

# **Intro to Computer Networks**

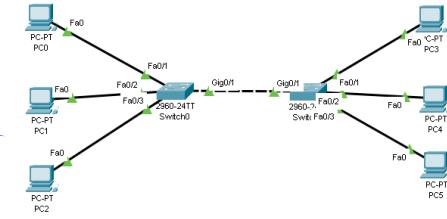
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**Naryn, 3:26 pm, August 22, 2022**

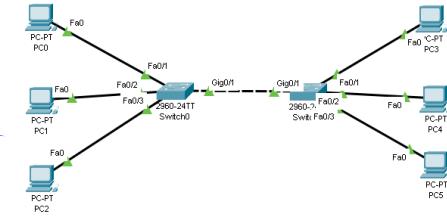


# Intro to Computer Networks



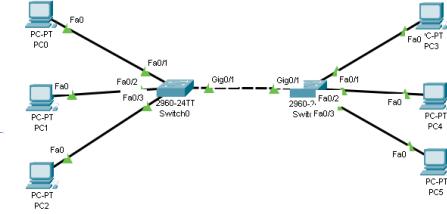
- A **computer network** is a set of computers sharing resources located on or provided by network nodes.
- The computers use **common communication protocols** over digital interconnections to communicate with each other. These interconnections are made up of telecommunication network technologies, based on physically wired, optical, and wireless radio-frequency methods that may be arranged in a variety of network topologies.

# Intro to Computer Networks



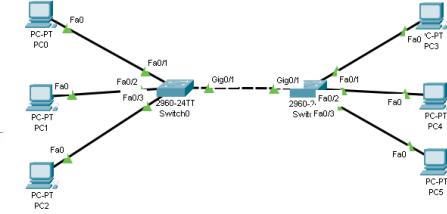
- The **nodes** of a computer network can include personal computers, servers, networking hardware, or other specialized or general-purpose hosts. They are identified by network addresses and may have hostnames. Hostnames serve as memorable labels for the nodes, rarely changed after initial assignment. Network addresses serve for locating and identifying the nodes by communication protocols such as the Internet Protocol.

# Intro to Computer Networks



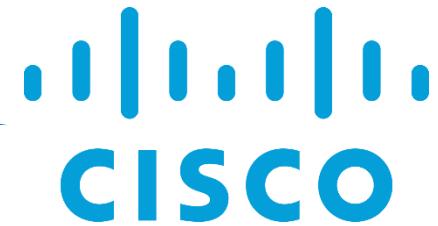
- Computer networks **may be classified** by many criteria, including the transmission medium used to carry signals, bandwidth, communications protocols to organize network traffic, the network size, the topology, traffic control mechanism, and organizational intent.

# Intro to Computer Networks



- Computer networks support **many applications** and services, such as access to the World Wide Web, digital video, digital audio, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications.

# Intro to Computer Networks

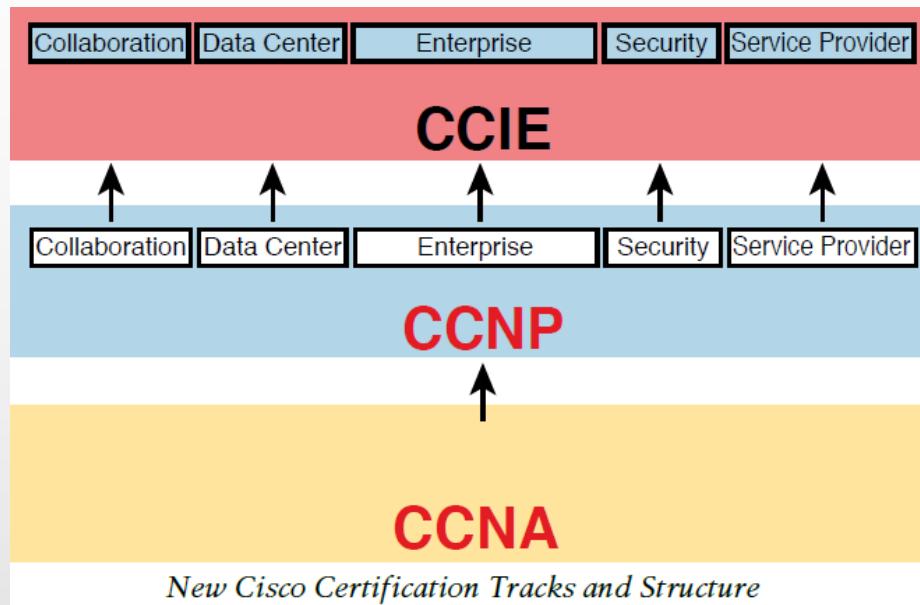
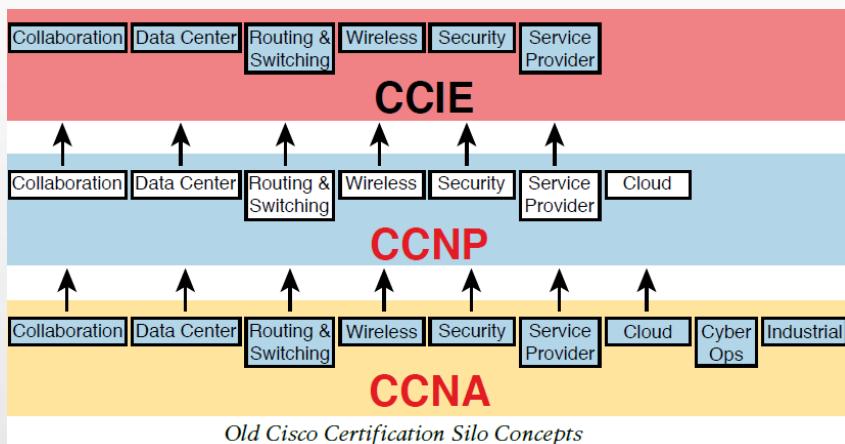


- **Cisco** is an American-based multinational technology conglomerate corporation headquartered in San Jose, California. Integral to the growth of Silicon Valley, Cisco develops, manufactures, and sells networking hardware, software, telecommunications equipment and other high-technology services and products. Cisco specializes in specific tech markets, such as the IoT, domain security, videoconferencing, and energy management with leading products including Webex, OpenDNS, Jabber, Duo Security, and Jasper.



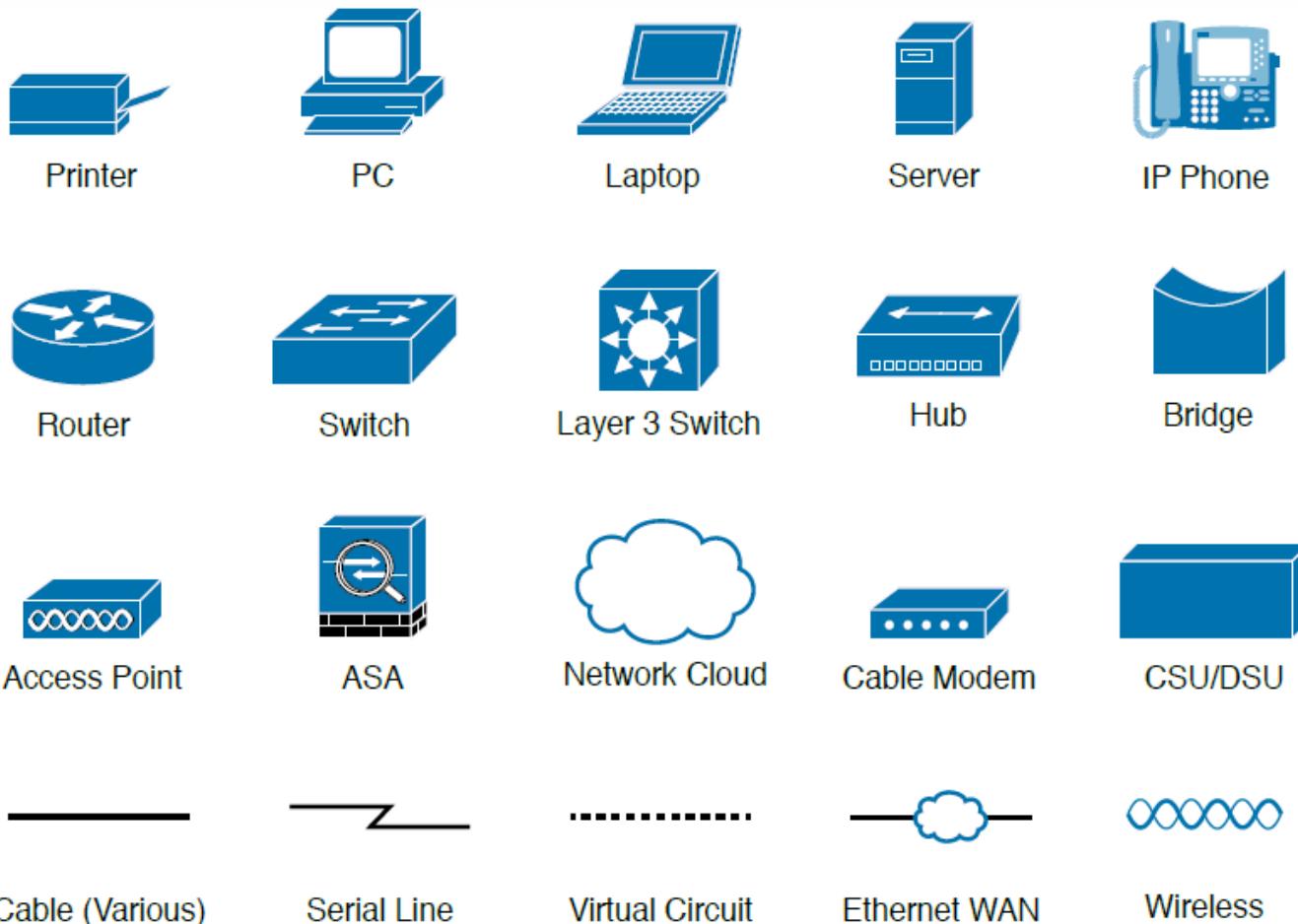
# Intro to Computer Networks

- **CCNA** (Cisco Certified Network Associate) is an IT certification from Cisco Systems. CCNA certification is an associate-level Cisco Career certification.
- **200-301 CCNA** exam tests your knowledge and skills related to network fundamentals, network access, security fundamentals, automation and programmability.



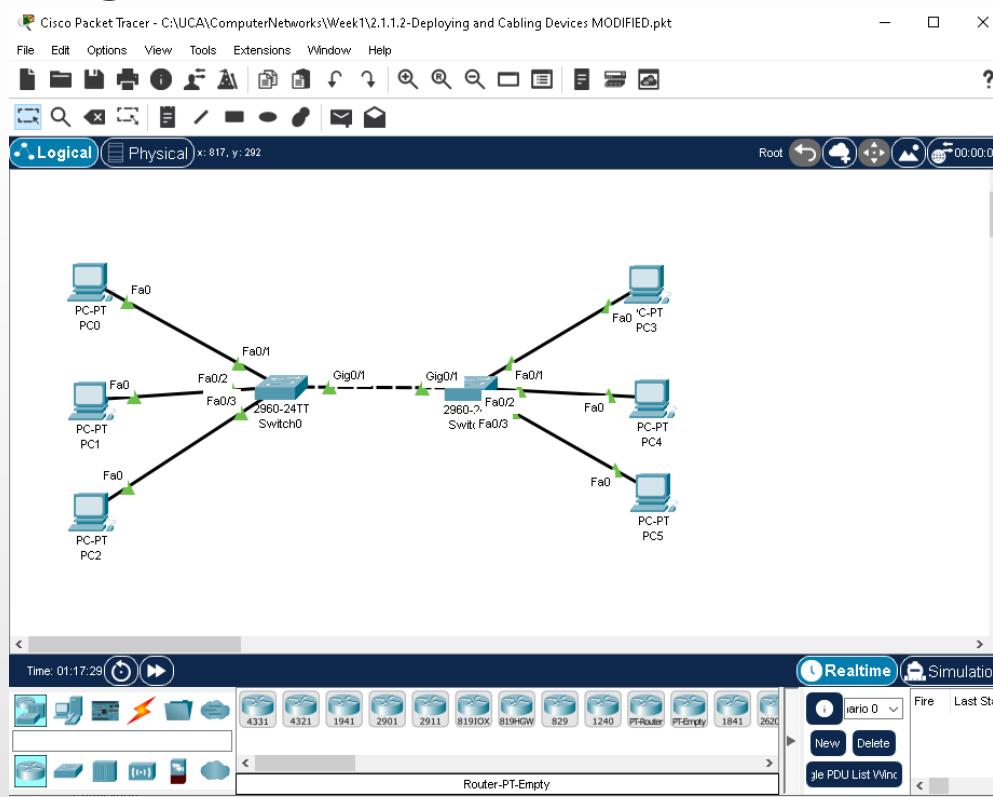
# Intro to Computer Networks

- Icons used in this course



# What we gonna use for practical work?

- **Packet Tracer** is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks.



# Outline of the course

- Intro to Computer Networks
- Basic Switch and End Device Configuration
- Protocols and Models
- Physical Layer
- Data Link Layer
- Ethernet Switching
- Network Layer
- Address Resolution
- Basic Router Configuration
- IPv4 Addressing
- IPv6 Addressing
- Internet Control Message Protocol (ICMP)
- Transport Layer
- Application Layer

**Other ideas ? :)**



# What we gonna discuss today?

- Outline of the course
- Syllabus
- Network Components
- Network Representations and Topologies
- Common Types of Networks
- Internet Connections
- Reliable Networks
- Network Trends
- Network Security



# References



- Course materials in Moodle and Ms Teams
- Wendell Odom. CCNA 200-301. Cisco Press, 2020

# Syllabus

- Syllabus
- Tutorials
  - work in groups up to 3 students
  - report: [Packet Tracer files] + written document OR 5-minute video
- Attendance: all time-slots, self-check in Moodle first 5 minutes



# Why do I need to study computer networks?

- Why do I need to study computer networks?
  - final year project
  - future career
  - personal interests
  - other motivation - ?

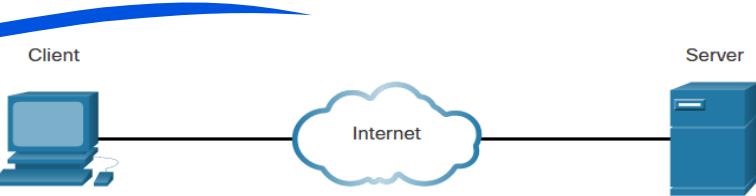


# Networking Today - No Boundaries

- World without boundaries
- Global communities
- Human network



# Network Components



- **Host Roles**

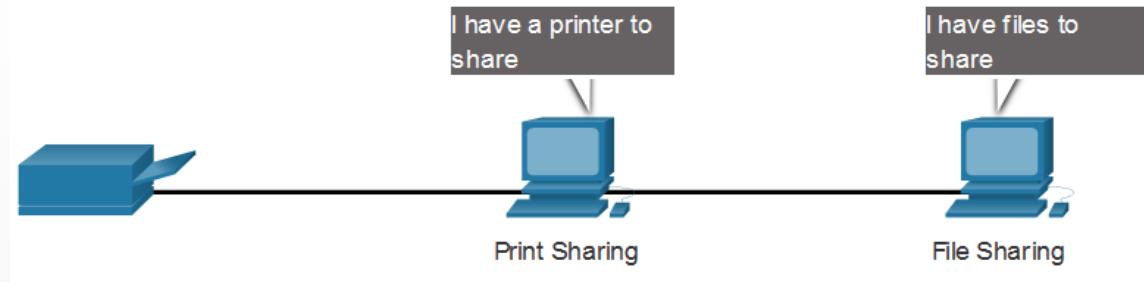
- Every computer on a network is called a host or end device.
- Servers are computers that provide information to end devices:
  - email servers
  - web servers
  - file server
- Clients are computers that send requests to the servers to retrieve information:
  - web page from a web server
  - email from an email server

Server Type	Description
Email	Email server runs email server software. Clients use client software to access email.
Web	Web server runs web server software. Clients use browser software to access web pages.
File	File server stores corporate and user files. The client devices access these files.

# Network Components

- Peer-to-Peer

- It is possible to have a device be a client and a server in a Peer-to-Peer Network. This type of network design is only recommended for very small networks.

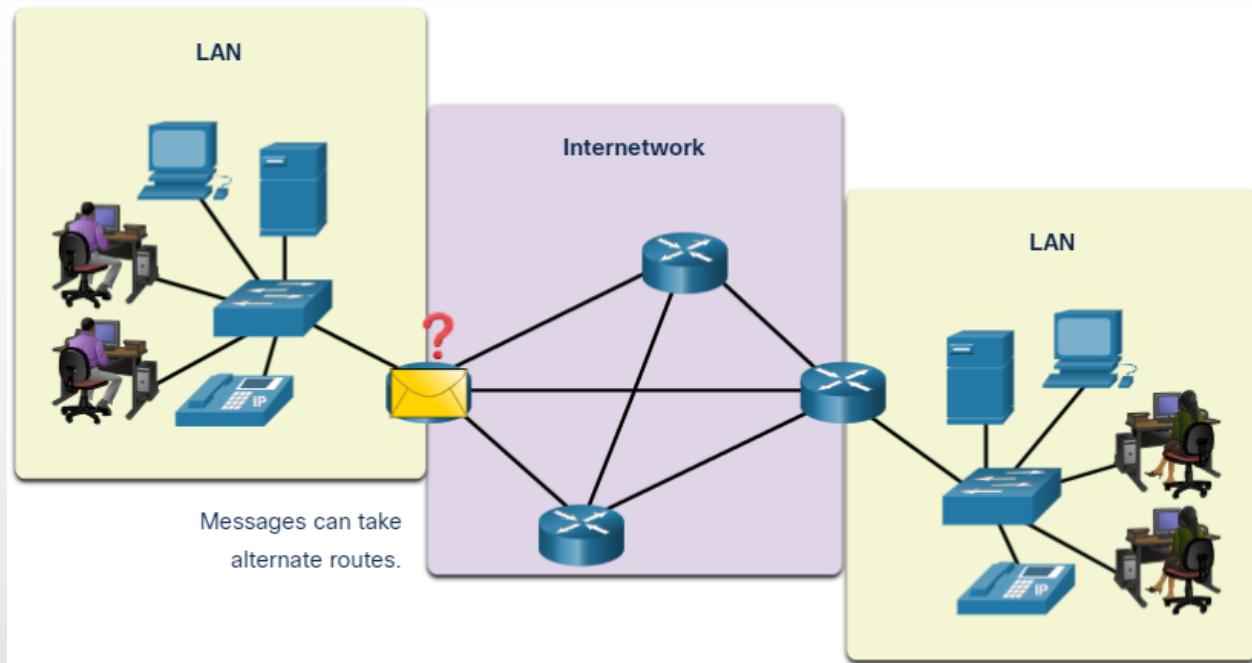


Advantages	Disadvantages
Easy to set up	No centralized administration
Less complex	Not as secure
Lower cost	Not scalable
Used for simple tasks: transferring files and sharing printers	Slower performance

# Network Components

- End Devices

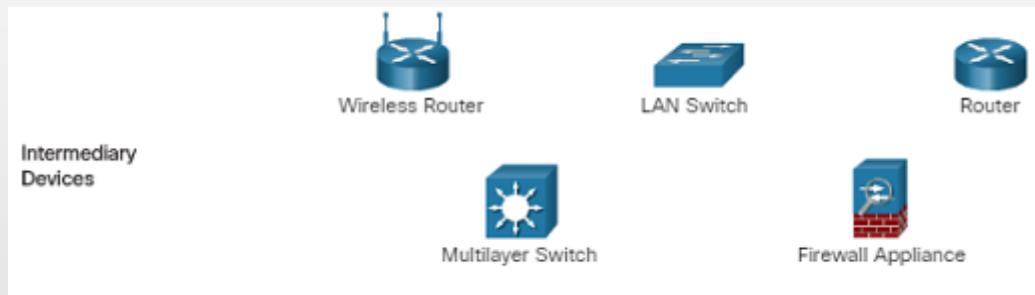
- An end device is where a message originates from or where it is received. Data originates with an end device, flows through the network, and arrives at an end device (laptops, servers, smartphones, etc.).



# Network Components

- **Intermediary Network Devices**

- An intermediary device interconnects end devices. Examples include switches, wireless access points, routers, and firewalls.
- Management of data as it flows through a network is also the role of an intermediary device, including:
  - Regenerate and retransmit data signals
  - Maintain information about what pathways exist in the network
  - Notify other devices of errors and communication failures

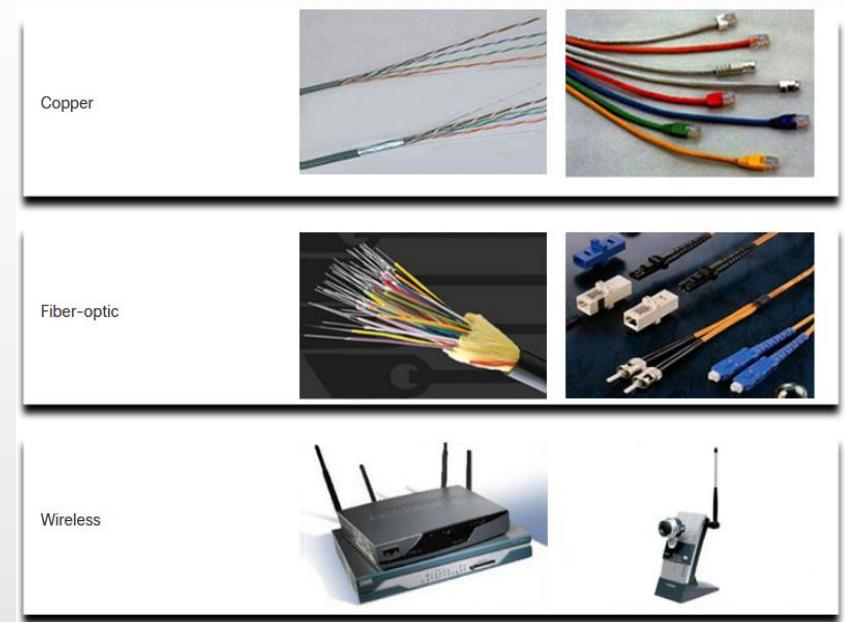


# Network Components

- Network Media

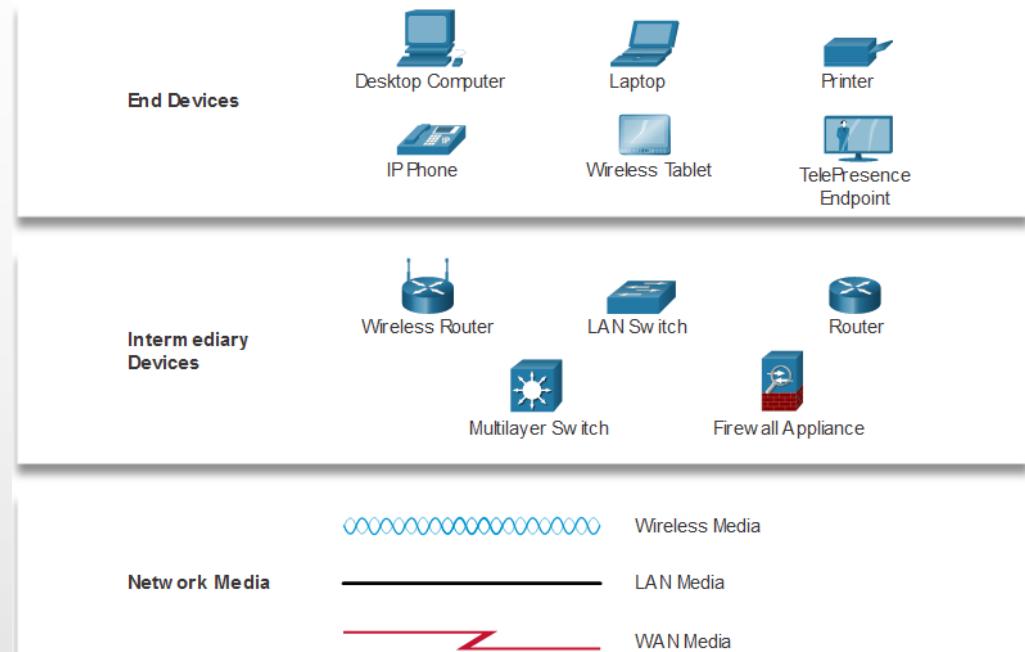
- Communication across a network is carried through a medium which allows a message to travel from source to destination

Media Types	Description
Metal wires within cables	Uses electrical impulses
Glass or plastic fibers within cables (fiber-optic cable)	Uses pulses of light.
Wireless transmission	Uses modulation of specific frequencies of electromagnetic waves.



# Network Representations and Topologies

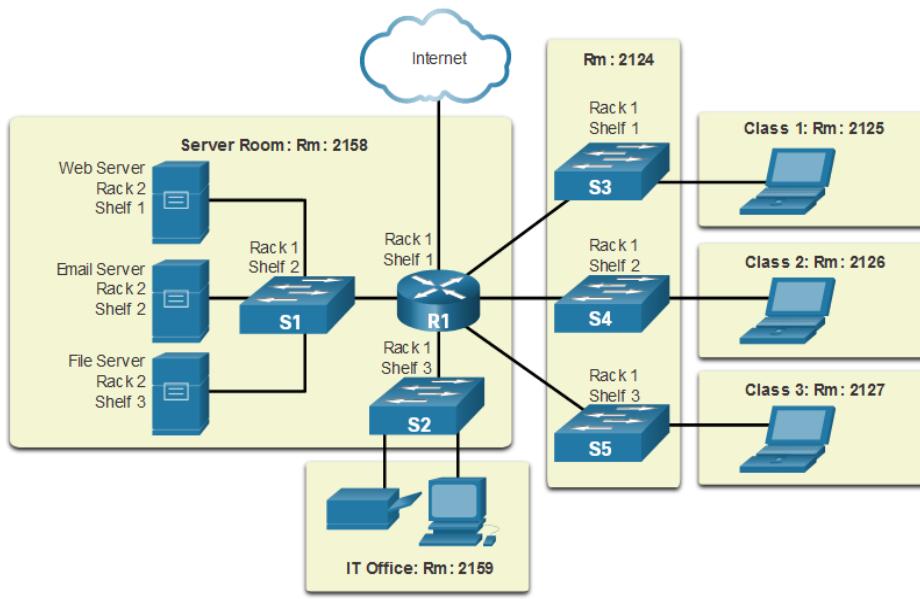
- Network diagrams, often called topology diagrams, use symbols to represent devices within the network
- Important terms to know include:
  - Network Interface Card (NIC)
  - Physical Port
  - Interface
- Often, the terms port and interface are used interchangeably



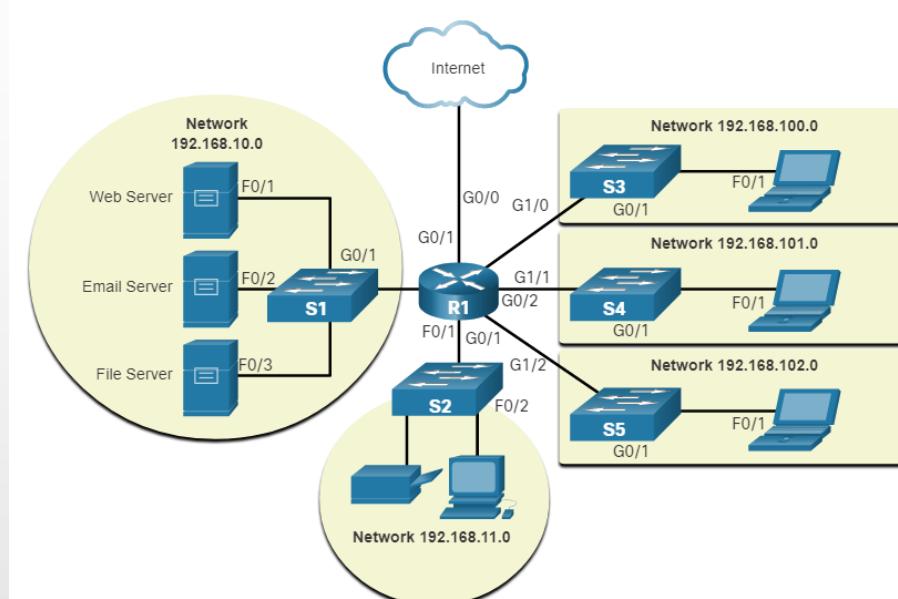
# Network Representations and Topologies

- Topology Diagrams

Physical topology diagrams illustrate the physical location of intermediary devices and cable installation.



Logical topology diagrams illustrate devices, ports, and the addressing scheme of the network.



# Common Types of Networks

- Networks of Many Sizes



Small Home



SOHO



Medium/Large



World Wide

- Small Home Networks – connect a few computers to each other and the Internet
- Small Office/Home Office – enables computer within a home or remote office to connect to a corporate network
- Medium to Large Networks – many locations with hundreds or thousands of interconnected computers
- World Wide Networks – connects hundreds of millions of computers world-wide – such as the internet

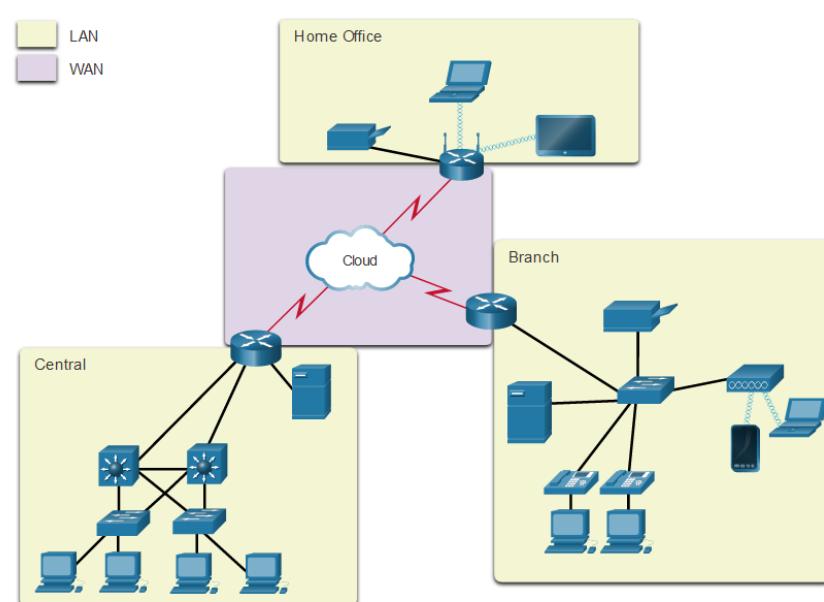
# Common Types of Networks

- LANs and WANs

- Network infrastructures vary greatly in terms of:
  - Size of the area covered
  - Number of users connected
  - Number and types of services available
  - Area of responsibility

- Two most common types of networks:

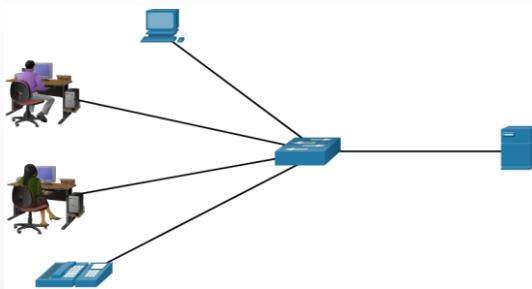
- Local Area Network (LAN)
- Wide Area Network (WAN)



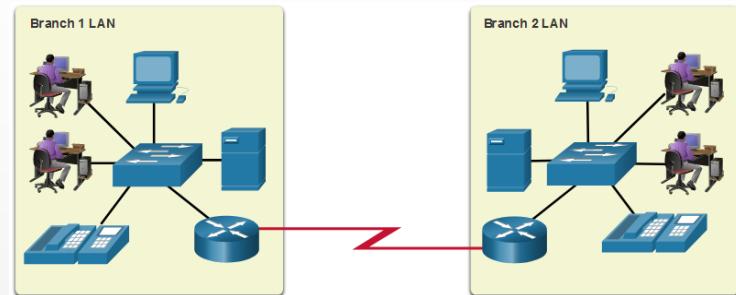
# Common Types of Networks

- LANs and WANs (cont.)

A LAN is a network infrastructure that spans a small geographical area.



A WAN is a network infrastructure that spans a wide geographical area.



LAN	WAN
Interconnect end devices in a limited area.	Interconnect LANs over wide geographical areas.
Administered by a single organization or individual.	Typically administered by one or more service providers.
Provide high-speed bandwidth to internal devices.	Typically provide slower speed links between LANs.

# Common Types of Networks

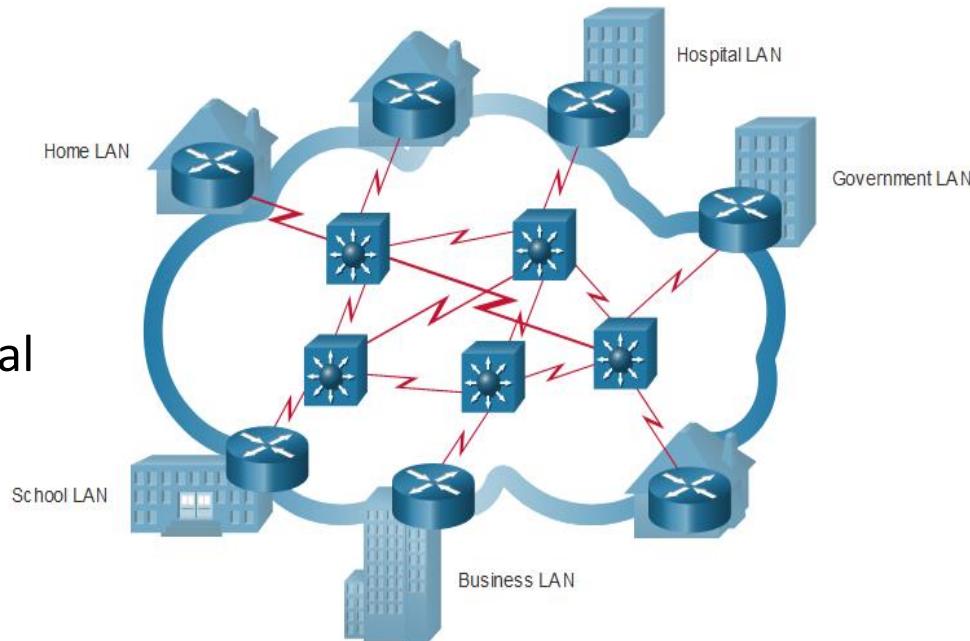
## • The Internet

The internet is a worldwide collection of interconnected LANs and WANs.

- LANs are connected to each other using WANs.
- WANs may use copper wires, fiber optic cables, and wireless transmissions.

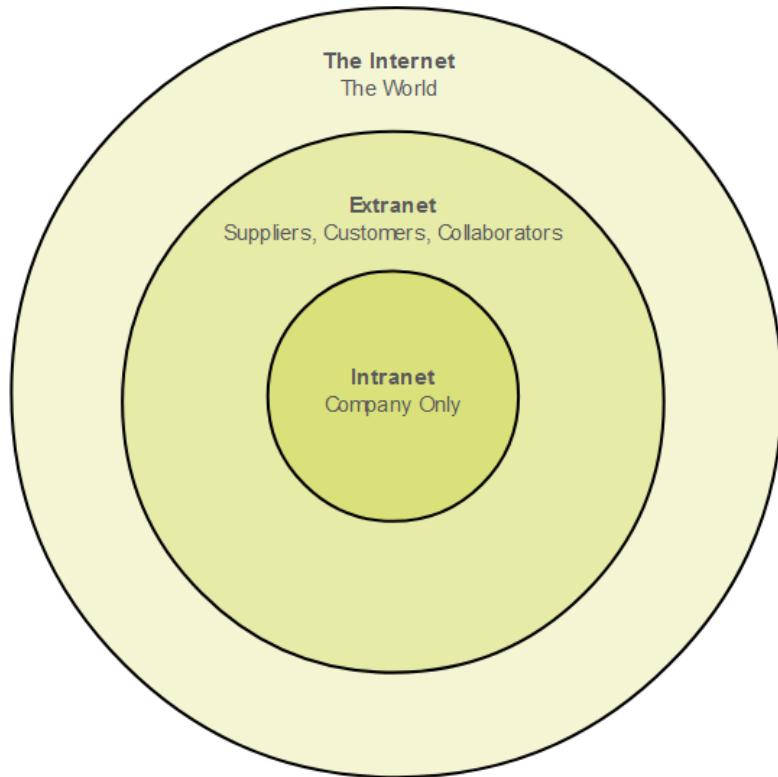
The internet is not owned by any individual or group. The following groups were developed to help maintain structure on the internet:

- IETF
- ICANN
- IAB



# Common Types of Networks

- Intranets and Extranets



- An **Intranet** is a private collection of LANs and WANs internal to an organization that is meant to be accessible only to the organization's members or others with authorization.
- An organization might use an **Extranet** to provide secure access to their network for individuals who work for a different organization that need access to their data on their network.

# Internet Connections

## • Internet Access Technologies

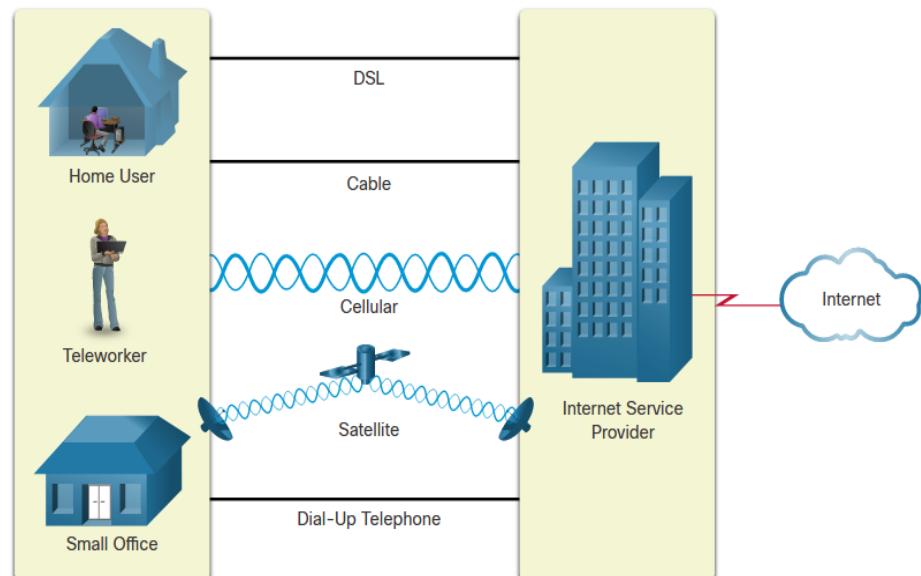
There are many ways to connect users and organizations to the internet:

- Popular services for home users and small offices include broadband cable, broadband digital subscriber line (DSL), wireless WANs, and mobile services.
- Organizations need faster connections to support IP phones, video conferencing and data center storage.
- Business-class interconnections are usually provided by service providers (SP) and may include: business DSL, leased lines, and Metro Ethernet.



# Internet Connections

- Home and Small Office Internet Connections



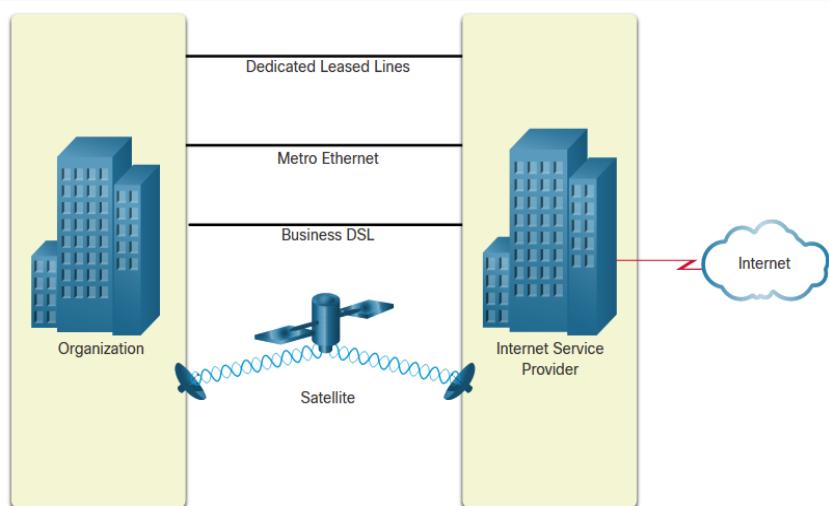
Connection	Description
Cable	high bandwidth, always on, internet offered by cable television service providers.
DSL	high bandwidth, always on, internet connection that runs over a telephone line.
Cellular	uses a cell phone network to connect to the internet.
Satellite	major benefit to rural areas without Internet Service Providers.
Dial-up telephone	an inexpensive, low bandwidth option using a modem.

# Internet Connections

## • Businesses Internet Connections

Corporate business connections may require:

- higher bandwidth
- dedicated connections
- managed services



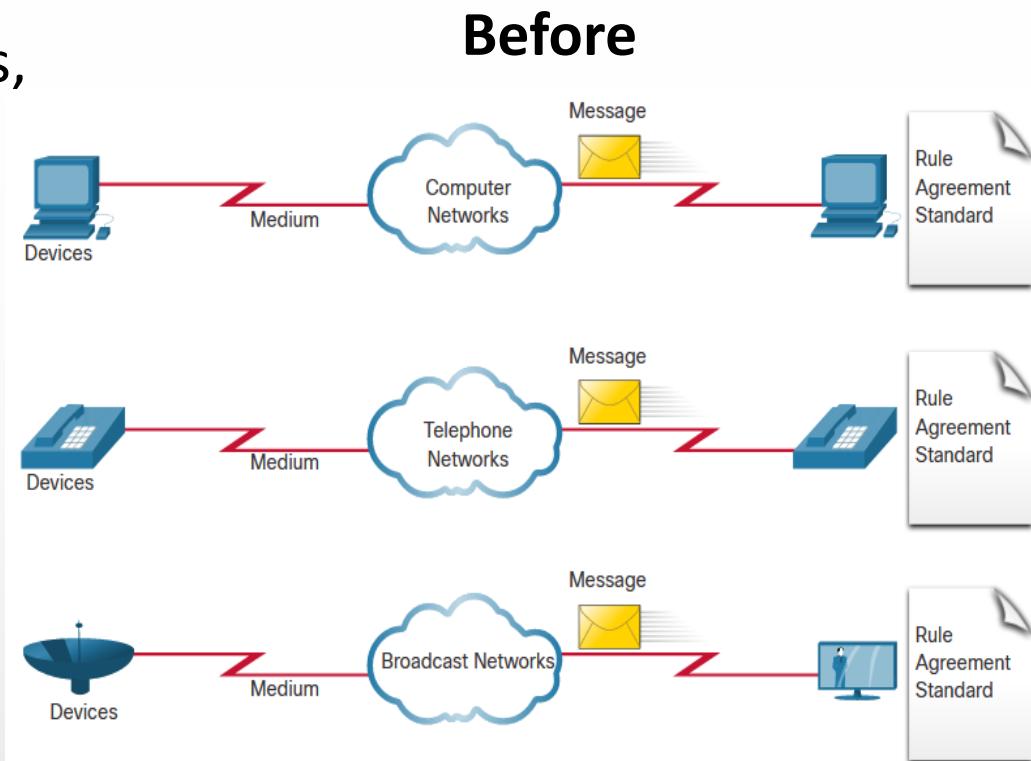
Type of Connection	Description
Dedicated Leased Line	These are reserved circuits within the service provider's network that connect distant offices with private voice and/or data networking.
Ethernet WAN	This extends LAN access technology into the WAN.
DSL	Business DSL is available in various formats including Symmetric Digital Subscriber Lines (SDSL).
Satellite	This can provide a connection when a wired solution is not available.

# Internet Connections

- The Converging Network

- Before converged networks, an organization would have been separately cabled for telephone, video, and data. Each of these networks would use different technologies to carry the signal

- Each of these technologies would use a different set of rules and standards



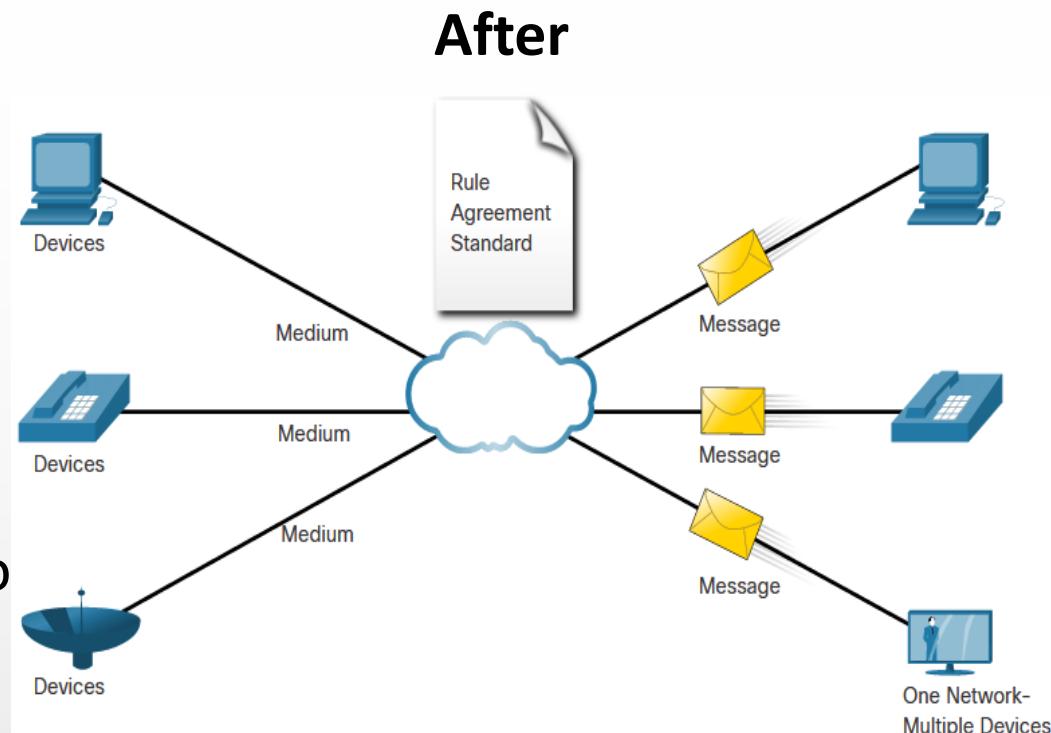
# Internet Connections

- The Converging Network (cont.)

- Converged data networks carry multiple services on one link including:

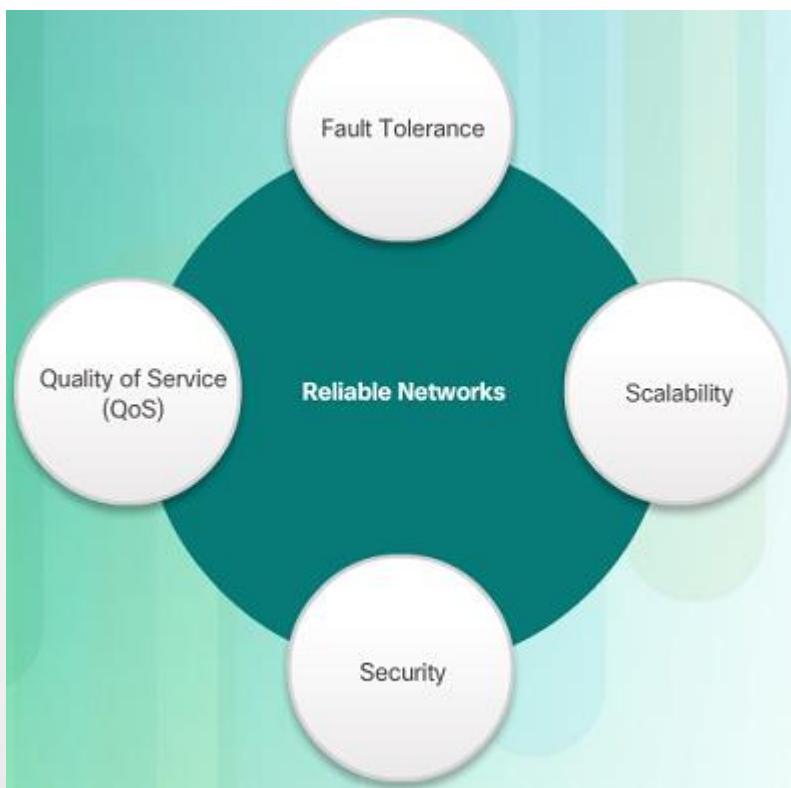
- data
- voice
- video

- Converged networks can deliver data, voice, and video over the same network infrastructure. The network infrastructure uses the same set of rules and standards.



# Reliable Networks

- Network Architecture

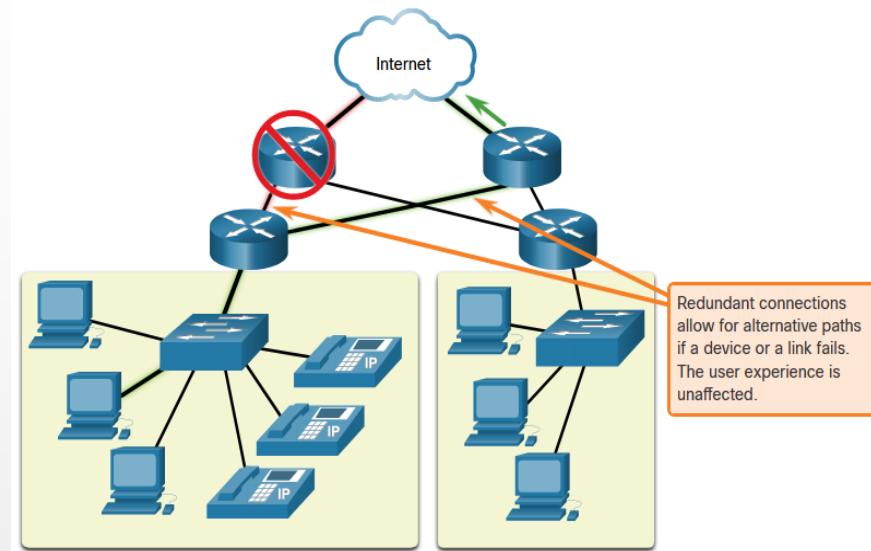


- Network Architecture refers to the technologies that support the infrastructure that moves data across the network.
- There are four basic characteristics that the underlying architectures need to address to meet user expectations:
  - Fault Tolerance
  - Scalability
  - Quality of Service (QoS)
  - Security

# Reliable Networks

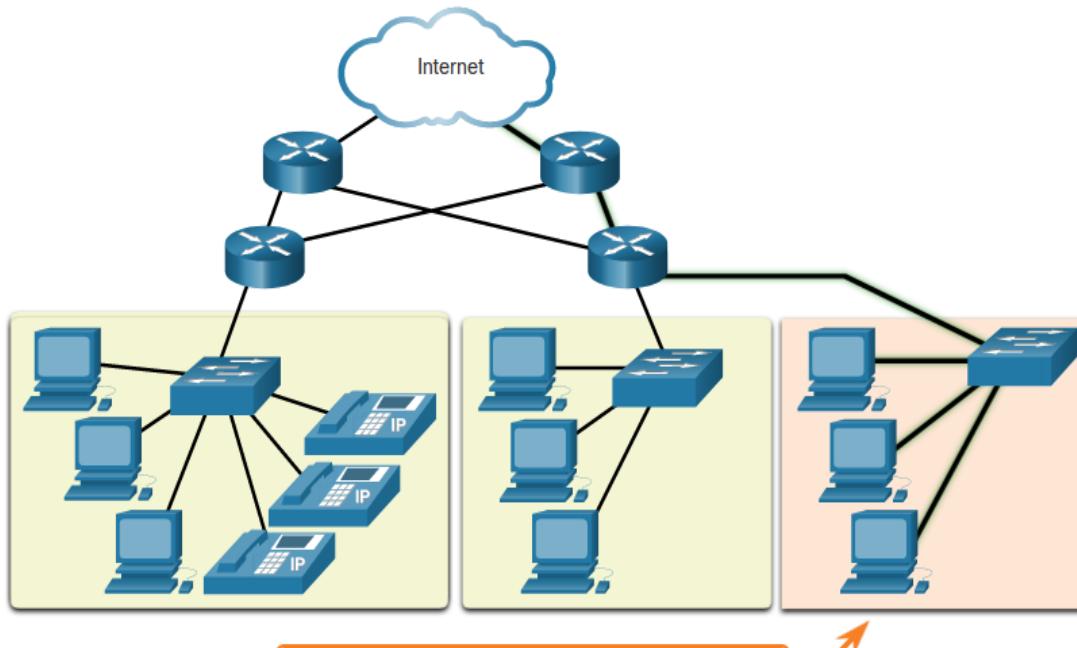
- Fault Tolerance

- A fault tolerant network limits the impact of a failure by limiting the number of affected devices. Multiple paths are required for fault tolerance.
- Reliable networks provide redundancy by implementing a packet switched network:
  - Packet switching splits traffic into packets that are routed over a network.
  - Each packet could theoretically take a different path to the destination.
- This is not possible with circuit-switched networks which establish dedicated circuits.



# Reliable Networks

- Scalability



- A scalable network can expand quickly and easily to support new users and applications without impacting the performance of services to existing users
- Network designers follow accepted standards and protocols in order to make the networks scalable

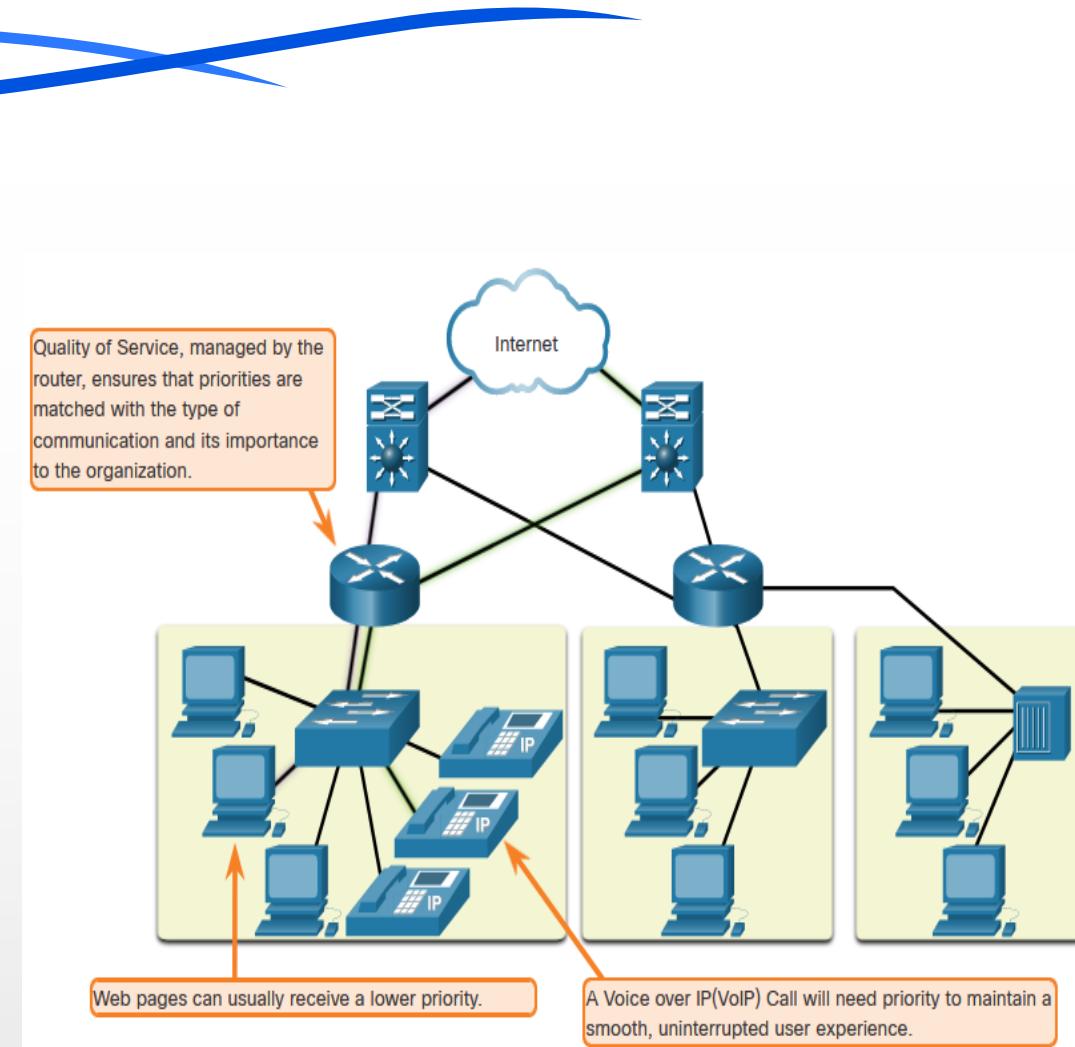
# Reliable Networks

## • Quality of Service

- Voice and live video transmissions require higher expectations for those services being delivered.

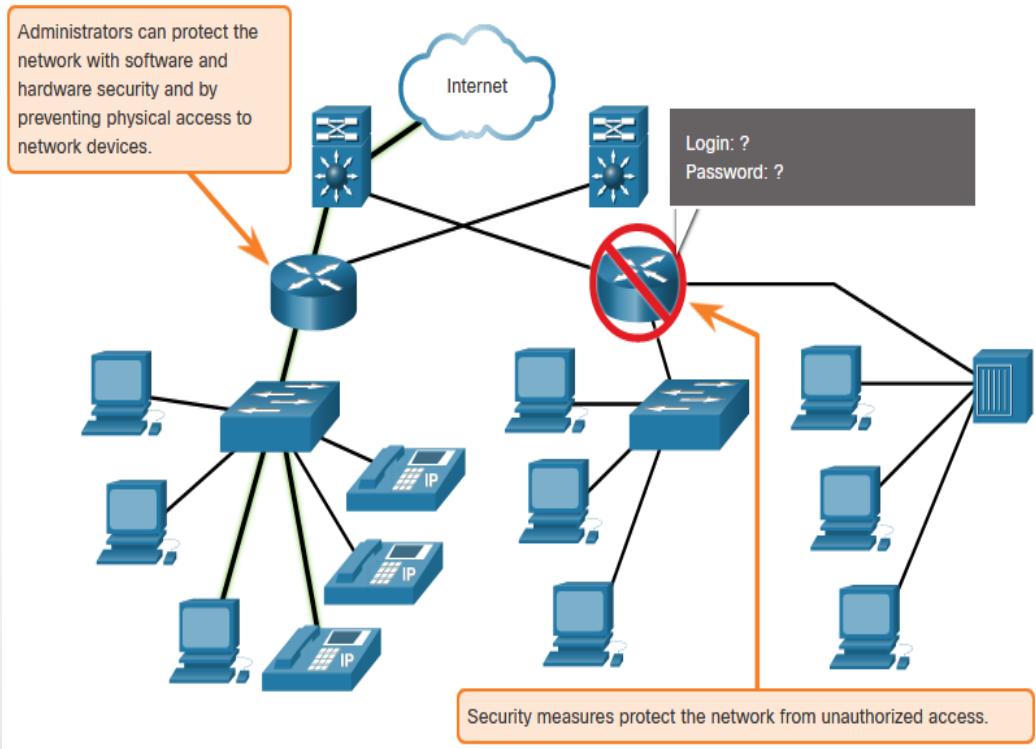
Have you ever watched a live video with constant breaks and pauses? This is caused when there is a higher demand for bandwidth than available – and QoS isn't configured.

- Quality of Service (QoS) is the primary mechanism used to ensure reliable delivery of content for all users.
- With a QoS policy in place, the router can more easily manage the flow of data and voice traffic.



# Reliable Networks

## • Network Security



- There are two main types of network security that must be addressed:

- Network infrastructure security
  - Physical security of network devices
  - Preventing unauthorized access to the devices
- Information Security
  - Protection of the information or data transmitted over the network

- Three goals of network security:

- Confidentiality – only intended recipients can read the data
- Integrity – assurance that the data has not been altered during transmission
- Availability – assurance of timely and reliable access to data for authorized users

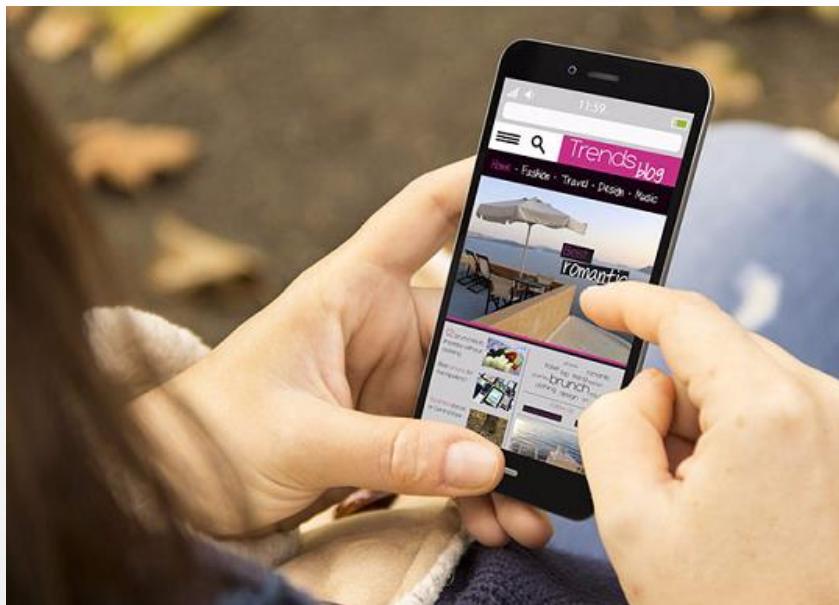
# Network Trends

- Recent Trends

- 
- The role of the network must adjust and continually transform in order to be able to keep up with new technologies and end user devices as they constantly come to the market.
  - Several new networking trends that effect organizations and consumers:
    - Bring Your Own Device (BYOD)
    - Online collaboration
    - Video communications
    - Cloud computing

# Network Trends

## ● Bring Your Own Device

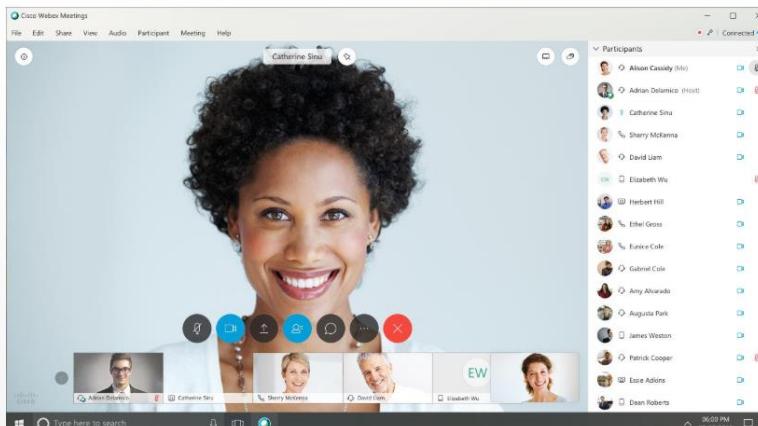


- Bring Your Own Device (BYOD) allows users to use their own devices giving them more opportunities and greater flexibility
- BYOD allows end users to have the freedom to use personal tools to access information and communicate using their:
  - Laptops
  - Netbooks
  - Tablets
  - Smartphones
  - E-readers
- BYOD means any device, with any ownership, used anywhere

# Network Trends

## • Online Collaboration

- Collaborate and work with others over the network on joint projects
- Collaboration tools including Cisco WebEx (shown in the figure) gives users a way to instantly connect and interact
- Collaboration is a very high priority for businesses and in education
- Cisco Webex Teams is a multifunctional collaboration tool:
  - send instant messages
  - post images
  - post videos and links



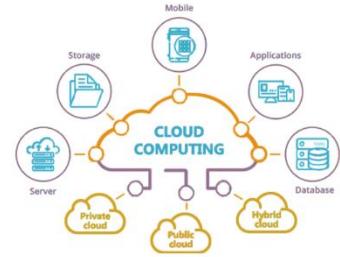
# Network Trends

- Video Communication

- Video calls are made to anyone, regardless of where they are located
- Video conferencing is a powerful tool for communicating with others
- Video is becoming a critical requirement for effective collaboration
- Cisco TelePresence powers and WebEx are two ways of working where everyone, everywhere



# Network Trends



- Cloud computing allows us to store personal files or backup our data on servers over the Internet
  - Applications can also be accessed using the Cloud
  - Allows businesses to deliver to any device anywhere in the world
- Cloud computing is made possible by data centers
  - Smaller companies that can't afford their own data centers, lease server and storage services from larger data center organizations in the Cloud

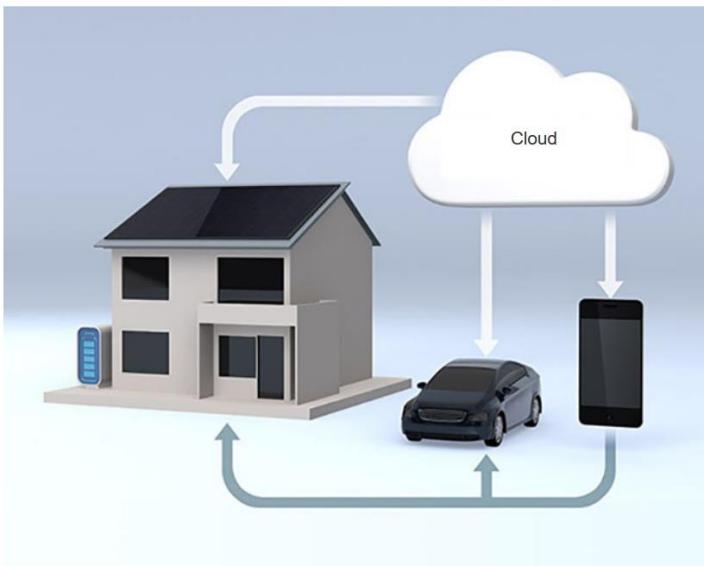
# Network Trends

- Technology Trends in the Home

- Smart home technology is a growing trend that allows technology to be integrated into every-day appliances which allows them to interconnect with other devices

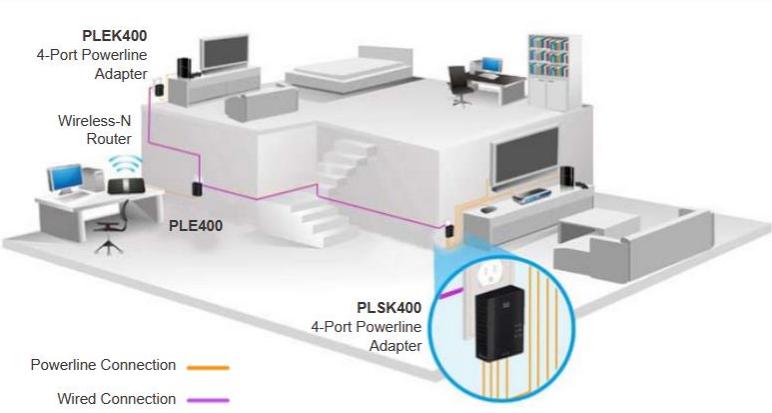
- Ovens might know what time to cook a meal for you by communicating with your calendar on what time you are scheduled to be home

- Smart home technology is currently being developed for all rooms within a house



# Network Trends

## ● Powerline Networking



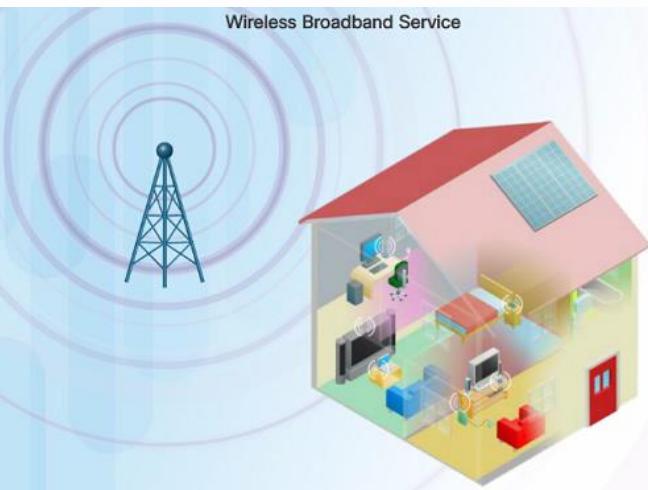
- Powerline networking can allow devices to connect to a LAN where data network cables or wireless communications are not a viable option
- Using a standard powerline adapter, devices can connect to the LAN wherever there is an electrical outlet by sending data on certain frequencies
- Powerline networking is especially useful when wireless access points cannot reach all the devices in the home

# Network Trends

## ● Wireless Broadband

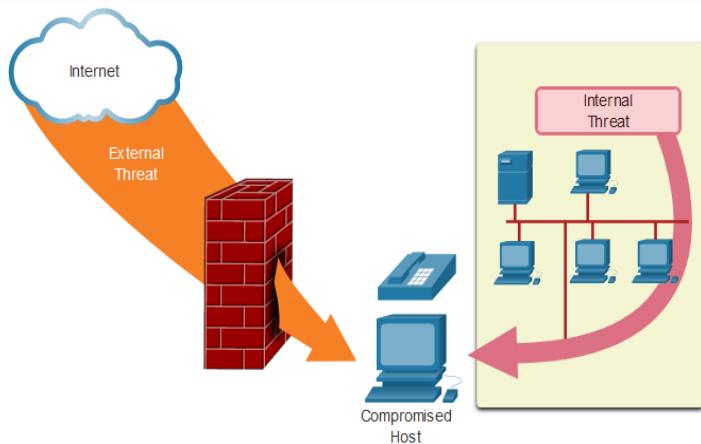
- In addition to DSL and cable, wireless is another option used to connect homes and small businesses to the internet.

- More commonly found in rural environments, a Wireless Internet Service Provider (WISP) is an ISP that connects subscribers to designated access points or hotspots.
- Wireless broadband is another solution for the home and small businesses.
- Uses the same cellular technology used by a smart phone.
- An antenna is installed outside the house providing wireless or wired connectivity for devices in the home.



# Network Security

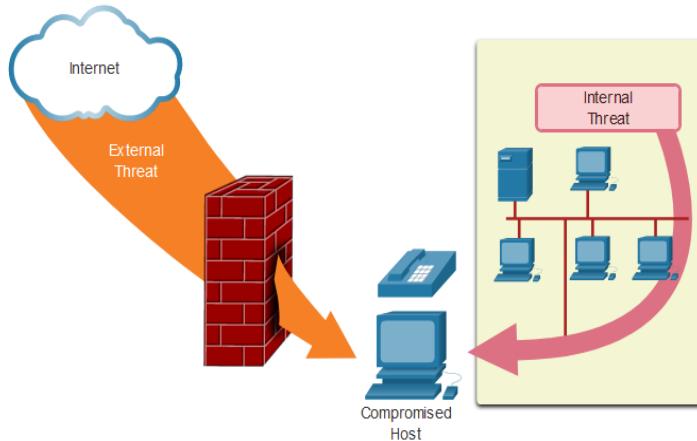
- Security Threats



- Network security is an integral part of networking regardless of the size of the network
- The network security that is implemented must take into account the environment while securing the data, but still allowing for quality of service that is expected of the network
- Securing a network involves many protocols, technologies, devices, tools, and techniques in order to secure data and mitigate threats
- Threat vectors might be external or internal

# Network Security

- Security Threats (Cont.)



- External Threats:

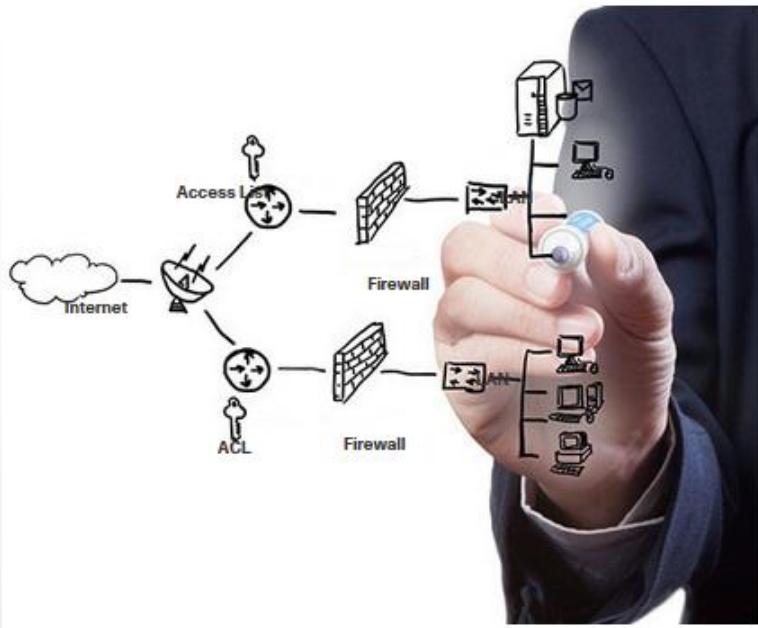
- Viruses, worms, and Trojan horses
- Spyware and adware
- Zero-day attacks
- Threat Actor attacks
- Denial of service attacks
- Data interception and theft
- Identity theft

- Internal Threats:

- Lost or stolen devices
- Accidental misuse by employees
- Malicious employees

# Network Security

## ● Security Solutions



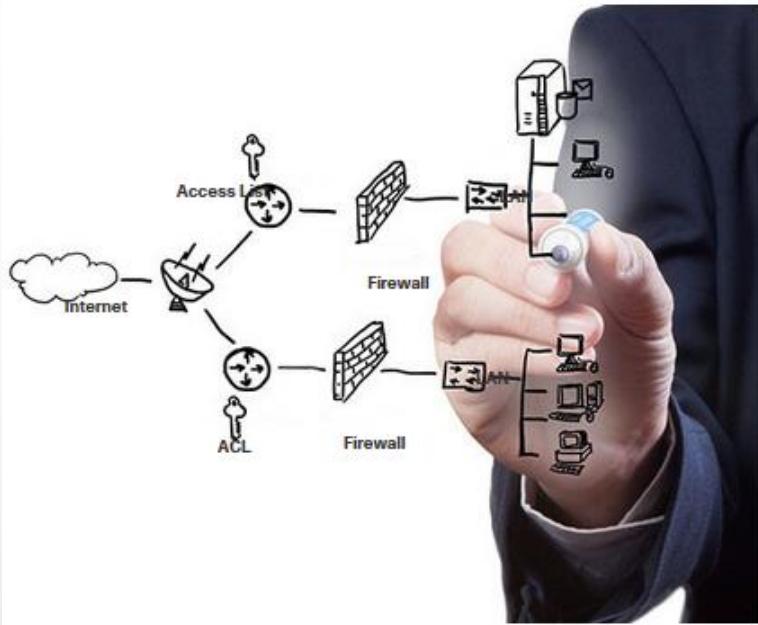
- Security must be implemented in multiple layers using more than one security solution

Network security components for home or small office network:

- Antivirus and antispyware software should be installed on end devices
- Firewall filtering used to block unauthorized access to the network

# Network Security

- Security Solutions (cont.)



- Larger networks have additional security requirements:
  - Dedicated firewall system
  - Access control lists (ACL)
  - Intrusion prevention systems (IPS)
  - Virtual private networks (VPN)
- The study of network security starts with a clear understanding of the underlying switching and routing infrastructure

# Homework



- Download and install Cisco Packet Tracer
- Deploy and cable network devices (tutorial assignment)

Do you have any  
questions or  
comments?





Thank you  
for your attention !

In this presentation:

- Some icons were downloaded from flaticon.com and iconscount.com
- Some info was taken from Siva Kumar Reddy Vasipally presentation “Introduction Mobile Application Development”