CHANNEL
CHARACTERISTICS
COMMUNICATION CHANNEL TERMINOLOGY

- **Simplex**
  - Data Link
  - Controller to Terminal
  - Transmission in One Direction Only - Unidirectional
  - Example: doorbell, radio, TV broadcasting.

- **Half Duplex**
  - Data Link
  - Controller to Terminal
  - Transmission in Both Directions but only One Way at a time
  - Example: CB radio.

- **Full Duplex**
  - Data Link
  - Controller to Terminal
  - Transmission in Both Directions Simultaneously - Bi-directional
  - Example: telephone.

- Simplex transmission in one direction only with no way of responding; e.g., doorbell, radio, TV broadcasting.

- Half Duplex (HDX) transmission in either direction, but only one way at a time (not simultaneously); e.g., CB radio.

- Full Duplex transmission in both directions simultaneously; e.g., telephone.
Noise is unwanted electrical signals that are introduced by circuit components or natural disturbances.

Distortion is an unwanted change in signal waveform as it travels through the system.

Both noise and distortion can cause communication errors. These errors result in extra bits, missing bits, or bits whose states have been changed.

Crosstalk is unwanted coupling between signal paths.
**White Noise** is the unavoidable noise background to all electronic processes.

**Impulse Noise** is caused by:

Lightning flashes during thunderstorms.
Voltage changes in adjacent lines or circuitry surrounding the communications line.
Intermittent electrical connections in any of the communications equipment through which the signal passes, or other such causes.

Such noise can totally destroy many bits of Digital Data. Very little damage to Analog Data.
**Attenuation** is the weakening, in strength, of a signal as it passes through the medium.

As the signal travels through the transmission medium, some of its power is absorbed, the signal gets weaker, and the receiving equipment has less and less chance of correctly interpreting the data.

**Attenuation Distortion** occurs because high frequencies lose power more rapidly than low frequencies during transmission. Thus the received signal is distorted by unequal loss of its component frequencies.
**Delay Distortion:**

Occurs when the method of transmission involves transmission at different frequencies.

The bits transmitted at one frequency may travel slightly faster than the bits transmitted at another frequency.

**Equalizer:**

Is a piece of equipment that tries to compensate for both attenuation distortion and delay distortion.
If delay in constant for all frequencies, then those frequencies travel the facility at a constant speed.

If various frequencies travel at different speeds, correction may be necessary.
CHANNEL CAPACITY

The information-carrying capacity of a communications channel is directly proportional to its bandwidth.

For example, a random stream of bits going across the voice bandwidth has a maximum capacity of 33,600 bits per second (approx). This is demonstrated by using Shannon's Law.

Using Shannon’s Law
Signal to Noise Ratio: 38,000-39,000 db (best case)
SPECTRUM vs. BANDWIDTH vs. CHANNEL CAPACITY

Spectrum = 300-3400 Hz (range of frequencies available for use).

Bandwidth = 3100 Hz (difference between highest and lowest frequencies).

Channel Capacity = 33,600 bps (maximum transmission rate)*

According to Shannon's Law the maximum speed, at best case, is between 38,000-39,000bd.

*Note: The value 33,600 bps is the maximum theoretical capacity for a voice-grade telephone channel.
56K MODEMS

- 56Kbps only work if one modem has direct digital connection.
- If any analog conversion is done, defaults to V.34
- Asymmetric, 33.6 upstream 56Kbps down
- 56Kbps is best case based on “clean” lines.
DIFFERENCES IN BANDWIDTH

**Narrowband** (0-300Hz) channels - used for non-voice service; e.g., teletype writer + other low speed data transmission.

**Voiceband** (300-3400Hz) channels - used for voice transmission, foreign exchange service and data communications.

**Wideband** or **Broadband** - used for high speed data facsimile and video transmission.
Frequency Ranges for Answer and **Originate Full Duplex Modems**
(Bell 130F)

![Graph showing frequency ranges for Answer and Originate full duplex modems.](chart.png)
FULL DUPLEX, 300 BPS, BELL 103/113

Specifications

- Data: Serial, Binary, Asynchronous, Full Duplex
- Data transfer rate: 0 to 300 bps
- Modulation: Frequency Shift Keyed (FSK) FM
- Frequency assignment:
- Originating end/Answering end
- Transmit:
  - 1070 Hz space 2025 Hz space
  - 1270 Hz mark 2225 Hz mark
- Receive:
  - 2025 Hz space 1070 Hz space
  - 2225 Hz mark 1270 Hz mark

Specifications and channel assignments for the full duplex 300 bps asynchronous bell 103/113 are shown in this illustration.
BAUD AND BPS

**Baud** - Number of signal changes or events on media per second.

**BPS** - Number of computer bits transmitted on media per second.

If one signal change conveys one bit of information, then the Baud equals the BPS. But, one signal change can convey more than one bit. Example; use an FM scheme with four frequencies:

- Frequency = 00
- Frequency = 01
- Frequency = 10
- Frequency = 11

Each signal change conveys 2 bits of information. BPS = 2 \* Baud rate. Using phase modulation: 8 phases - 3 bits each BPS = 3 \* Baud. Many 9600 BPS modems used 12 phases with 4 having 2 amplitudes: 16 representations - 4 bits each. A 2400 Baud modem can transmit 9600 BPS.
The modulation technique determines the BPS vs. Baud reduction. Baud is the change in the line signal per unit time.
DATA TRANSMISSION CODES

The definition of that combination of bits used to represent each character is called the Data Communications Code.

For example, there may be an 8 bit data communication code in which the letter A is represented by 10000011 and the number 9 as 01110011.

There are many different codes. All the codes are based on the use of bits to represent characters. The number of different characters that can be represented by the code depends on the number of bits required to form a character.

Two frequently used codes are ASCII and EBCDIC. BAUDOT and BCD are two others.