LE 517
Data Communications and Networks

Week 4:- Transmission, Interface and Multiplexing

By

Dr. Piya Techateerawat

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Transmission, Interface and Multiplexing

- **Transmission Modes**
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Transmission Modes

- *A transmission mode* defines " the way in which a bit group y in goes from one to device to another."

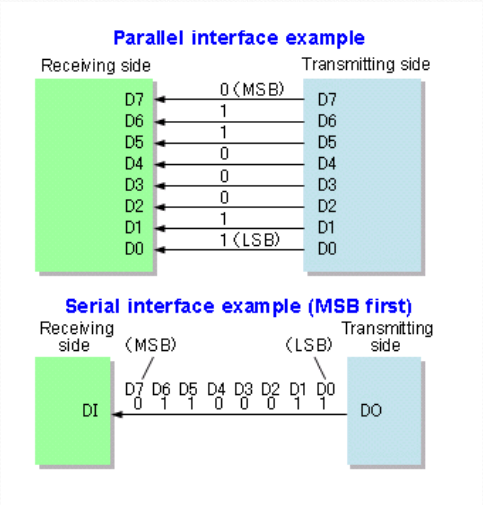
Transmission, Interface and Multiplexing

- Transmission Modes
  - **Serial and Parallel Transmission**
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Serial and Parallel Transmission

- **Serial Transmission**:- Using just one line to transmits all the bits along it one after another.
  - *Normally, cheaper, more reliable but slower than parallel.*
- **Parallel Transmission**:- A group of bits is transmitted simultaneously by using a separate line for each bit.

Serial and Parallel Transmission



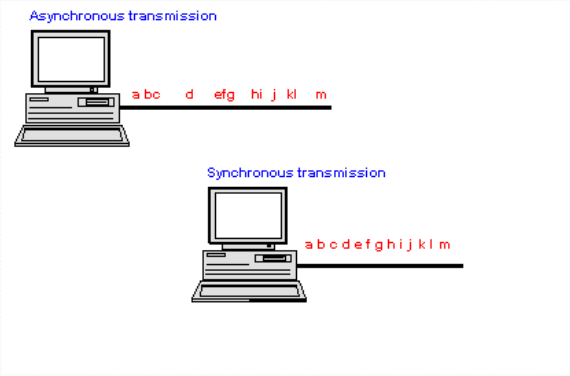
Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - **Asynchronous and Synchronous Transmission**
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Asynchronous and Synchronous Transmission

- **Asynchronous transmission**:-
  - bits are divided into small groups and sent independently.
  - Sending can be any time and the receiver never knows when bits are arrived.
- **Synchronous transmission**:-
  - Sending much larger bit groups.
  - Each group has start and stop bit.
  - Each group called " data frame" or "frame"

Asynchronous and Synchronous Transmission



Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - **Simplex, Half-Duplex and Full-Duplex Communications**
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Simplex, Half-Duplex and Full-Duplex Communications

- **Simplex :-**
  - one way communication always.
- **Half-duplex:-**
  - Both way communication but one way at a time.
- **Full-duplex:-**
  - Both way communication simultaneously.

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- **Interface Standards**
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

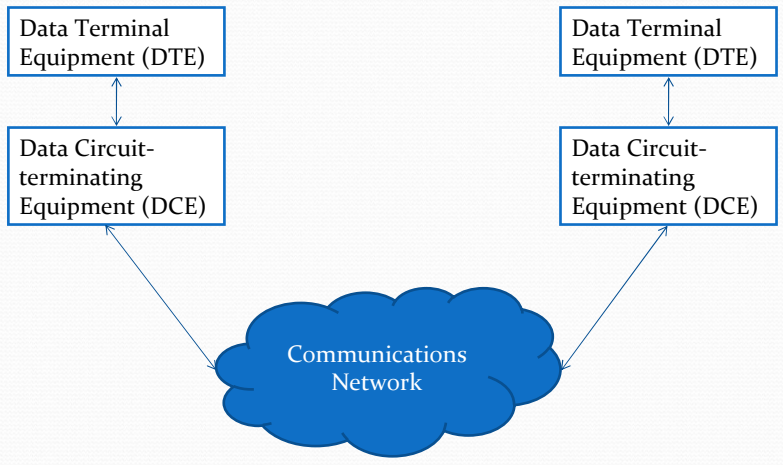
Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - **RS-232 Standards**
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - **RS-232 Subsets**
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

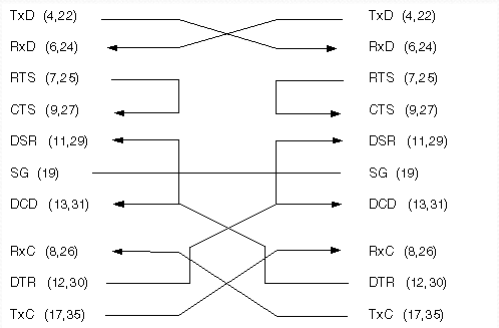
DTE-DCE



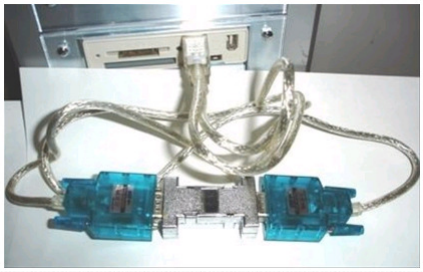
Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - **Null Modems**
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

NULL Modem



NULL Modem



Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - **RS-449 Interface**
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

RS-449 Interface

- Standard from Electronic Industries Association (EIA)
- To increase both distance and bandwidth from RS-232.

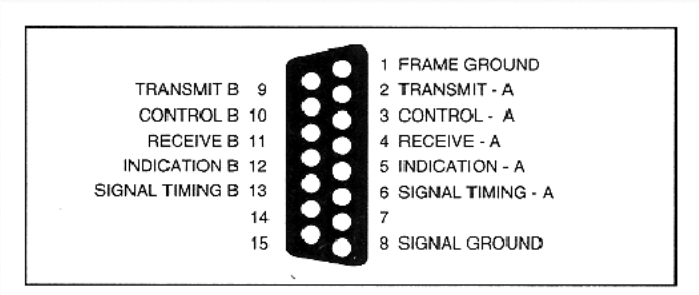
- Bandwidth can reach 10 Mbps (40 feet)
- Distance can reach 4000 ft (100 Kbps)

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - **X.21 Interface**
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

X.21 Interface

- Standard from CCITT.
- The first digital signal interface.
- Interim standard to ISDN (Integrated Services Digital Network)



Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- **Multiplexing**
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - **Frequency Division Multiplexing (FDM)**
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - T-1 Carrier

Frequency Division Multiplexing (FDM)

- To use high speed network on low cost of connecting.
- FDM:-
  - Used with analog signals by dividing bandwidth to separate ranges or channels.
  - Commonly used in television and radio transmission.
  - Carrier signal:- a signal to define each channel and mix with data by modulation technique.

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - **Time Division Multiplexing (TDM)**
  - Statistical Multiplexers
  - T-1 Carrier

Time Division Multiplexing (TDM)

- TDM:-
  - Many input signals are combined and transmitted together.
  - TDM separate the packets based on time frame.
  - Used with digital signals.
  - Keep signals physically distinct but logically packages together.

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - **Statistical Multiplexers**
  - T-1 Carrier

Statistical Multiplexers

- Statistical Multiplexers:-
  - The multiplexer scan the buffers and create a variable-size frame depending on how many buffer data contain data.
  - Improved version of TDM
  - It can be efficient when there is idle spaces from some channel.
  - Idle spaces from one channels can provide to the other channels.

Transmission, Interface and Multiplexing

- Transmission Modes
  - Serial and Parallel Transmission
  - Asynchronous and Synchronous Transmission
  - Simplex, Half-Duplex and Full-Duplex Communications
- Interface Standards
  - RS-232 Standards
  - RS-232 Subsets
  - Null Modems
  - RS-449 Interface
  - X.21 Interface
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
  - Statistical Multiplexers
  - **T-1 Carrier**

T-1 Carrier

- Designed for high speed media.
- Voice and data signal can be transmitted together.
- TDM is used for T-1.

Carrier	Frame Format	Number of Channels	Data Rate in Mbps
T-1	DS-1	24	1.544
T-1c	DS-1C	48	3.152
T-2	DS-2	96	6.312
T-3	DS-3	672	44.376
T-4	DS-4	4032	274.176

Reference

- http://www.necel.com/en/faq/msb_lsb.gif
- http://networking.ringofsaturn.com/Protocols/X21.gif @ 24 OCT 2008
- http://coad.net/blog/images/SerialPortRS232SerialCOMPortinC.NET_EE09/SerialComNullModem4.jpg@ 24 OCT 2008

Q & A