Module 4: Build a Simple Network

Networking Essentials (NETESS)

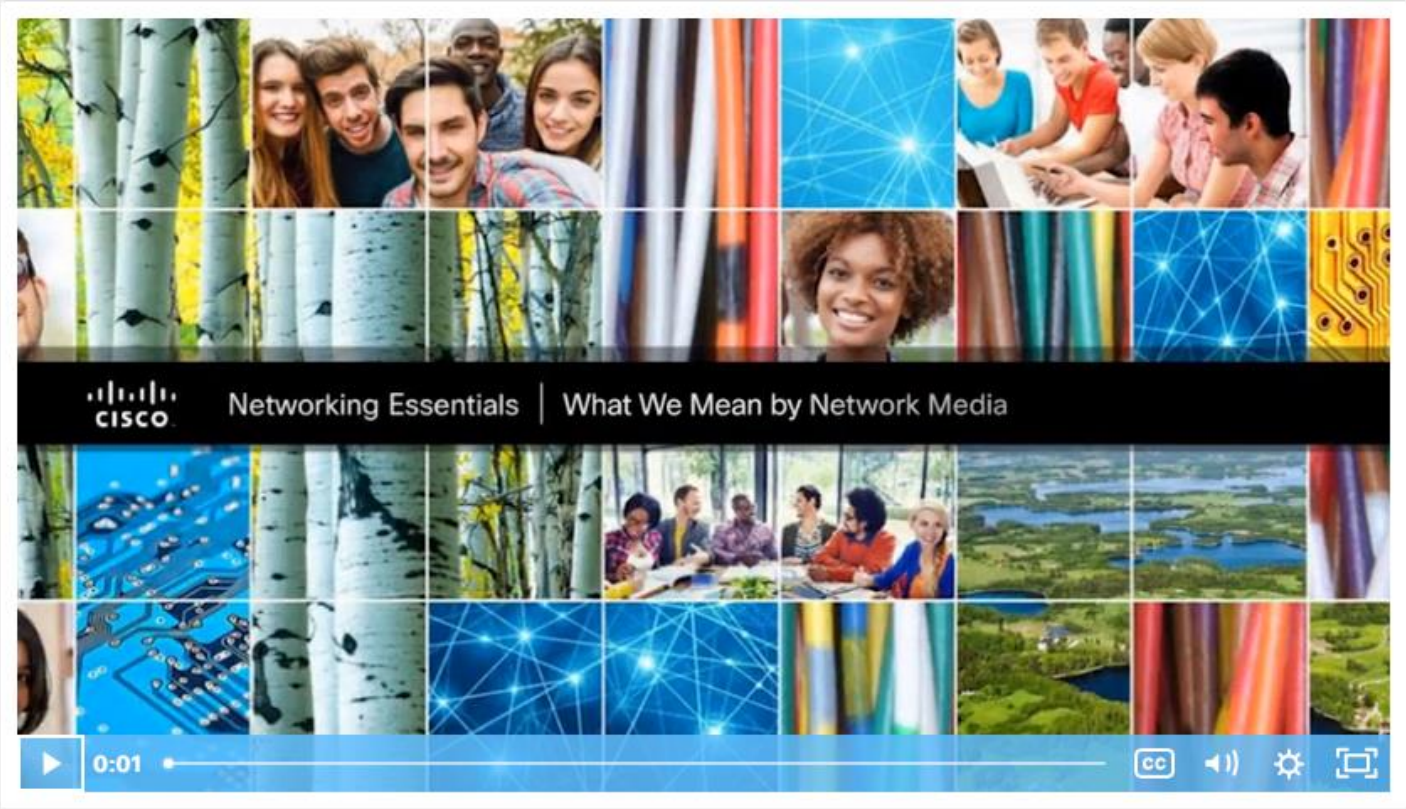
Module Objective

Module Title: Build a Simple Network
Module Objective: Build a simple home network.

Topic Title	Topic Objective
Ethernet Cabling	Describe Ethernet twisted-pair cables.
Coaxial and Fiber-Optic Cabling	Describe coaxial and fiber-optic cabling.
Twisted-Pair Operation	Explain how a twisted-pair cable transmits and receives signals.
Verify Connectivity	Verify connectivity in a simple routed network.

4.1 Network Media Types

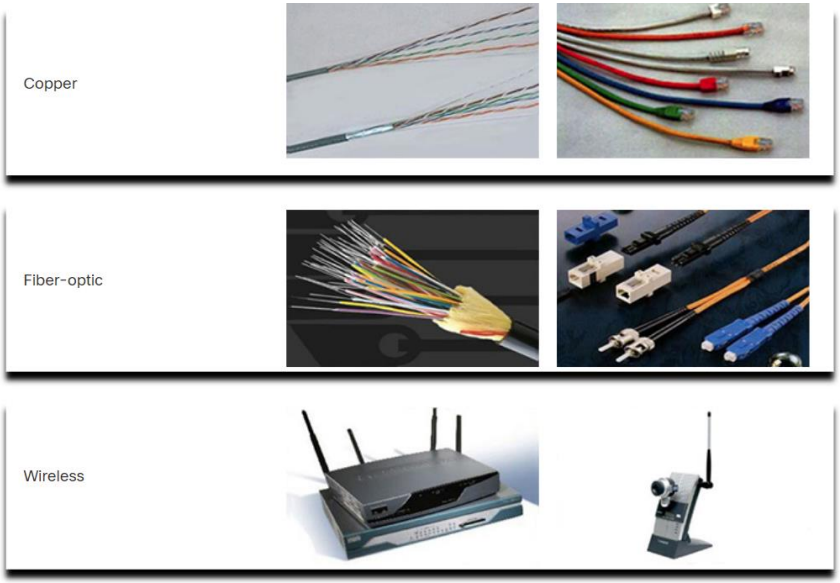
Video - Network Media Types



Three Media Types

- Communication transmits across a network on media.
- Modern networks primarily use three types of media to interconnect devices.

- **Metal wires within cables** - Data is encoded into electrical impulses.
- **Glass or plastic fibers within cables (fiber-optic cable)** - Data is encoded into pulses of light.
- **Wireless transmission** - Data is encoded via modulation of specific frequencies of electromagnetic waves.

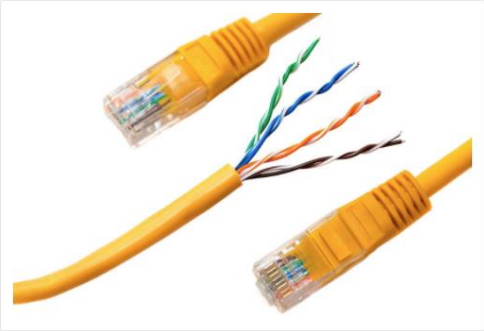


Common Network Cables

The three most common network cables are twisted-pair cable, coaxial cable, and fiber-optic cable.

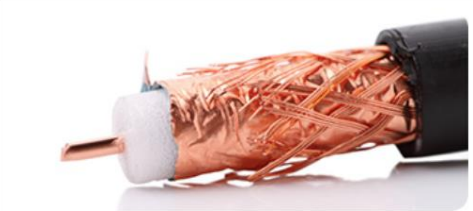
Twisted-Pair Cable

Ethernet technology generally uses twisted-pair cables to interconnect devices.



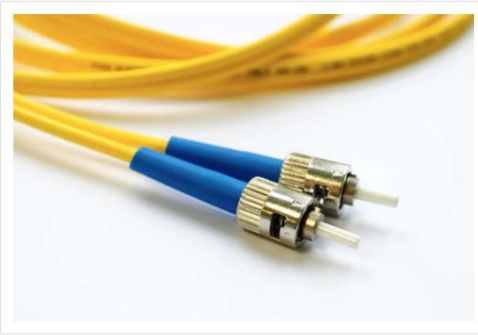
Coaxial Cable

- It was one of the earliest network cabling types developed.
- It is used as a high-frequency transmission line to carry high-frequency or broadband signals.



Fiber-Optic Cable

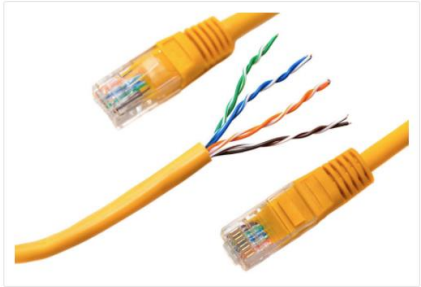
It can be either glass or plastic and it can carry digital information at very high speeds over long distances.



4.2 Ethernet Cabling

Twisted-Pair Cables

- The networks in most homes and schools are wired with twisted-pair copper cable.
- This type of cable is inexpensive and readily available.



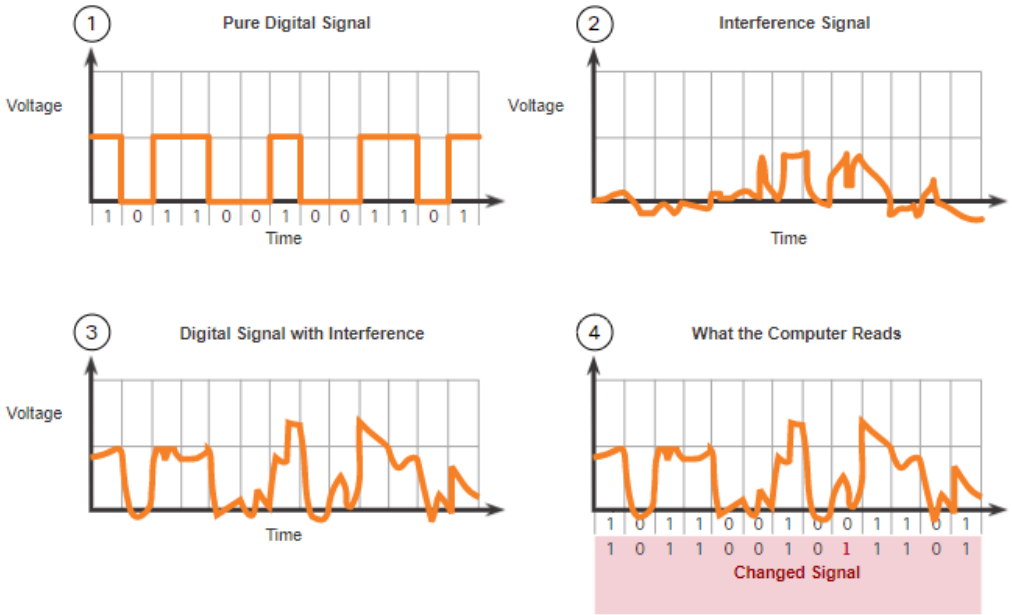
- The Ethernet patch cables are an example of copper twisted-pair cable.
- Twisted-pair cables consist of one or more pairs of insulated copper wires that are twisted together and housed in a protective jacket.

- Twisted-pair cable uses pulses of electricity to transmit data.
- Data transmission over copper cable is sensitive to electromagnetic interference (EMI).

- Another source of interference, called crosstalk, occurs when cables are bundled together for long lengths.

Twisted-Pair Cables (Cont.)

Interference can cause problems with data being transmitted on the cable.



1. A pure digital signal is transmitted.
2. On the medium, there is an interference signal.
3. The digital signal is corrupted by the interference signal.
4. The receiving computer reads a changed signal. Notice that a 0 bit is now interpreted as a 1 bit.

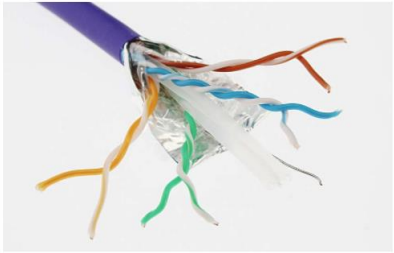
Types of Twisted-Pair Cables

There are two commonly installed types of twisted-pair cable:

- **Unshielded twisted-pair (UTP)** - This is the most common type of network cable in North America and many other areas.
- **Shielded cables (STP)** - These are used almost exclusively in European countries.

- **UTP** cables are used to connect workstations, hosts and network devices.
- Ethernet UTP cables consists of 4 pairs of twisted cables.
- Each pair is identified by a specific color code.

- **STP** cables are immune to EMI and RFI interference.
- STP cables are expensive, not as flexible, and have additional requirements because of the shielding.



Types of Twisted-Pair Cables (Cont.)

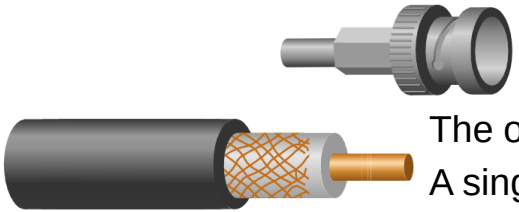
Many different categories of UTP cables have been developed to support a specific technology.

Category	Speed	Features
Cat 3 UTP	10 Mbps at 16 MHz	• Suitable for Ethernet LANs • Most often used for phone lines
Cat 5 UTP	100 Mbps at 100 MHz	• Manufactured with higher standard than Cat 3 to allow for higher data transfer rates
Cat 5e UTP	1000 Mbps at 100 MHz	• Manufactured with higher standard than Cat 5 to allow for higher data transfer rates • More twists per foot than Cat 5 to better prevent EMI and RFI from outside sources
Cat 6 UTP	1000 Mbps at 250 MHz	• Manufactured with higher standard than Cat 5e • More twists per foot than Cat 5 to better prevent EMI and RFI from outside sources
Cat 6a UTP	1000 Mbps at 500 MHz	
Cat 7 ScTP	10 Gbps at 600 MHz	

4.3 Coaxial and Fiber-Optic Cabling

Cable TV and Satellite Cables

- Coaxial cable (or coax) carries data in the form of electrical signals.
- It provides improved shielding compared to UTP and can therefore carry more data.
- It is used by cable television companies to provide service and for connecting the various components that make up satellite communication systems.
- With the addition of a cable modem, the cable television provider can offer data and internet service, as well as television signals and telephone over the same coaxial cable to customers.



Usually terminated with a BNC or F-series connector

The outer jacket is an insulator to protect against EMI and RFI

A single center conductor is copper or aluminum

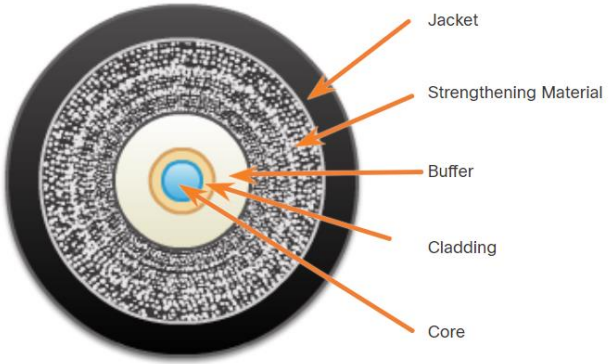
A metallic braid helps to shield against EMI and RFI

Fiber-Optic Cables

- Fiber-optic cables transmit data using pulses of light.
- Fiber-optic cable is constructed of either glass or plastic and it is immune to EMI and RFI.

Parts of a fiber-optical cable are:

- **Jacket** - typically a PVC jacket that protects the fiber against abrasion, moisture, and other contaminants.
- **Strengthening Material** - Surrounds the buffer, prevents the fiber cable from being stretched when it is being pulled
- **Buffer** - Used to help shield the core and cladding from damage.
- **Cladding** - Made from slightly different chemicals than those used to create the core. It tends to act like a mirror.
- **Core** - The light transmission element at the center of the optical fiber. Light pulses travel through the fiber core.

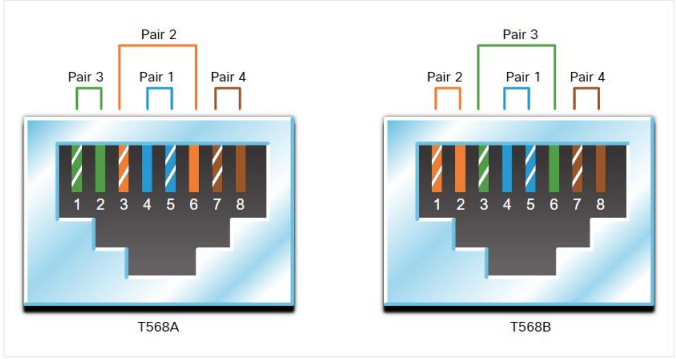


4.4 Twisted-Pair Operation

Twisted-Pair Wiring Schemes

- The color coding of the wire pairs in an UTP cable is determined by the type of standard that is used to make the cable.
- Different standards have different purposes and are closely governed by the standards organizations.

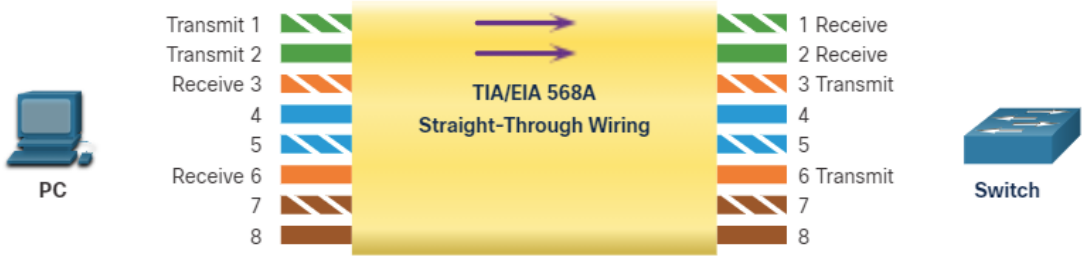
  - There are two standards that are widely implemented for typical Ethernet installations.
  - The TIA/EIA organization defines two different patterns, or wiring schemes, called T568A and T568B.
  - Each wiring scheme defines the pinout, or order of wire connections, on the end of the cable.
  - One of the two wiring schemes (T568A or T568B) should be chosen for a network installation.
  - It is important that the same wiring scheme is used for every termination in that project.



Twisted-Pair Transmit and Receive Pairs

- Ethernet NICs and the ports on networking devices are designed to send data over UTP cables.
- Specific pins on the connector are associated with a transmit function and a receive function.
- The interfaces on each device are designed to transmit and receive data on designated wires within the cable.

- When two **unlike devices** are directly connected using an UTP Ethernet cable, it is important that the transmit function and the receive function on each end of the cable are reversed.
  - This cable is called straight-through cable and it has the same color patterns on both ends of the cable.



4.5 Verify Connectivity

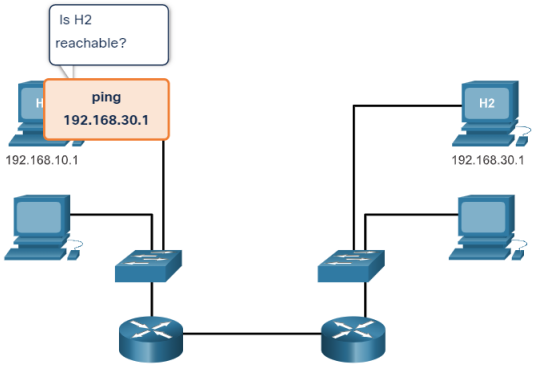
Video - The ping Command

Using the ping Command

- A host that sends messages across the internet must have an IP address to identify it to the other devices in the network.
- The **ping** utility can be used to test end-to-end connectivity between the IP address of the sending host and the IP address of the destination host.
- It measures the time that it takes test messages to make a round trip from the source to the destination, and whether the transmission is successful.
- However, if the test message does not reach the destination, or if delays are encountered along the way, **ping** cannot determine where the problem is located.

The format of the ping command is ping x.x.x.x, where x.x.x.x is an IP address or domain name of the destination host:

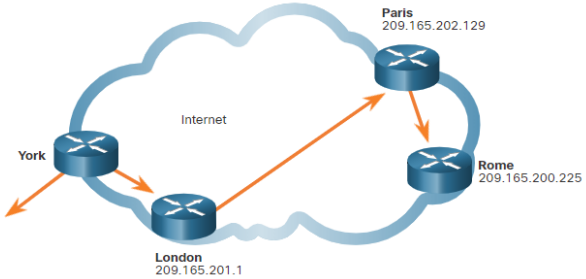
For example, **ping 192.168.30.1**, **ping www.cisco.com**, etc.



The traceroute Command

- The **traceroute** utility traces the route a message takes from its source to the destination.
- Each individual network through which the message travels is referred to as a hop.
- The **traceroute** command displays each hop along the way and the time it takes for the message to get to that network and back.

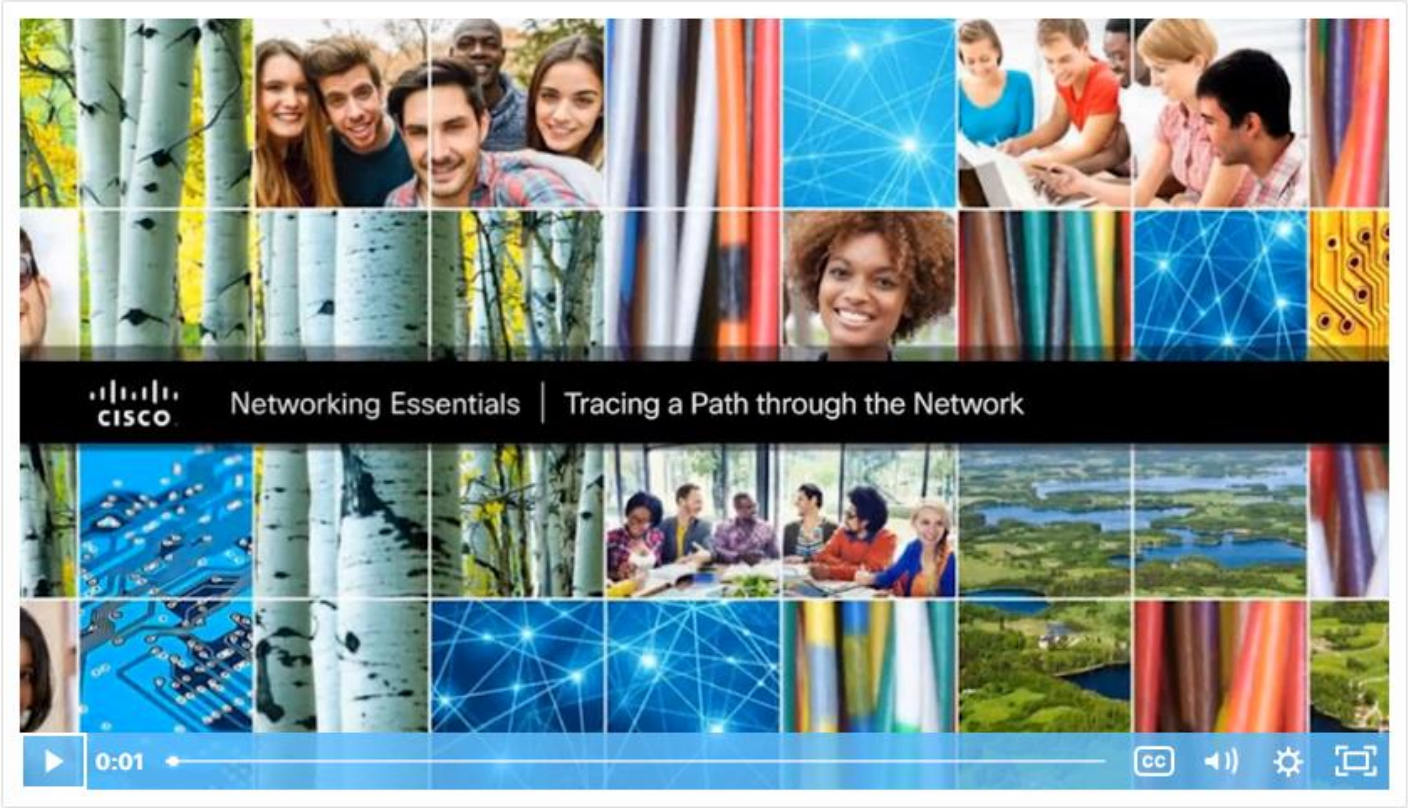
- If a problem occurs, the output of the traceroute utility can help determine where a message was lost or delayed.
- The traceroute utility is called **tracert** in the Windows environment.



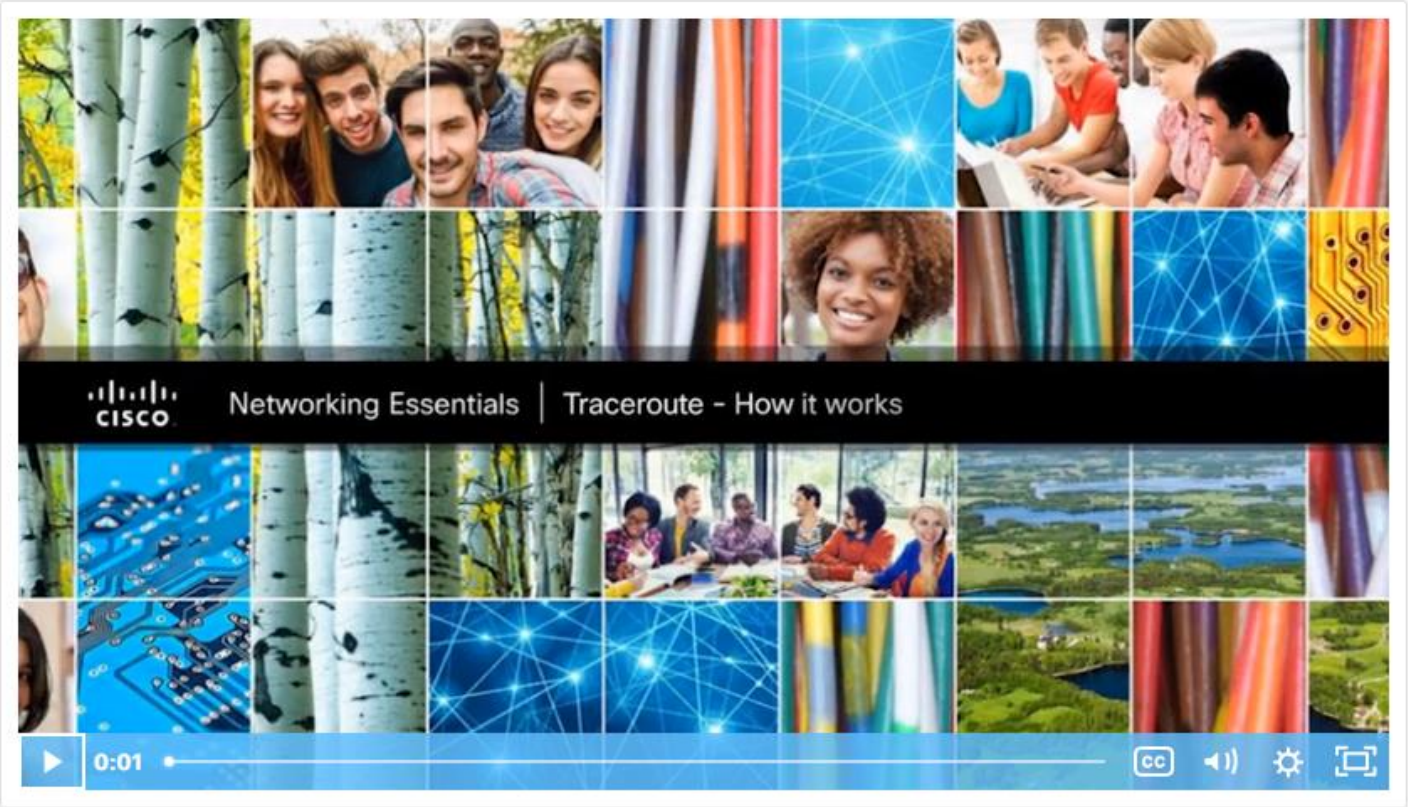

```
York# traceroute ROME

Type escape to abort.
Tracing the route to Rome (209.165.200.225)

1. LONDON (209.165.201.1) 8msec 8 msec 4 msec
2. PARIS (209.165.202.129) 8 msec 8 msec 8 msec
3. ROME (209.165.200.225) 8msec 8 msec 4 msec
York#
```

Video - Build a Network in Packet Tracer

Video - Trace a Path through the Network



Video - Traceroute Operation



Lab - Build a Simple Network

In this lab, you will complete the following objectives:

- Identify cables and ports for use in the network.
- Cable a physical lab topology.
- Enter static IP address information on the LAN interface of the hosts.
- Verify that PCs can communicate using the ping utility.

Lab - Trace a Route

In this lab, you will complete the following objectives:

- Test network connectivity using **ping**.
- Trace a route to a remote server using Windows **tracert**.
- Trace a route to a remote server using web-based tools and software tools.
- Compare traceroute results.

4.6 Build a Simple Network Summary

What Did I Learn in this Module?

- Modern networks primarily use three types of media to interconnect devices and to provide the pathway data communications: copper wires within cables, glass or plastic fibers (fiber-optic cable), and wireless transmission.
- Twisted-pair is the most common network cable. The wires are grouped in pairs and twisted together to reduce interference.
- Data transmission over copper cable is sensitive to EMI and RFI, which can reduce the data throughput rate that a cable can provide.
- Two types of twisted-pair cable are UTP and STP.
- Fiber-optic cables transmit data using pulses of light. Fiber-optic cable is constructed of either glass or plastic, it is immune to EMI and RFI.
- Fiber-optic cables provides high bandwidth of data transmission over long distance.
- Two standards for Ethernet cable wiring scheme are T568A and T568B developed by TIA/EIA.
- Straight-through cables, or patch cables, are used to connect between two unlike devices.
- Crossover cables, are used to connect between two like devices.
- The ping utility tests end-to-end connectivity between two IP hosts.
- The traceroute utility traces the route a message takes from its source to the destination.

Module 4 - Build a Simple Network

New Terms and Commands

- copper cable
- coaxial cable
- fiber-optical cable
- twisted-pair cable
- UTP cable
- STP cable
- UTP cable category
- RJ-11 connector
- RJ-45 connector
- twisted-pair wiring scheme
- TIA/EIA
- T568A
- T568B
- straight-through cable
- patch cable
- crossover cable
- like devices
- unlike devices
- ping utility
- traceroute utility
- tracert command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