HEX using Figure above then → 11 bits (Framing):

$$T_{bit} = \frac{1}{R} = \frac{1}{1200} = 0.83\text{ms}$$

Total time required to send char ‘I’ → (Framing):

$$T_{frame} = 11 \times 0.83 = 9.13ms$$

Propagation Time = Distance/Propagation speed

$$T_{prop} = \frac{d}{v} = \frac{15}{3 \times 10^5} = 50\mu\text{sec}$$

Example (1):

Asynchronous data is transmitted in the form of characters as follows: 5 information bits of duration 20ms, and a start bit of the same duration of 20 ms, and a stop bit of duration 30ms. Determine:

(a) The transmission rate in bps.
(b) The signaling rate in bauds.

Sol:

(n=7 bits= 1 Start + 5 Infor. + 1 Stop)

(a)

Total transmission time of a Single Character (T_{total}) → (Framing)

$$T_{total} = (5+1)\times 20 + 1\times 30 = 150\text{ms}$$

Let R= Transmission Rate (Bit Rate)

$$R = \frac{n}{T_{total}} = \frac{7}{150\times 10^{-3}} = 46.67\text{bps}$$

(b) Since the **shortest signaling element has duration of 20ms:**

$$Signalling\ \ Rate = \frac{1}{20\times 10^{-3}} = 50\text{bauds}$$

Note: Bit Rate≠ Baud Rate

Example (2):

A modem transmits using an eight-level signaling technique. If each signaling element has duration of 0.8333ms. Determine:

(a) The baud Rate (b) The bit Rate

Sol:

(a)

Baud Rate=**Inverse of the shortest signaling element** → (Signal change)

Baud Rate=1/0.8333ms=1200 bauds

(b) For 8 levels → means 2^3 → using n=3bits for each level (000, 001,…..111)

Thus each **three bits** are transmitted every 0.8333ms,

$$\text{Bit Rate} = \frac{n}{T_{baud}} = \frac{3}{0.833\times 10^{-3}} = 3600\text{bps}$$

Or

$$\boxed{\text{Bit Rate} = n \times \text{Baud Rate} = 3\times 1200 = 3600\text{bps}}$$

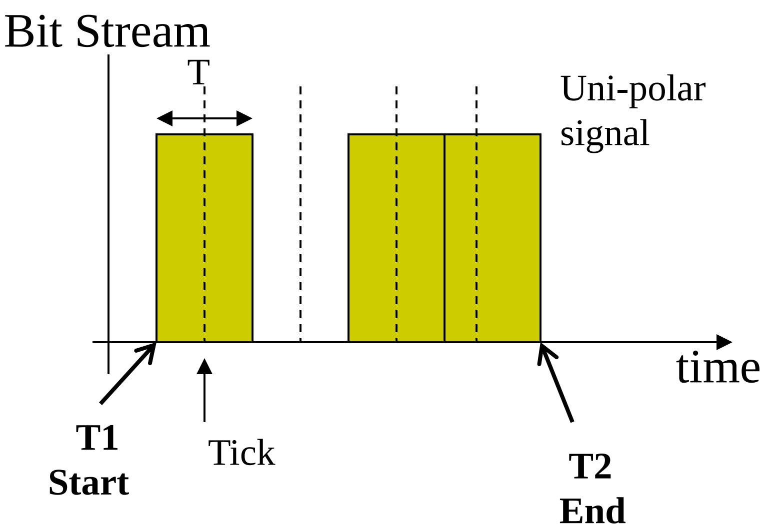
Synchronization and Framing:

When does the **Receiver** measure the signal to recover the bits?

At RX, there are **Two Problems:**

1) Keeping the correct pace when reading the bits → **Synchronization**

2) Finding Start time T1 and End time T2 →**Framing**



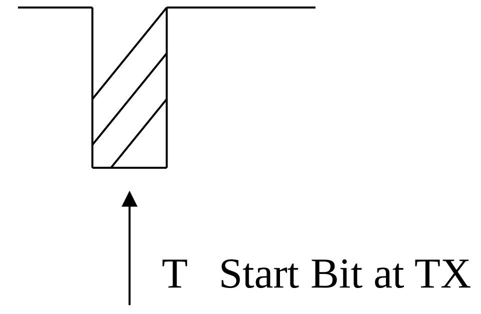
- Using Clock at time (T1+T/2) →

- Incorrect clock means Loss of Synchronous → Clock Drift **i.e. Not exactly find "Tick" at RX**

Example: To avoid Clock Drift (Loss of Synch) at RX

Consider 11 bit sequence including 1 extra bit (i.e. start bit) for clock

Assume at Start bit, Synch is late 10% of T.



Let (clock period) **T** at TX
Let (clock period) **S** at RX.

To find S is the period of the receiver clock, then we must achieve the <u>Two conditions:</u>

(1)

$$(10+0.5)\times \underset{\substack{\uparrow \\ \text{At RX} \\ \text{Clock}}}{S} + 10\% \times \underset{\substack{\uparrow \\ \text{At TX} \\ \text{Clock}}}{T} < 11\times T$$

and,

(2)

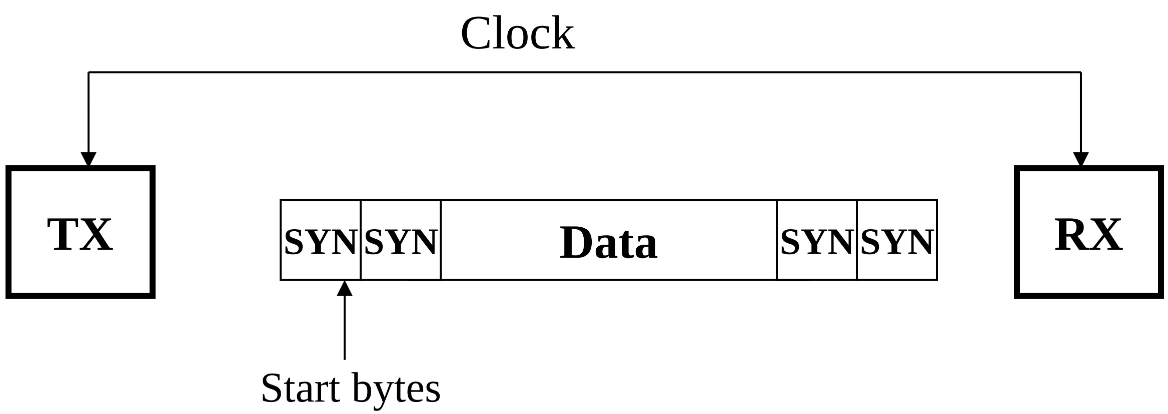
$$(10+0.5)\times S > 10\times T \quad \text{where} \quad \left|\frac{S-T}{T}\right| < 3.8\%$$

Synchronous Mode:

- It transmits long sequences of bits called **Packets** → Long Sequences increases **Transmission efficiency**.

- The receiver is synchronized by either very accurate clock (Quartz Clock) or a self-synchronizing code (**e.g Bi-phase code) –Manchester code, AMI, 4B/5B**

- **Examples**: Bit-oriented and character-oriented Packet transmissions.

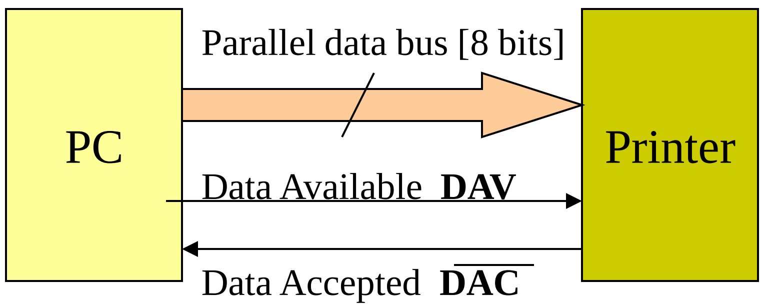


Synch Mode: ● No Start bit ● No Stop bits ● No Gaps (Min. interval)
● Hardware Implementation (only) → USART

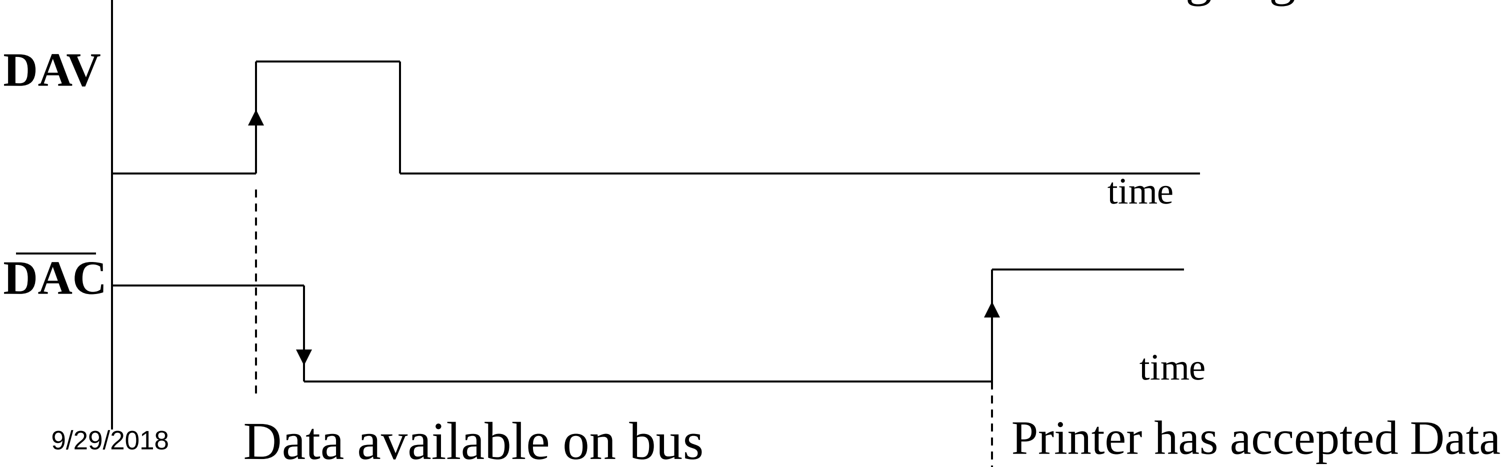
Asynchronous Mode can be software or hardware implemented.

Parallel Transmission: -Transmitting all bits as one byte (8bit=8lines) or character at one time + control signals (handshaking) –The cable distance is short – Fast data rate (speed) – impractical over long distance (very expensive)

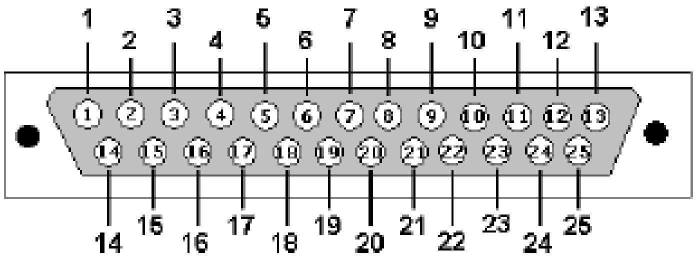
Example: Printer-to PC

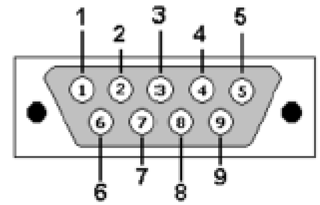


Parallel Transmission & Handshaking Signals



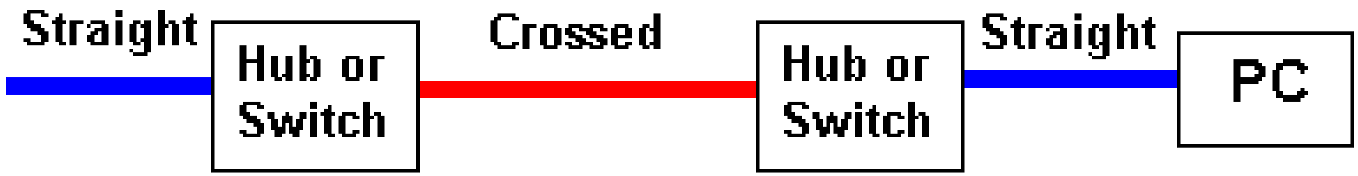
<u>RS-232 Cables</u>: DB25 (25 pin) DB9 (9 pin)





DB25	**Signal**		**DB9**	**Signal**
2	TXD	Transmit Data	2	RXD
3	RXD	Receive Data	3	TXD
4	RTS	Request To Sent	4	DTR
5	CTS	Clear To Send	6,1	DSR, CD
6,8	DSR, CD	Data Set Ready, Carrier Detect	7	RTS
7	GND	Signal Ground	8	CTS
20	DTR	Data Terminal Ready	5	GND
22	RI	Ring Indicator	9	RI

DTE = Data Terminal Equipment. (**e.g. PC Terminal**.)
DCE = Data Circuit Terminating Equipment. (**e.g. Modem, Hub, Switch**.)



Straight Connection

<u>DTE (PC)</u>		>> <<	<u>DCE (MODEM)</u>
[2]	**TXD**	→	**TXD**
[3]	**RXD**	→	**RXD**
[4]	RTS	→	RTS
[5]	CTS	→	CTS
[6]	DSR	→	DSR
[7]	**SG**	→	**SG**
[8]	CD	→	CD
[20]	DTR	→	DTR
[21]	RI	→	RI

Null-Modem (Cross-Connection)

<u>DTE (PC)</u>		>> <<	<u>DTE (PC)</u>
[2]	**TXD**	←	**RXD**
[3]	**RXD**	→	**TXD**
[4]	RTS		RTS
[5]	CTS		CTS
[6]	DSR		DSR
[7]	**SG**	>>>>>>>>>>>>	**SG**
[8]	CD	Not Required	CD
[20]	DTR		DTR
[21]	RI	Not Required	RI