Networking Media

What is a signal?	Examples of signals
• **Means of communication**: This refers to a sign or indication that conveys information about something or that tells someone to do something. • **Communicated information**: This refers to an event or act, which shows that something exists or that gives information about something. • **Electronics transmitted information**: This refers to a detectable physical quantity or impulse (as a voltage, current, or magnetic field strength) by which messages or information can be transmitted/conveyed via telegraphy, telephony, radio, radar, or television.	• **Electrical signals** (voltages and currents in a circuit) • **Acoustic signals** (audio or speech signals) • **Video signals** (intensity variations in an image) • **Biological signals** (sequence of bases in a gene) • **Noise** (interference – unwanted and undesired form of signal) The main purpose of the signal is to ensure that the synchronization (or clocking) between the sender and receiver over a physical medium is maintained, as well as support transmission of the data signal in a form that can be interpreted by both the sender and receiver.

Parts of a Wave

Waves refer to disturbances that causes energy to travel through a medium from one location to another.

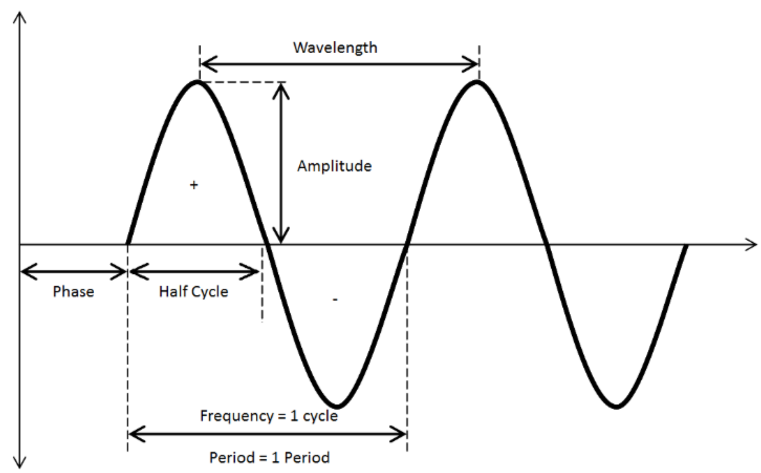
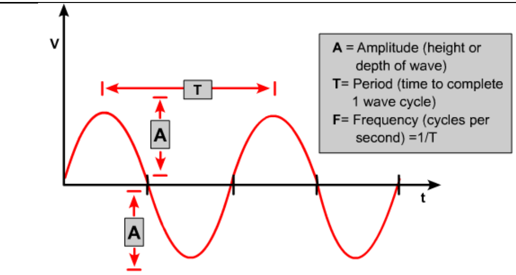
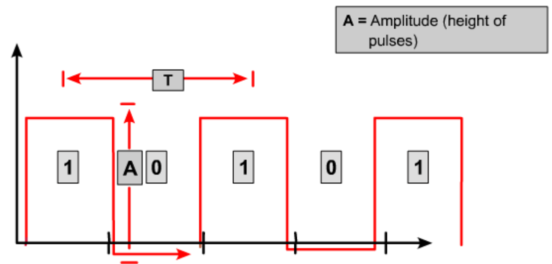


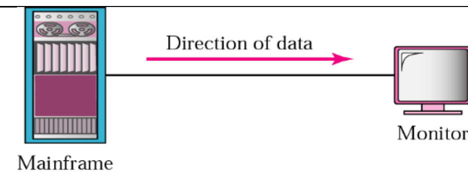
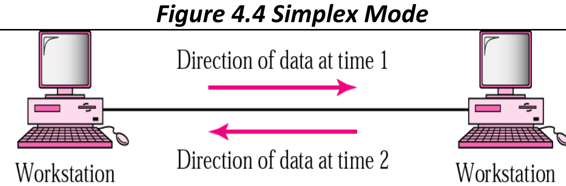
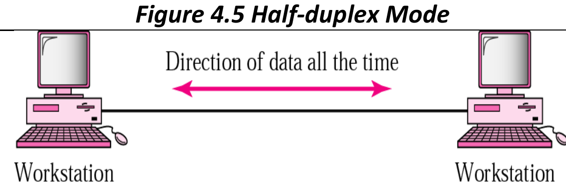
Figure 4.1 Attributes of a Wave

- ***Wavelength*** – it refers to the horizontal distance of a wave from a point to the corresponding point on the next wave. This is measured in meters (m) in SI.
- ***Amplitude*** – It refers to a vertical distance from a given point on the wave from the horizontal axis. In layman's term, it is the height above and below the x–axis. This is measured in volts, amperes, or watts, depending on the type of signal.
- ***Phase*** – It describes the position of the waveform relative to time zero; it is a measurement of the delay of the wave relative to some fixed reference point or another sine wave.
- ***Frequency*** – It refers to the number of waves made per second or as cycles per second. It is the reciprocal of the period of time to complete one (1) wave cycle. The unit given is Hertz (Hz); 1 Hz means 1 cycle per second (cps).
- ***Period*** – This refers to the amount of time (expressed in seconds) required to complete one (1) full cycle.

General Categories of Waves

Analog (short for "analogous") wave – It is a wave in which both the amplitude and time continuously varies over their respective intervals that results in a wavy characteristic. Examples of this wave include human voice and music.	 ***Figure 4.2 Sinusoidal wave***
Digital wave – It is a wave with several discrete (jumpy) states, such as high or low, and on or off. It has fixed amplitude but its pulse width and frequency can be changed. An example of this signal is the data stored in the memory of a computer in the form of 0s and 1s.	 ***Figure 4.3 Square Wave***

Kinds of Transmission Modes

Simplex Mode (shown in Figure 4.4)**:** It is a connection wherein data flows in one (1) direction only (unidirectional). This type is either *transmit-only* or *receive-only* (e. g. connection from computer to printer or from the mouse to computer).	 ***Figure 4.4 Simplex Mode***
Half-duplex Mode (shown in Figure 4.5)**:** It is a connection wherein data can flow in both directions, but not simultaneous (both at the same time) over a shared physical medium.	 ***Figure 4.5 Half-duplex Mode***
Full-duplex Mode (shown in Figure 4.6): It is a connection wherein data simultaneously flows in both directions (e.g. both users in a telephone conversation can speak and be heard at the same time).	 ***Figure 4.6 Full-duplex Mode***

Crosstalk causes an interference with the signals that may be present on the two (2) adjacent wire pairs in cable. This happens when the adjacent wires in the cable (which acts like antennas) receives the transmitted electromagnetic energy (generated from the changing of voltages on a wire) that is radiated outward from the transmitting wire like a radio signal from a transmitter. ***Note: Attenuation*** (aka signal deterioration) refers to the decrease in signal strength as it travels through cable or across a system. This is expressed in decibels (dB) using negative numbers.

Types of Crosstalk:

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• ***Near-end Crosstalk (NEXT)*** (shown in Figure 4.7) – This occurs when two (2) wires are near each other and untwisted. The energy from one (1) wire can wind up in an adjacent wire and vice versa. This can cause noise at both ends of a terminated cable.

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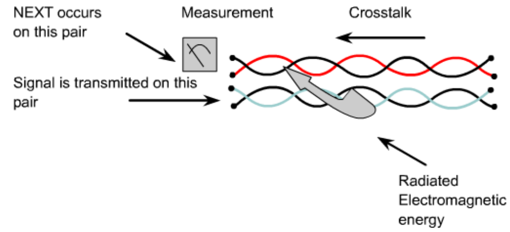

Figure 4.7 Near-end Crosstalk (NEXT)

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• ***Far-end Crosstalk (FEXT)*** (shown in Figure 4.8) – This is similar to the Near End Cross Talk (NEXT), except that the signal is sent from the local end and crosstalk is measured at the far end. This implies that the noise caused by FEXT still travels back to the source, but it is attenuated as it returns. Due to attenuation, signals that induce FEXT creates less noise on a cable than NEXT.

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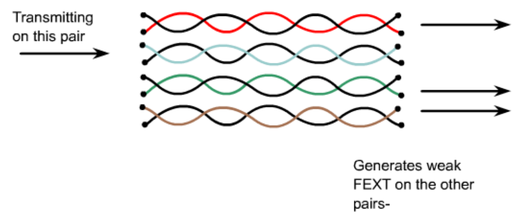

Figure 4.8 Far-end Crosstalk (FEXT)

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• ***Power Sum NEXT (PSNEXT)*** (shown in Figure 4.9) – This is derived from the summation of the individual NEXT, which effects on each pair by the other three (3) pairs. The combined effect of crosstalk from multiple simultaneous transmission sources can be very detrimental to the signal.

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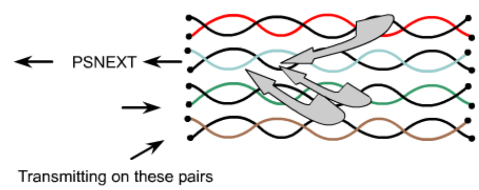

Figure 4.9 Power Sum NEXT (PSNEXT)

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The ***TIA/EIA-568-B*** standard specifies ten tests that a copper cable must pass if it will be used for modern, high-speed Ethernet LANs.

10 primary test parameters to meet TIA/EIA standards are:

1. ***Wire map*** – This is used to identify installation wiring errors; it insures that no open or short circuits exist on the cable and also verifies that all eight (8) wires are connected to the correct pins on both ends of the cable.
   - An <u>open circuit</u> occurs if the wire does not attach properly at the connector.
   - A <u>short circuit</u> occurs if two (2) wires are connected to each other.
2. ***Insertion loss*** – These measures the amount of energy that is lost as the signal arrives at the receiving end of the cabling link. The insertion loss measurement quantifies the effect of the resistance which the cabling link offers to the transmission of the electrical signals.
3. ***Near-end crosstalk (NEXT)***
4. ***Power sum near-end crosstalk (PSNEXT)***
5. ***Equal-level far-end crosstalk (ELFEXT)*** – This is derived by subtracting the attenuation of the disturbing pair from the Far End Crosstalk (FEXT); this pair induces in an adjacent pair.
6. ***Power sum equal-level far-end crosstalk (PSELFEXT)*** – This is derived from an algebraic summation of the individual ELFEXT effects on each pair by the other three (3) pairs. There are four (4) PSELFEXT results for each end.
7. ***Return loss*** – This is a measure in decibels of all reflections that are caused by the impedance mismatches at all locations along the link.
8. ***Propagation delay, or delay*** – This is a measurement of how long it takes for a signal to travel along the cable being tested. Delay is measured in nanoseconds (nS).
9. ***Cable length*** – This refers to the physical or sheath length of the cable; it is in contrast to electrical or helical length, which is the length of the copper conductors. Physical length will always be slightly less than electrical length due to the twisting of the conductors.
10. ***Delay skew*** – This refers to the delay difference between the fastest and slowest pairs in a UTP cable.

Ethernet LAN standards to L1 and L2 of the OSI model

- For LAN to function properly, the physical layer medium must meet the industry standards specified for the data rate used to transmit signals over the Ethernet (10, 100, 1000, or 10,000 Mbps).
- The Project 802 further divided OSI's Data-Link Layer into sub-layers: the LLC (Logical Link Control) Sub-layer and the MAC (Media Access Control) Sub-layer to accommodate multiple LAN access methods as shown in Figure 4. 11.

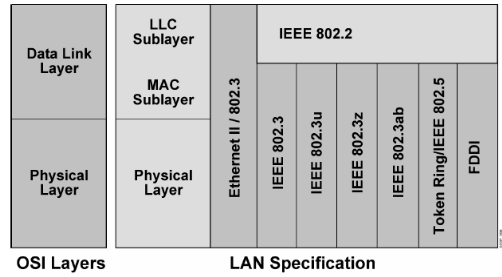

Figure 4.10 Layer 1 (Physical Layer) and Layer 2 (Data Link Layer) Segments of the Network

IEEE 802 LAN specifications

Name	Description
IEEE 802.3	Ethernet
IEEE 802.4	Token bus
IEEE 802.6	Metropolitan Area Network
IEEE 802.7	Broadband LAN using Coaxial Cable
IEEE 802.8	Fiber Optic TAG
IEEE 802.11	Wireless LAN (WLAN) & Mesh (Wireless-Fidelity)
IEEE 802.14	Cable modems
IEEE 802.15	Wireless Personal Area Network (WPAN)
IEEE 802.15.1	Bluetooth
IEEE 802.15.7	Light Communications
IEEE 802.20	Mobile Broadband Wireless Access

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