Transmission

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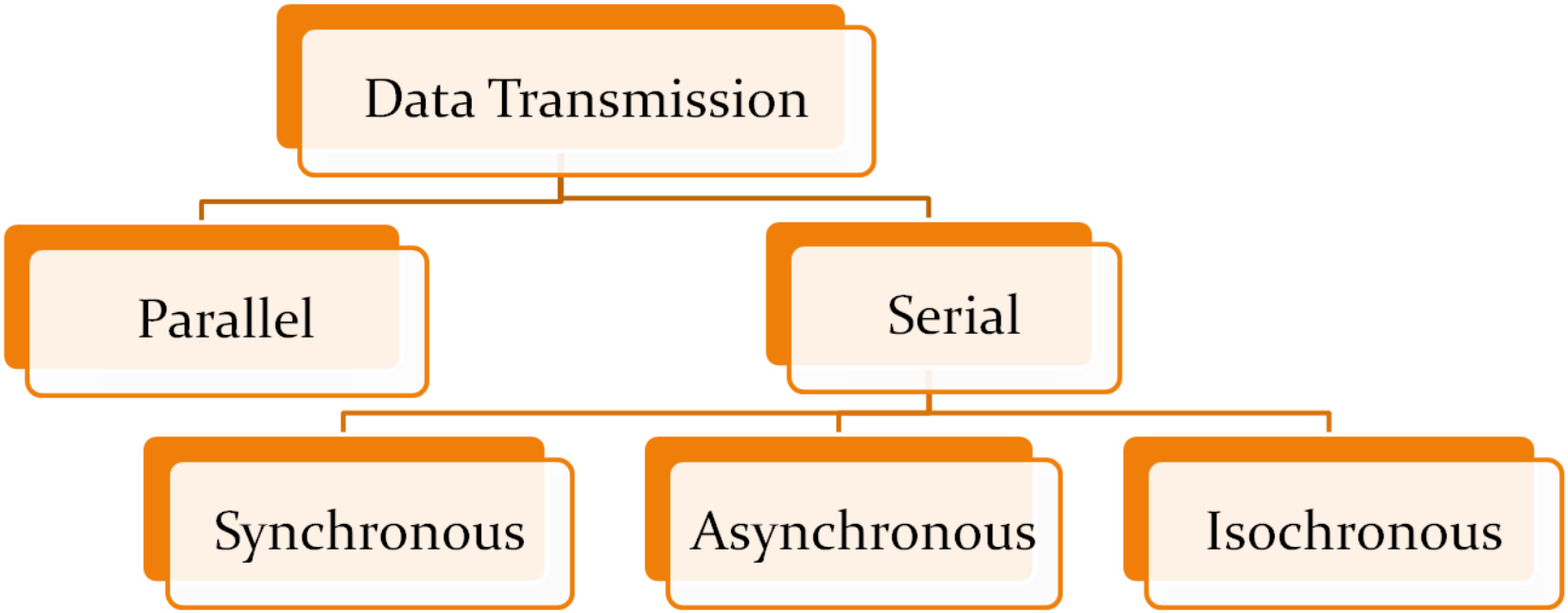
CS2032 – Principles of Computer Communication

Outcomes

- After successful completion of this lesson you will be able to
- Explain transmission modes
- Explain analog and digital multiplexing techniques

Transmission Modes

The way in which a bit group goes from one device to another



Parallel Transmission

- Parallel: group of bits sent simultaneously by using a separate line for each bit
- Pros – Fast
- Cons - Over longer distances;
- costly to use many wires
- need thicker wires to reduce signal degradation and bundling into a single cable is not practical
- bits may not be received simultaneously

Serial Transmission

- Serial: bits sent over a single line one bit after another
- Pros:
- Cheap
- Reliable
- Cons:
- Complexity because, sender and receiver must determine the order of bits

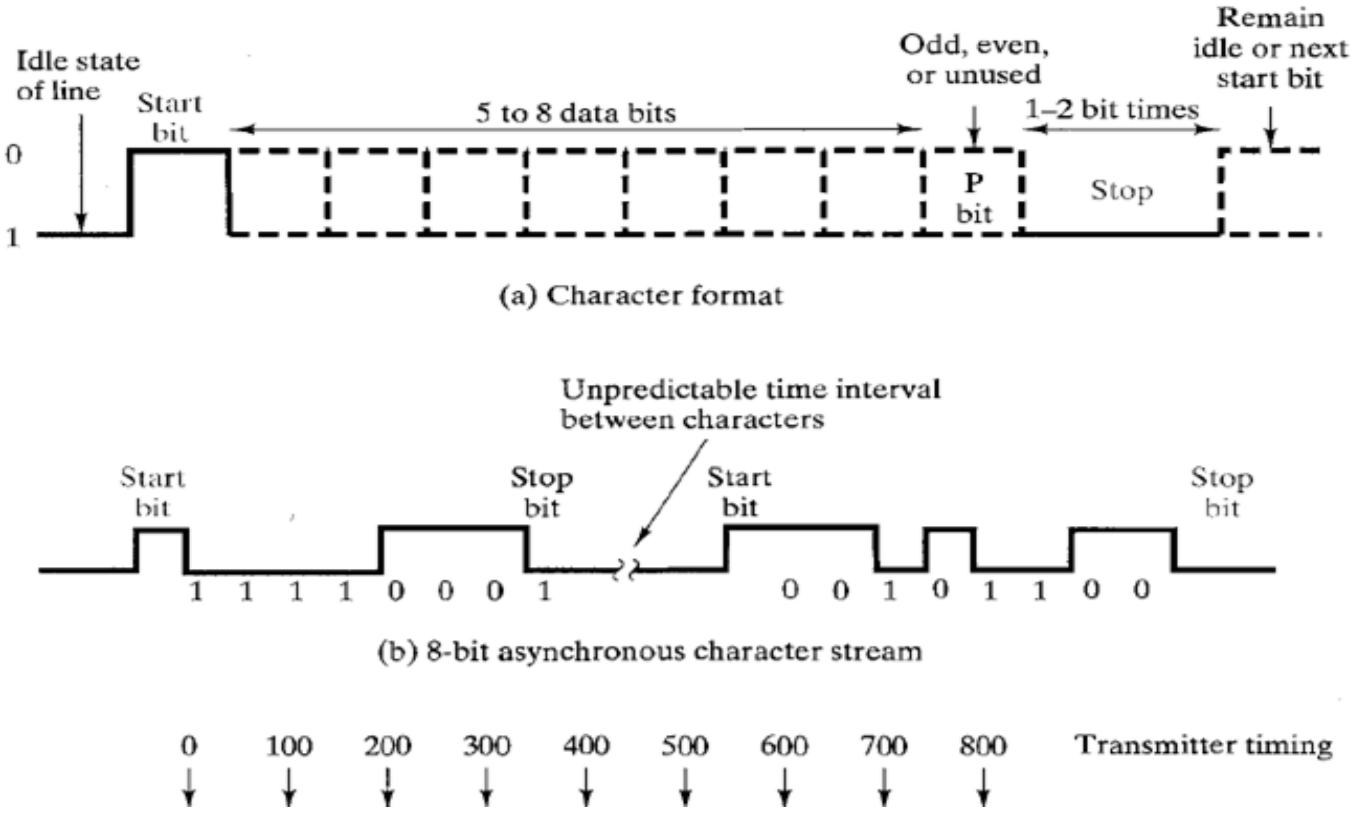
Asynchronous Transmission

- Bits are divided into small groups (e.g. byte) and sent independently
- E.g. keyboard inputs
- Properties of the communication
- receiver does not know when a group of bits will arrive
- unpredictable time intervals between transmissions
- timing maintained within each group

Asynchronous Transmission (2)

- Must signal that sender is going to send a group of bits before sending actual bits
- **Start Bit** – changes the line from idle state (normally considered as binary 1) to 0
- Must signal that sender has finished sending a group of bits
- **Stop Bits** – changing line state back to logic 1 (idle)
- Cons – Too much of overhead bits

Example for Asynchronous Tx



Synchronous Transmission

- Larger bit groups are sent without start/stop bits for each character
- Such a bit group is called a **Frame**
- Frame structure varies from protocol to protocol
- Organization of a generic frame

Syn – synchronization bits
Ctrl – control bits
Data – Data bits
Error – Error checking bits
End – End-of-frame bits

Simplex, Half-Duplex & Full Duplex

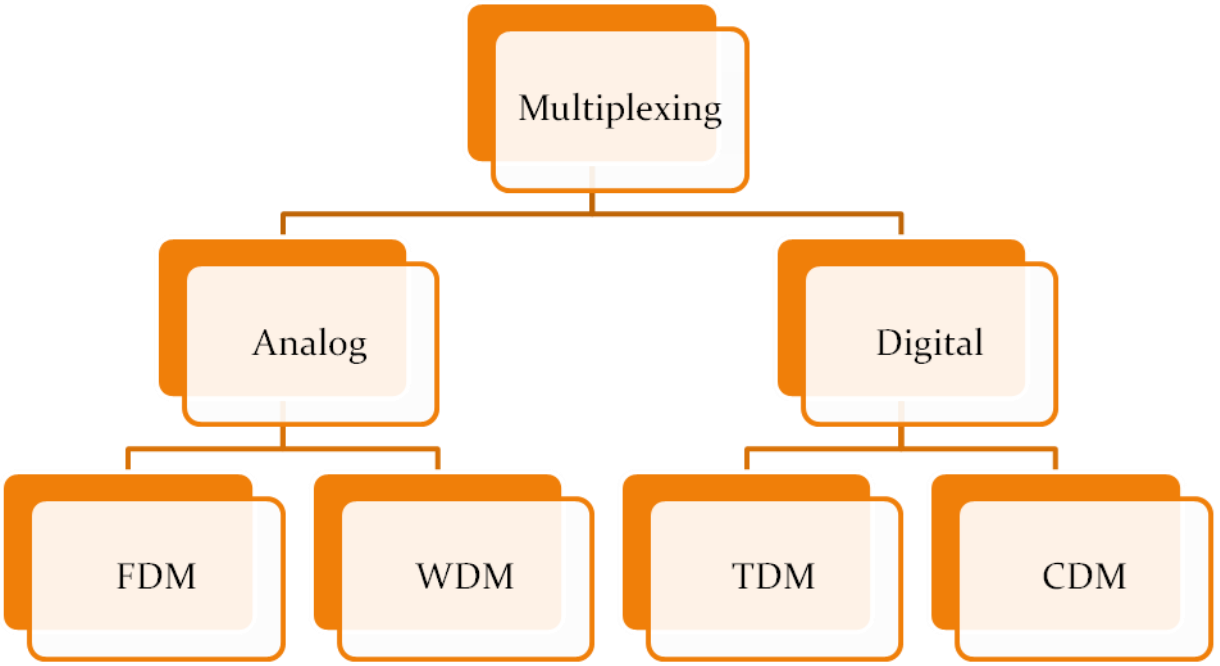
- Simplex : communication happens always to the same direction
- Half-duplex : both devices can send and receive but one sends at a time
- Full-duplex : devices can send and receive at the same time

Multiplexing

Many to one!

Multiplexer (Mux): device that routes transmission from multiple sources to a single destination

e.g.



Frequency Division Multiplexing (FDM)

- Used with analog signals (e.g. Television and Radio)
- Steps of FDM
- Divide bandwidth of a medium into separate ranges called **channels**. Separate the channels from each other by **guard bands**.
- Define a **carrier signal** for each channel
- Combine **modulated signals** from all channels into a single analog signal
- Receiving Mux will use **bandpass filters** to extract the original signals (e.g. separating sound and pictures from TV signals)

Time Division Multiplexing (TDM)

- Used with digital signals
- Logically package bits from different sources
- E.g.
- A_i, B_i, C_i, D_i where i=1,2,3… are bit streams from four different sources
- A_i, B_i, C_i, D_i are buffered separately at Mux
- Mux scans each buffer, takes groups of bits from each and store in a frame
- Byte multiplexers and Block multiplexers

TDM(2)

- When the inputs are continuous bit streams

$$\sum_{i=1}^{n} r_i = r_{output}$$

- input rate Vs output rate
- Input streams are faster than the mux can create frames/data rate of the transmission media after mux and Size of buffer space in the mux
- Inputs are too slow, utilization of transmission capacity of medium

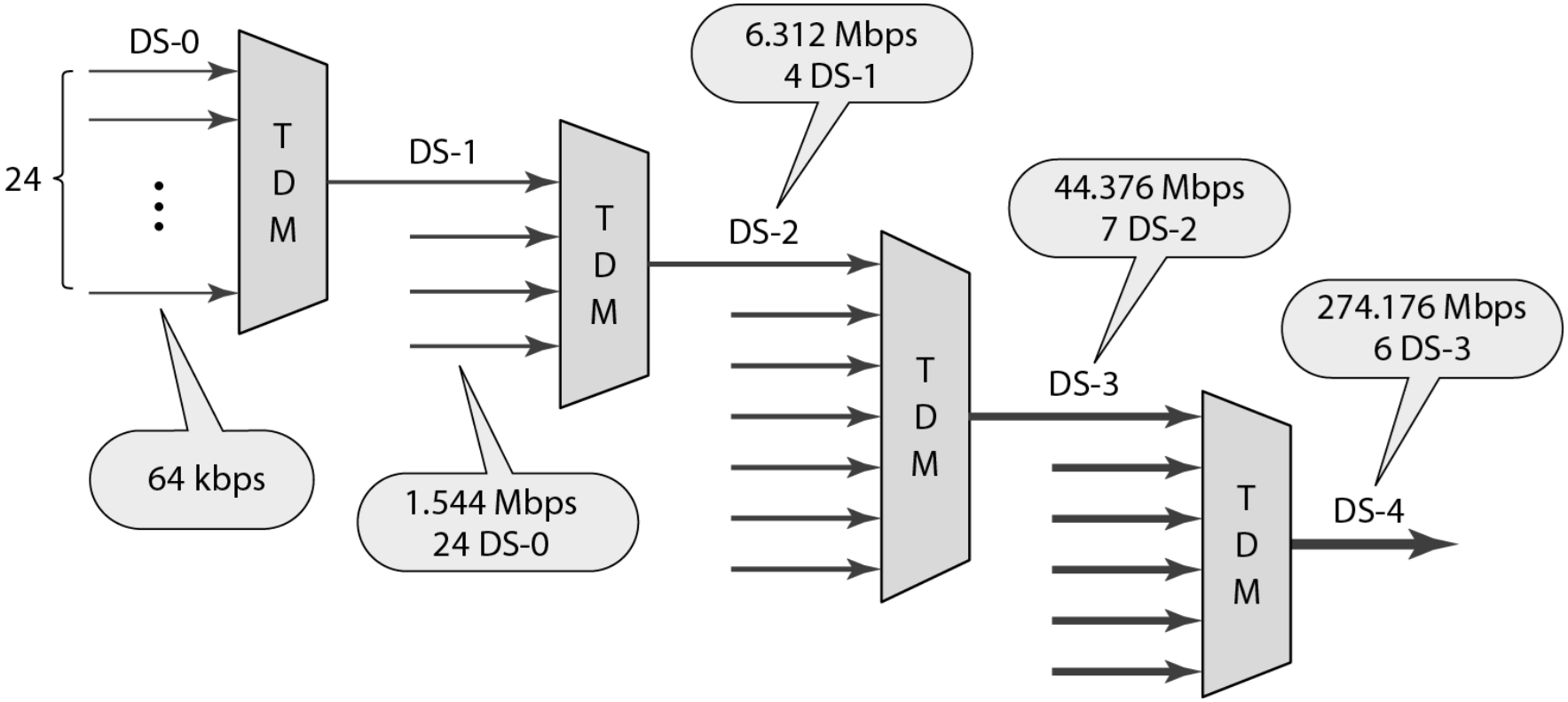
TDM(3)

- **Bursty** data streams in the input
- Sudden arrivals of data bits followed by variable periods of inactivity (e.g. a user thinking and typing)
- Two approaches
- Construct frames of fixed size with empty parts (fill bogus bits into the frame when the corresponding buffers are empty)
- Construct variable-sized frames with data from non-empty buffers → Statistical Multiplexers

TDM(4)

- **Statistical TDM** for input bursts
- E.g.
- A_i, B_i, C_i, D_i where i=1,2,3… are bit streams from four different sources
- A_i, B_i, C_i, D_i are buffered separately at Mux
- Firstly, A_1 and C_1 arrive but the buffers for C_i, D_i are empty at the moment, so the Mux puts A_1 and C_1 into a frame and sends
- Next, B_1,C_2 and D_1 arrive, so the Mux puts them into a frame and sends

Digital Hierarchy



Thank you

References

- Recommended text
- Data Communications, Stallings
- Data Communications and Networking, Forouzan