CCNA 1 v3.1 Module 4
Cable Testing

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Objectives

Upon completion of this module, the student will be able to perform tasks related to the following:	
4.1	Background for Studying Frequency-Based Cable Testing
4.2	Signals and Noise

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Sine Wave

- A wave is energy traveling from one place to another.
- The frequency is the number of waves each second, measured in Hertz.
- One Hertz is equal to one wave per second, or one cycle per second.

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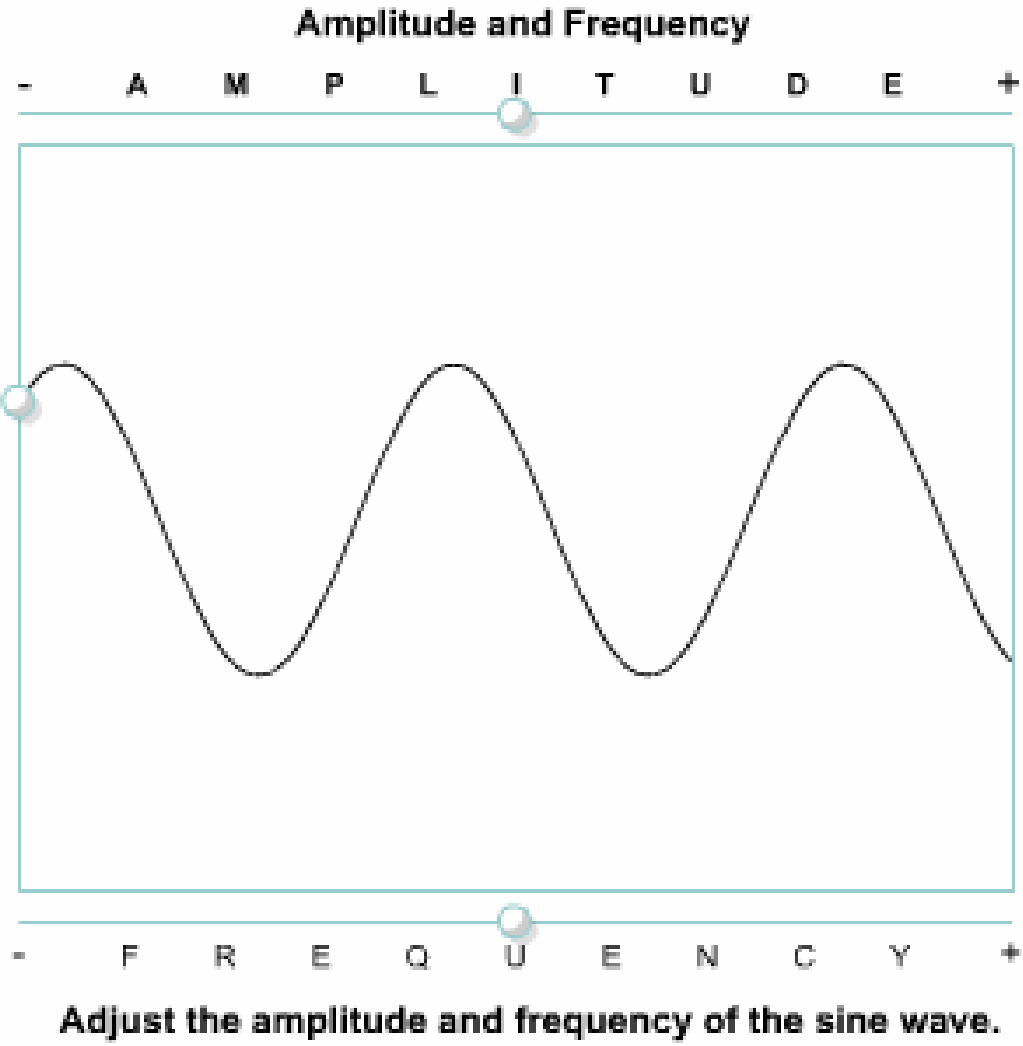
Waves



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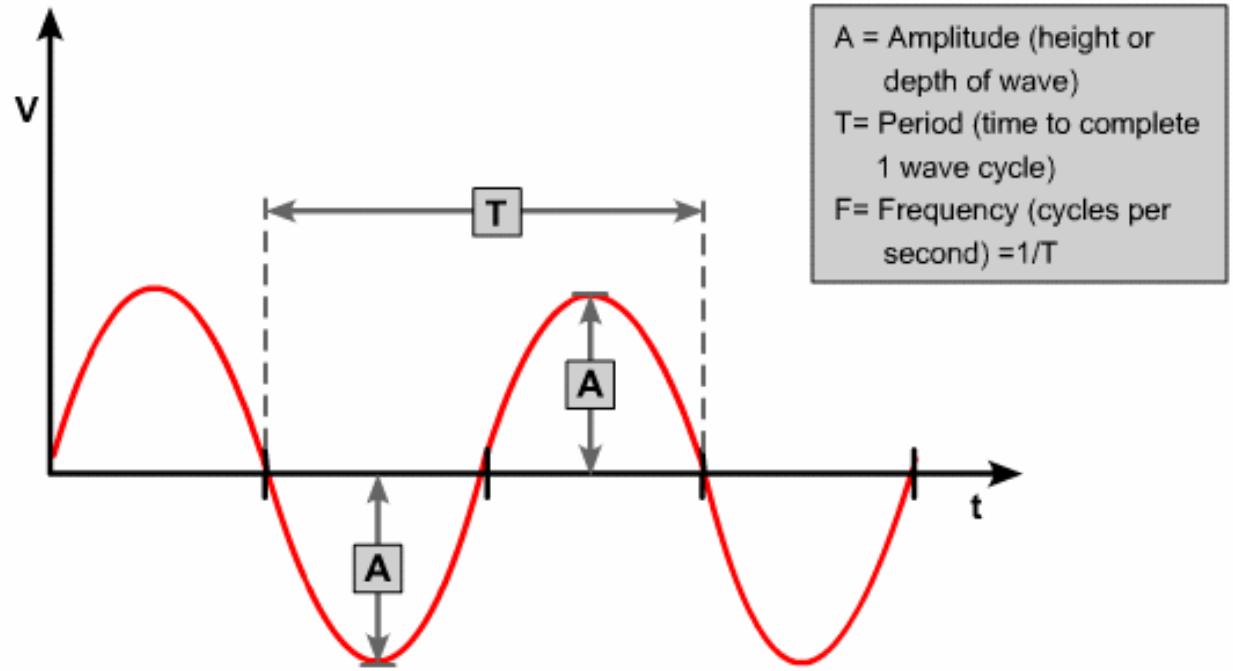
Sine Waves and Square Waves



- Continuous voltage
- Voltage varies as time progresses
- Many encodings possible

Sine waves are periodic, which means that they repeat the same pattern at regular intervals

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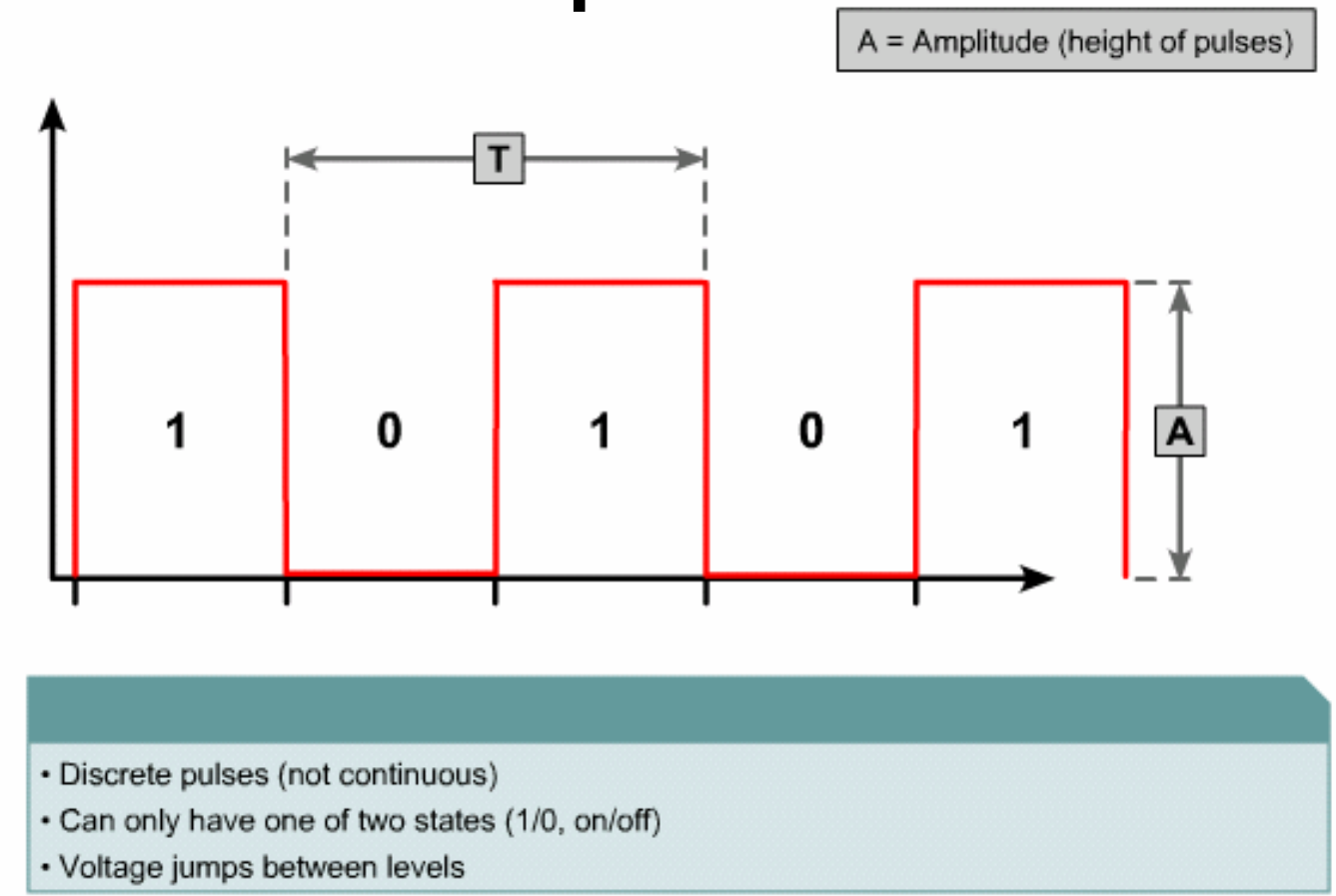
Sine Waves and Square Waves



- **Square waves, like sine waves, are periodic.**
- **The wave holds one value for some time, and then suddenly changes to a different value.**

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Exponents and Logarithms

- Multiplication is a shortcut for addition. Recall that means 10 +10+ 10.

  It is 3 multiply by 10

- Exponents are a shortcut for multiplication. 10x10x10 can be written as 10^3.

  therefore $1000 = 10^3$

- AND Logarithm is a shortcut for exponents. Log of 10^3 means 3

  10000000000000000 in logarithmic terms can be written as just 17

Why LOG?

- Just to make big numbers look small
- Important in internetworking and Electronics

Try the interactive media 4.1.3

1 billion =10^9 and log $10^9 = 9$

1 billionth is Log $10^{-9} = -9$ (equals 0.000000001)

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Decibels

There are two formulas for calculating decibels:

- $dB = 10 \log_{10} (P_{final}/P_{ref})$
- $dB = 20 \log_{10} (V_{final}/V_{ref})$

The decibel (dB) is a measurement unit important in describing networking signals.it measures the loss or gain of the power of a wave. Decibels are usually Negative numbers representing a loss in power as the wave travels,
Positive values representing a gain in power if the signal is amplified

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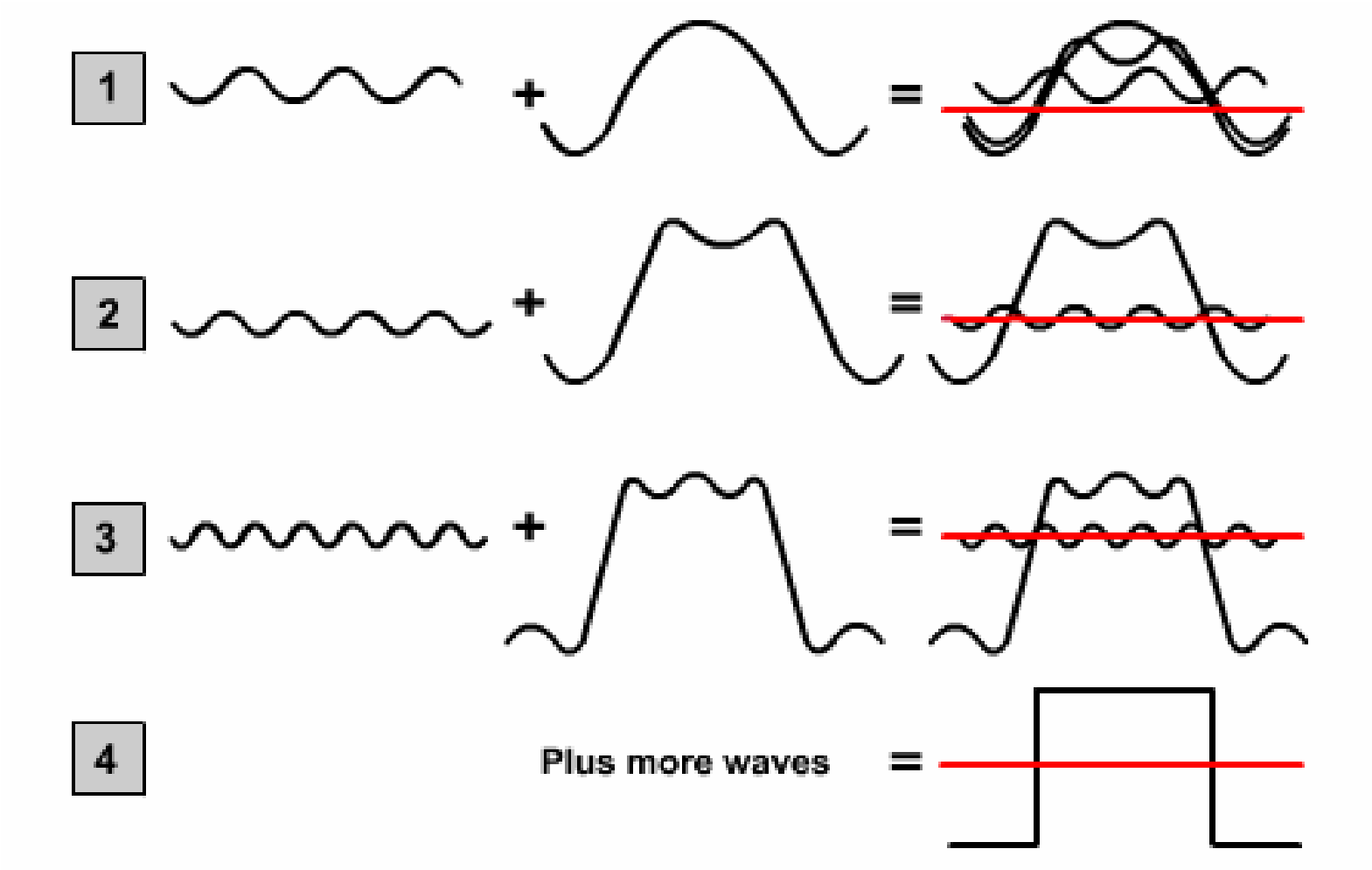
Analog and Digital Signals in Time and Frequency



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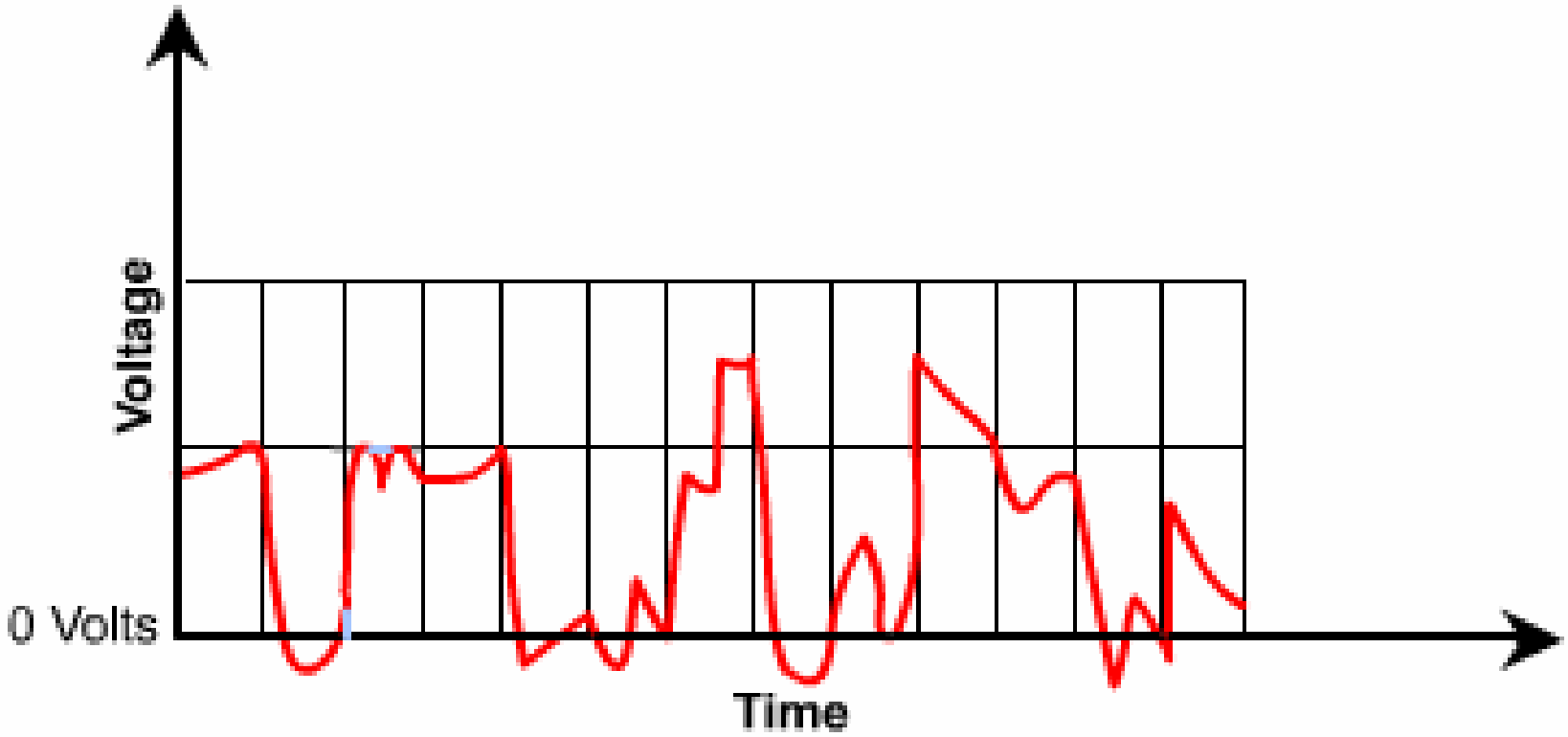
Noise in Time and Frequency



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Bandwidth

Unit of Digital Bandwidth	Abbrev.	Equivalence
Bits per second	bps	1 kbps = 1,000 bps
Kilobits per second	kbps	1 kbps = 1,000 bps
Megabits per second	Mbps	1 Mbps = 1,000,000 bps = 1,000 kbps
Gigabits per second	Gbps	1 Gbps = 1,000,000,000 bps = 1,000 Mbps

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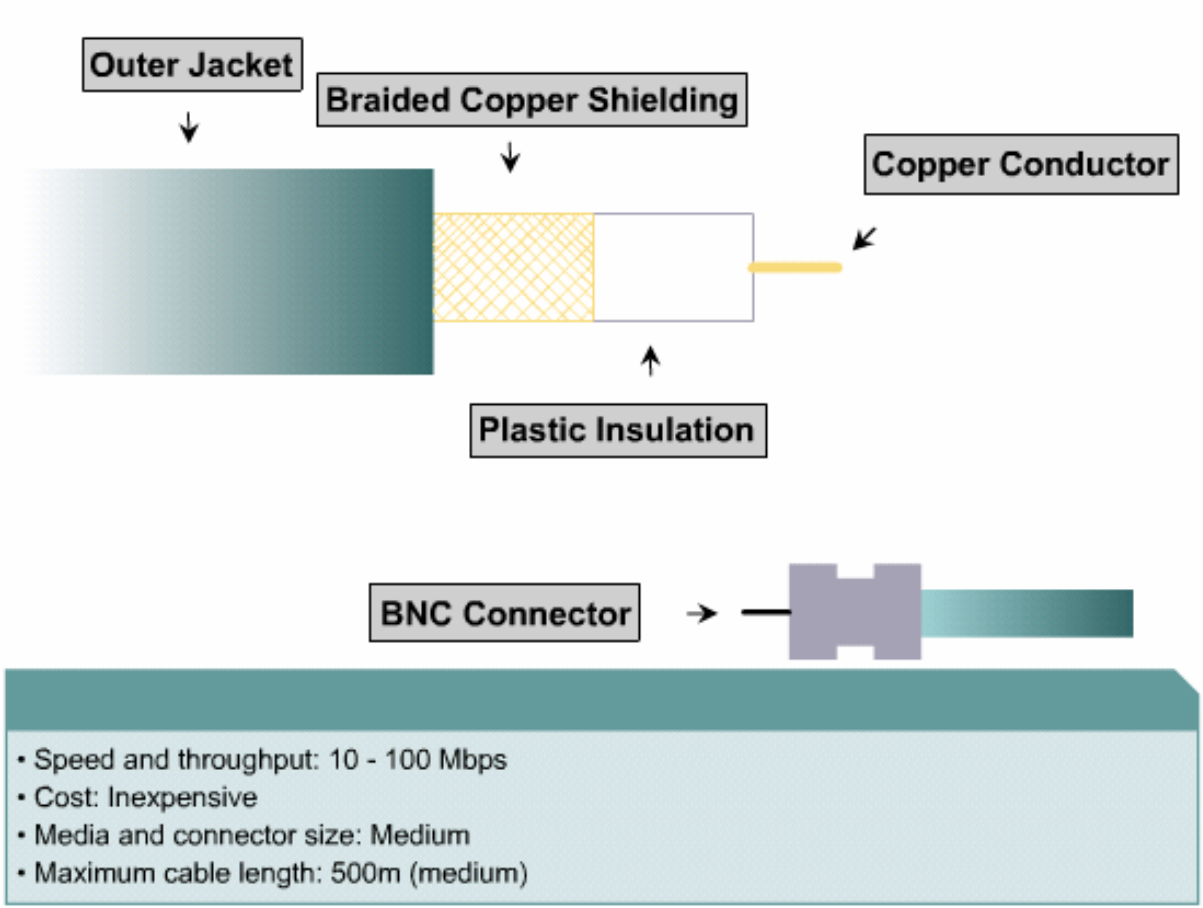
Signaling over Copper and Fiber



- Speed and throughput: 10 - 100 Mbps
- Cost: Inexpensive
- Media and connector size: Medium
- Maximum cable length: 500m (medium)

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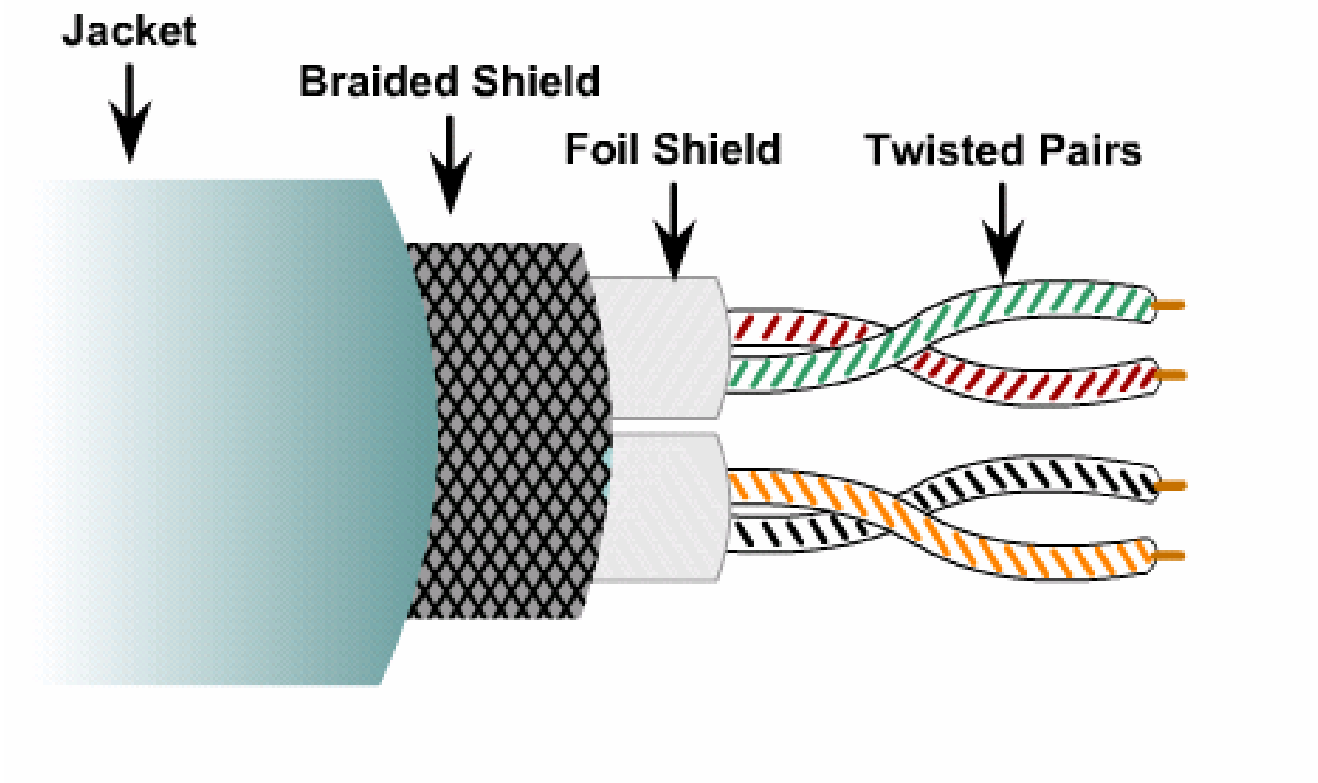
Signaling over Copper and Fiber



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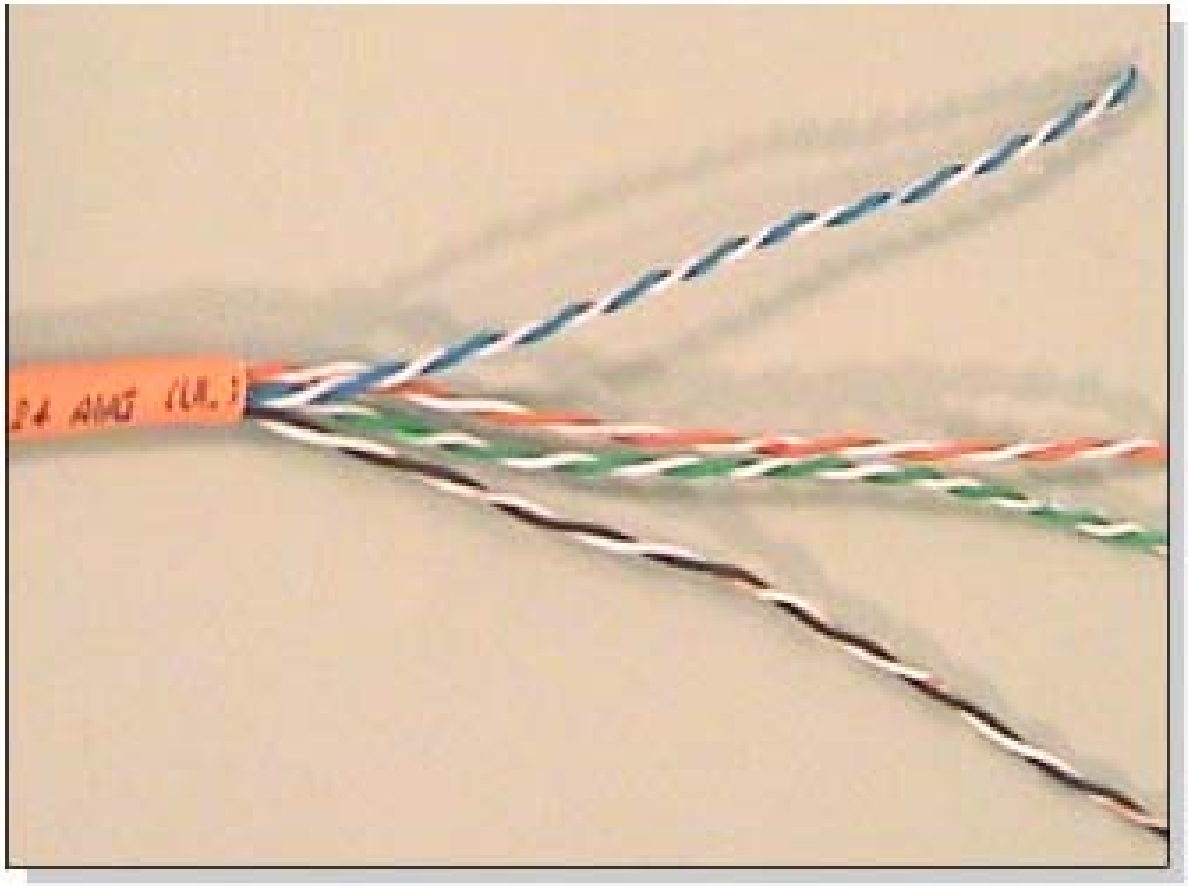
Signaling over Copper and Fiber



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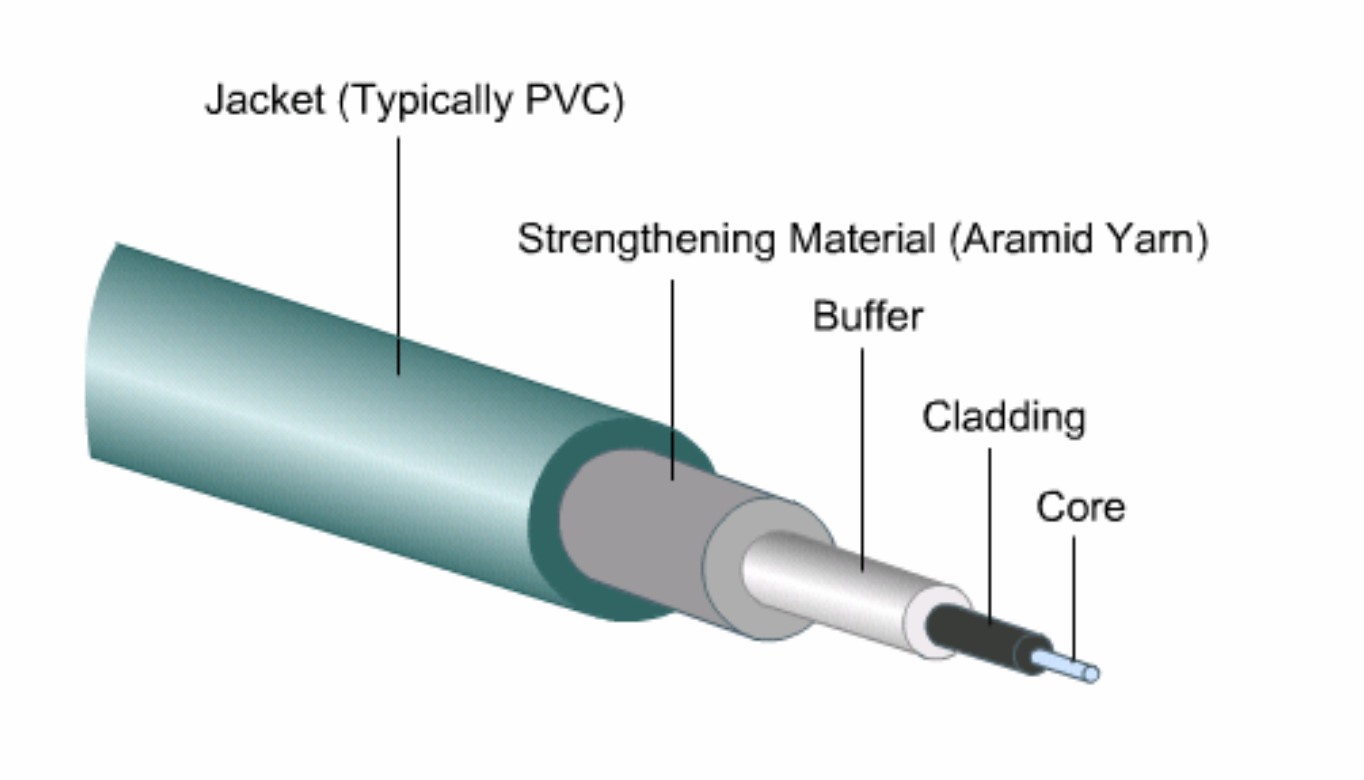
Signaling over Copper and Fiber



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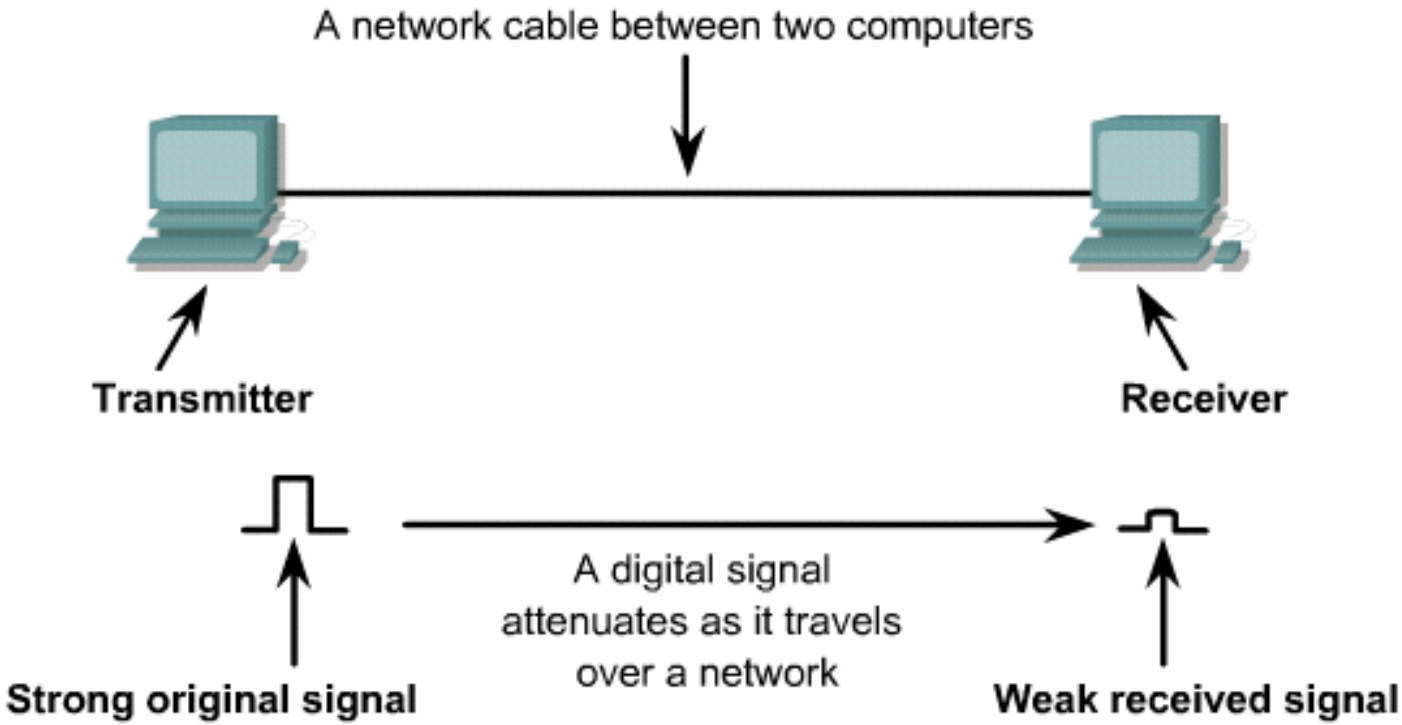
Attenuation and Insertion Loss on Copper Media



- **Attenuation is the decrease in signal amplitude over the length of a link.**
- **Attenuation is expressed in decibels (dB) using negative numbers.**
- **Smaller negative dB values are an indication of better link performance.**

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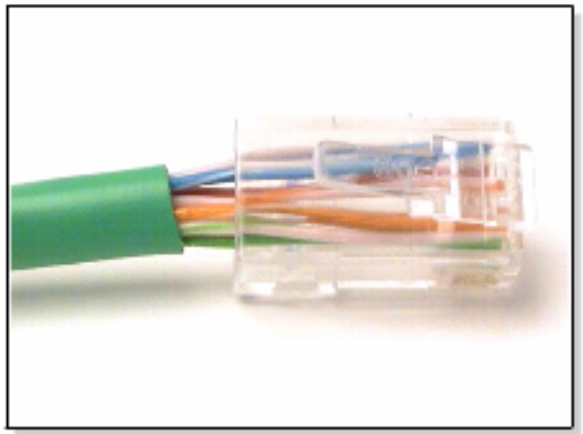
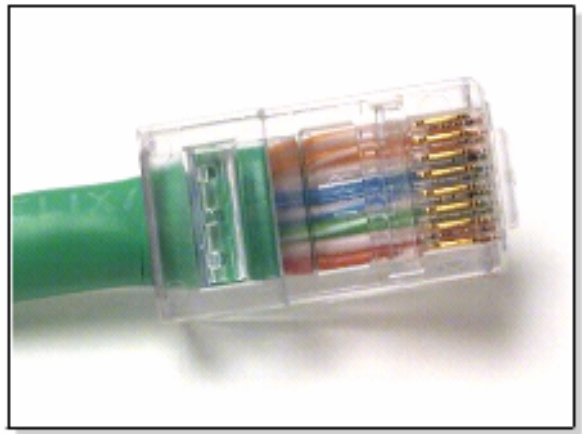
Sources of Noise on Copper Media



Bad Connector - Wires are untwisted for too great a length.



Good Connector - Wires are untwisted to the extent necessary to attach the connector.

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Noise

- Noise in communications refers to undesirable signals.
- Noise is any electrical energy on the transmission cable that makes it difficult for a receiver to interpret the data sent from the transmitter
- Noise that affects all transmission frequencies equally is called white noise.
- Noise that only affects small ranges of frequencies is called narrowband interference

Many possible sources of noise:

- Nearby cables which carry data signals
- Radio frequency interference (RFI), which is noise from other signals being transmitted nearby
- Electromagnetic interference (EMI), which is noise from nearby sources such as motors and lights
- Laser noise at the transmitter or receiver of an optical signal

Make effort to minimise noise

Interactive Media 4.1.7

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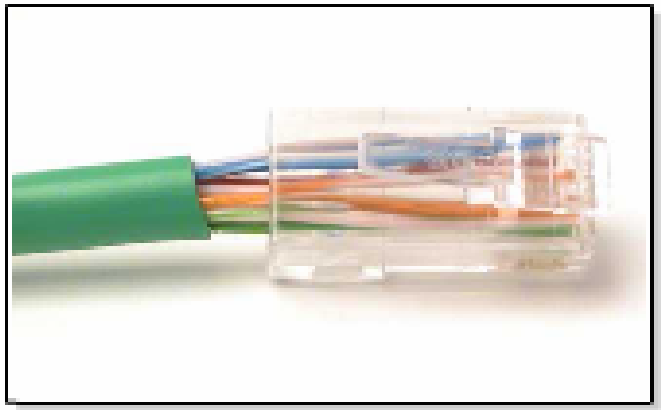
Crosstalk

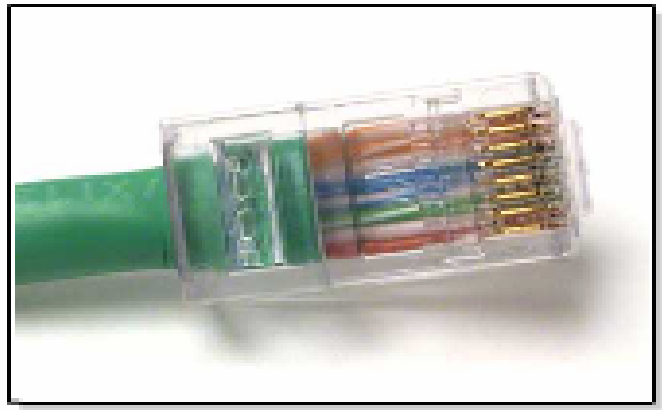
- **Crosstalk involves the transmission of signals from one wire to a nearby wire.**
- **When voltages change on a wire, electromagnetic energy is generated.**
- **This energy radiates outward from the transmitting wire like a radio signal from a transmitter.**
- **Adjacent wires in the cable act like antennas, receiving the transmitted energy, which interferes with data on those wires**

- Crosstalk is measured in four separate tests
- A cable tester measures NEXT by applying a test signal to one cable pair
- The equal-level far-end crosstalk (ELFEXT) test measures FEXT
- Power sum equal-level far-end crosstalk (PSELFEXT) is the combined effect of ELFEXT from all wire pairs

Sources of Noise on Copper Media



Bad Connector - Wires are untwisted for too great a length.



Good Connector - Wires are untwisted to the extent necessary to attach the connector.

- Twisted-pair cable is designed to take advantage of the effects of crosstalk in order to minimize noise
- Higher categories of UTP require More Twists on each wire pair in the cable to minimize crosstalk at high transmission frequencies

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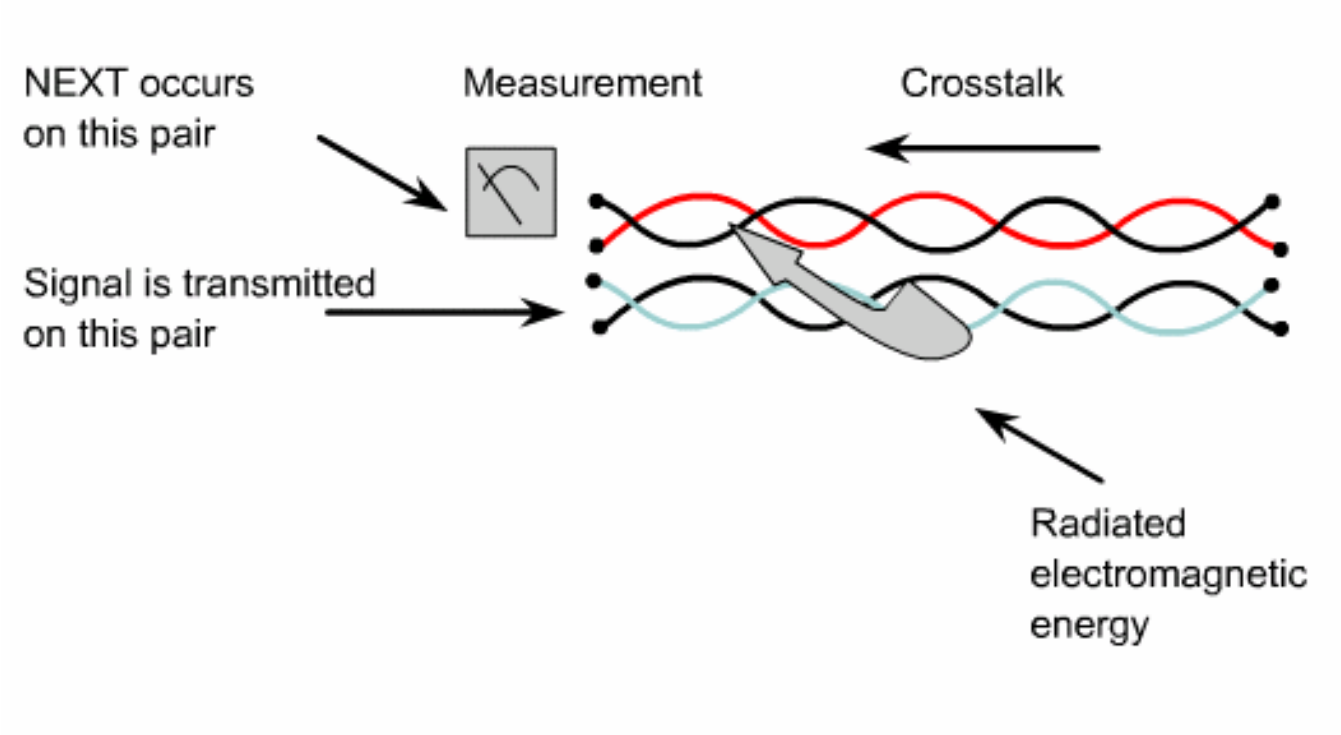
Types of Crosstalk

Near-end crosstalk (NEXT)



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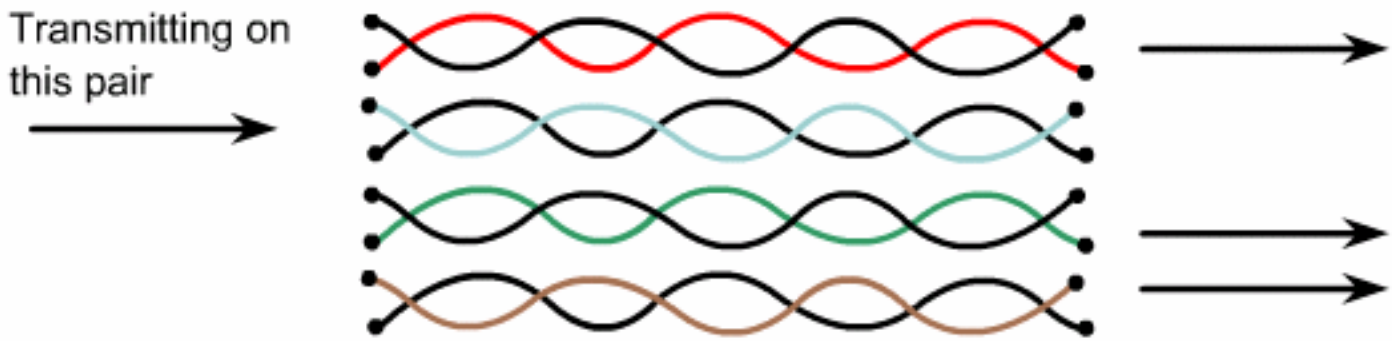
Types of Crosstalk

Far-end crosstalk (FEXT)



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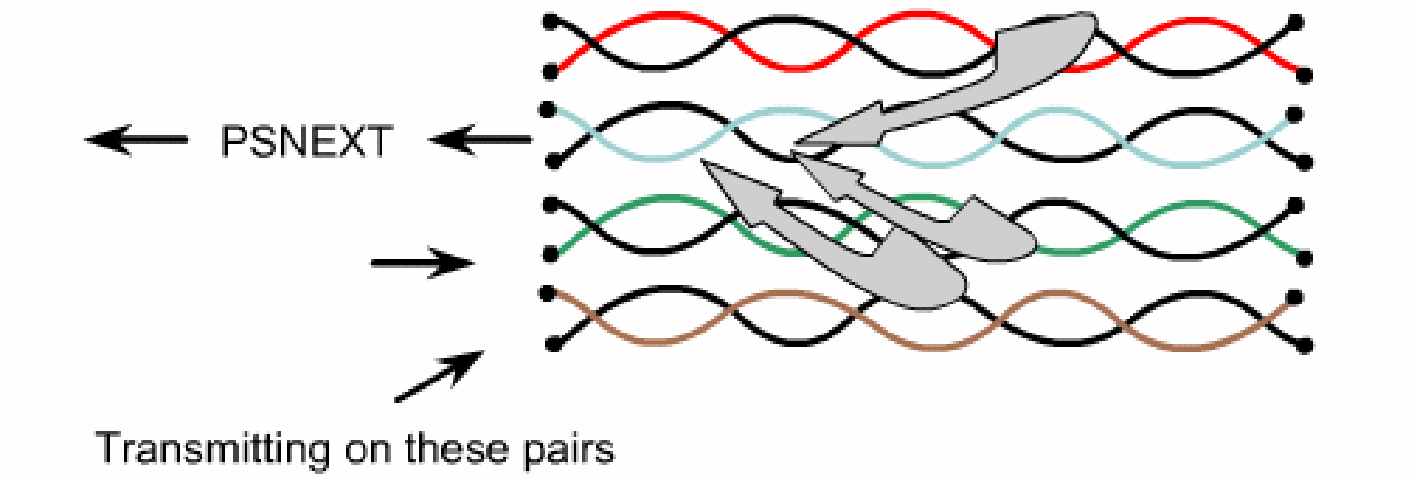
Types of Crosstalk

Power sum near-end crosstalk (PSNEXT)



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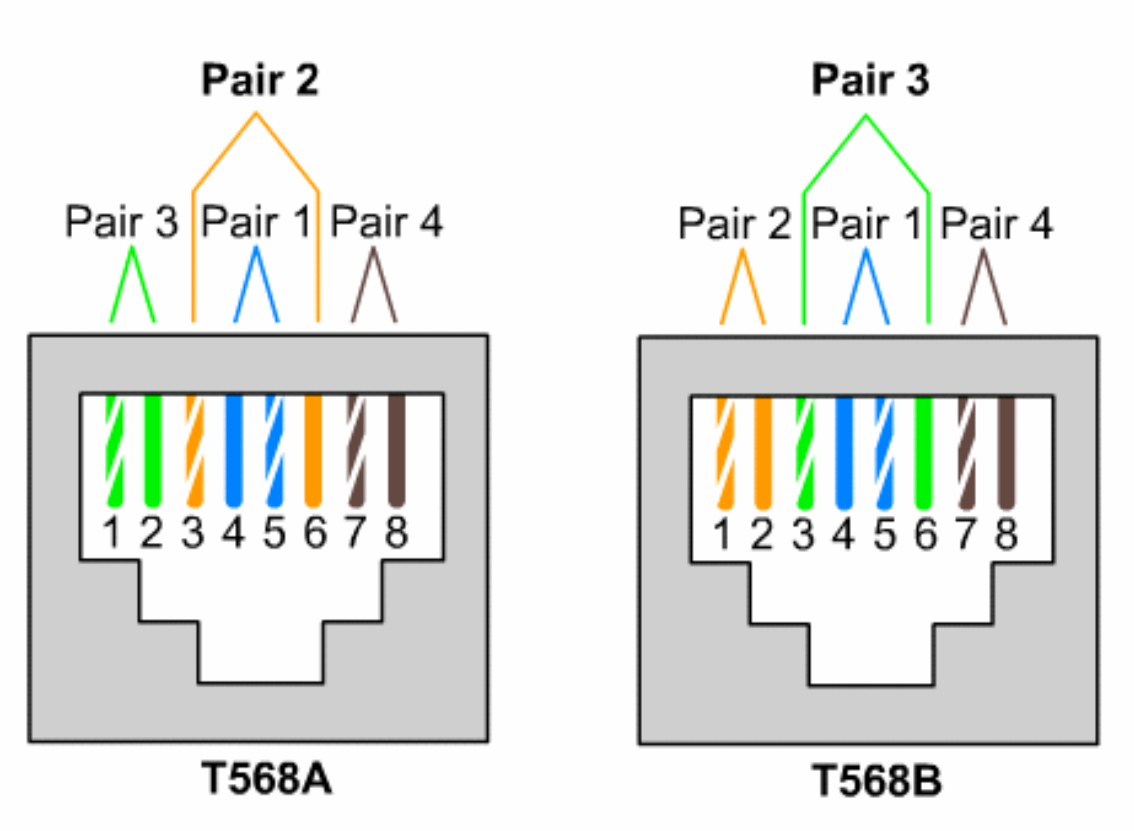
Cable Testing Standards



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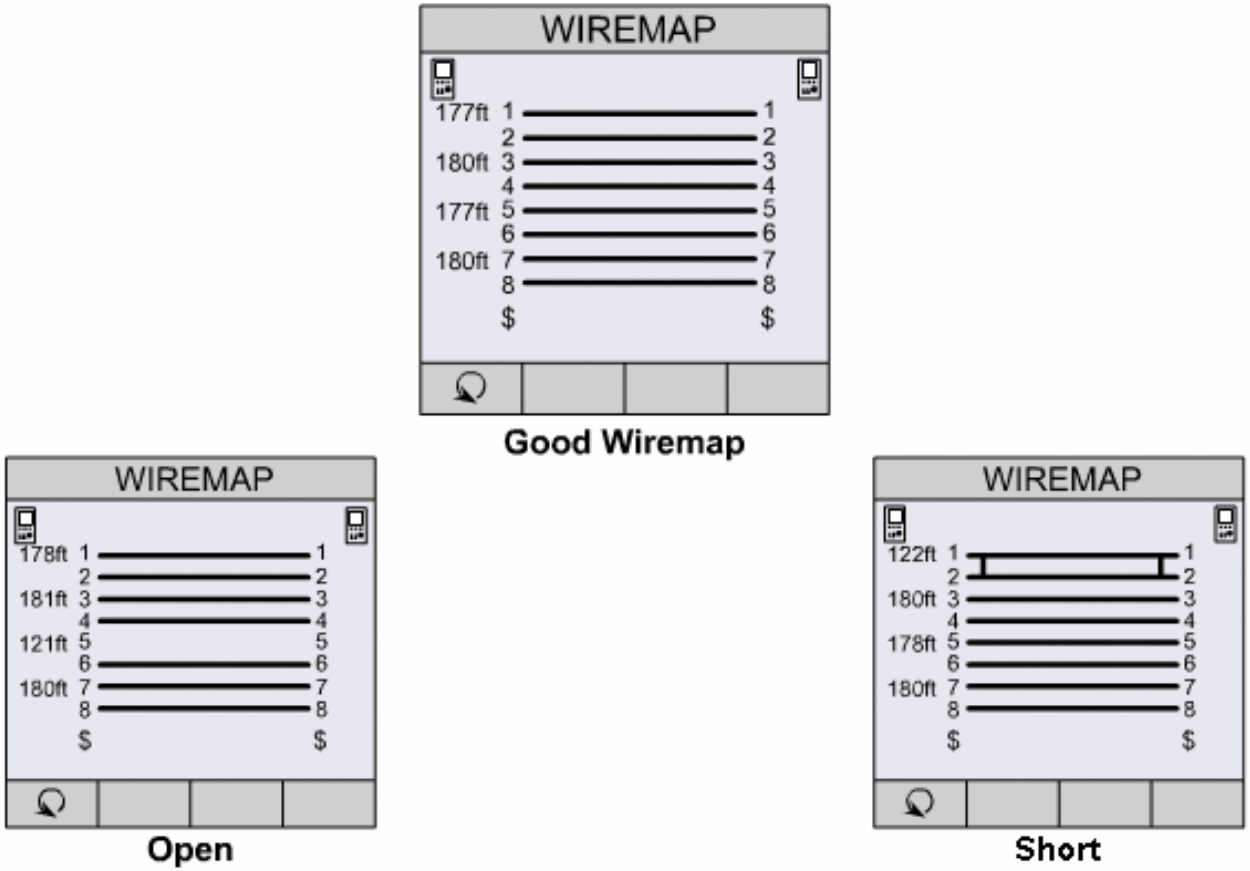
Cable Testing Standards



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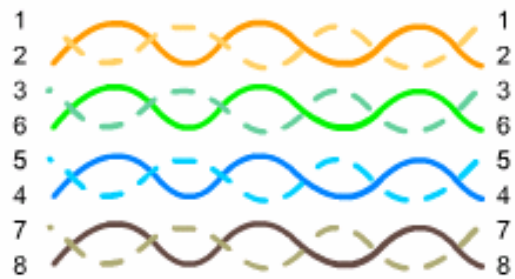
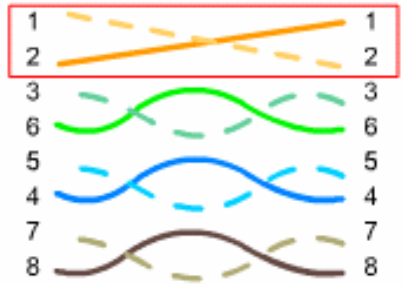
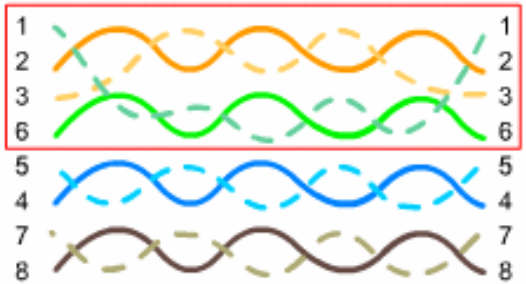
Cable Testing Standards



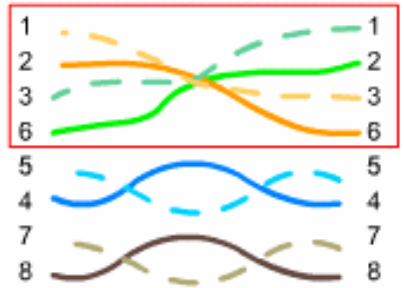
Correct T568B Wiring



Reversed-pair wiring fault



Split-pair Wiring Fault



Transposed-pair Wiring Fault

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Crosstalk

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Analog and Digital Bandwidth

- **Analog Bandwidth could be used to describe the range of frequencies transmitted by a radio station or an electronic amplifier.**
- **Units of measurement for analog bandwidth is Hertz,**

Example: Analog bandwidth value is 200 MHz for FM radio stations.

- **Digital bandwidth measures how much information can flow from one place to another in a given amount of time.**
- **Unit of measurement for digital bandwidth is bits per second (bps).**

Unit of Digital Bandwidth	Abbrev.	Equivalence
Bits per second	bps	1 bps = fundamental unit of bandwidth
Kilobits per second	kbps	1 kbps = 1,000 bps
Megabits per second	Mbps	1 Mbps = 1,000,000 bps = 1,000 kbps
Gigabits per second	Gbps	1 Gbps = 1,000,000,000 bps = 1,000 Mbps

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Time-based Parameters

- Propagation delay is a simple measurement of how long it takes for a signal to travel along the cable being tested.
- Delays are measured in the hundredths of nanoseconds.
- The TIA/EIA-568-B standard sets a limit for propagation delay for the various categories of UTP.
- The delay difference between pairs is called delay skew.

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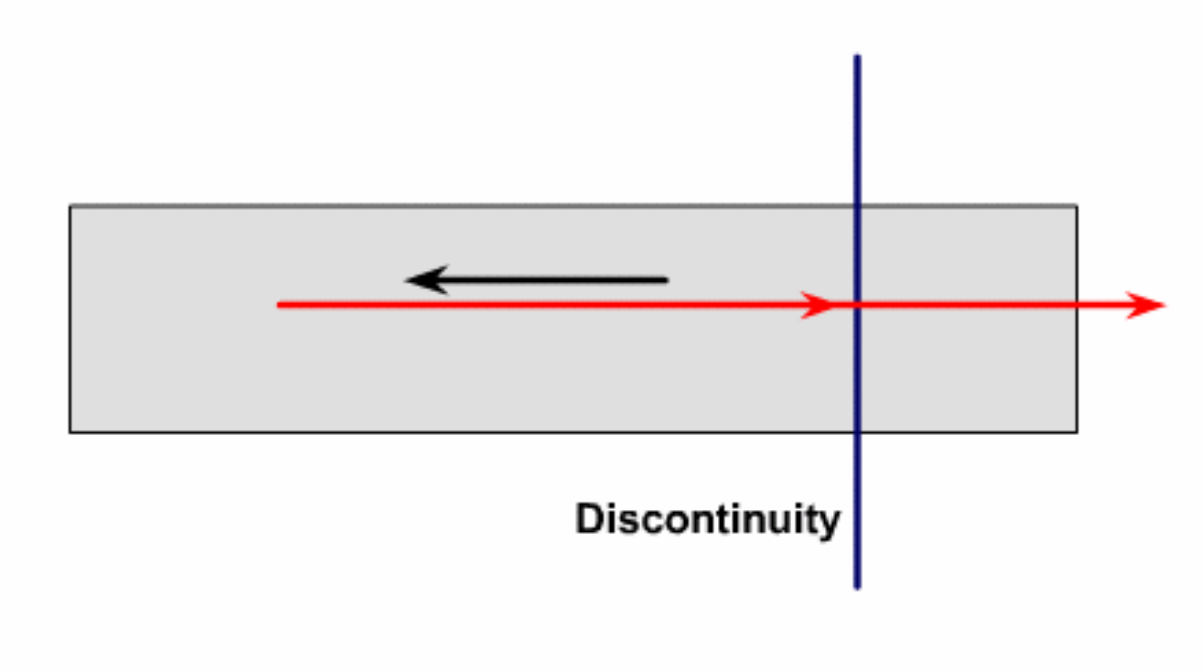
Testing Optical Fiber



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Testing Optical Fiber

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New Standard

- On June 20, 2002, the Category 6 (or Cat 6) addition to the TIA-568 standard was published.
- This new standard specifies the original set of performance parameters that need to be tested for Ethernet cabling as well as the passing scores for each of these tests.
- A quality cable tester is the Fluke DSP-LIA013 Channel/Traffic Adapter for Cat5e.

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Summary

Summary

- Cabling testing involves certain electrical and mathematical concepts and terms, such as signal, wave, frequency, and noise. Understanding those terms is helpful when learning about networking, cabling, and cable testing.
- Attenuation (signal deterioration) and noise (signal interference) cause problems in networks because the data is not recognizable when it is received. Proper attachment of cable connectors and proper cable installation are important.

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