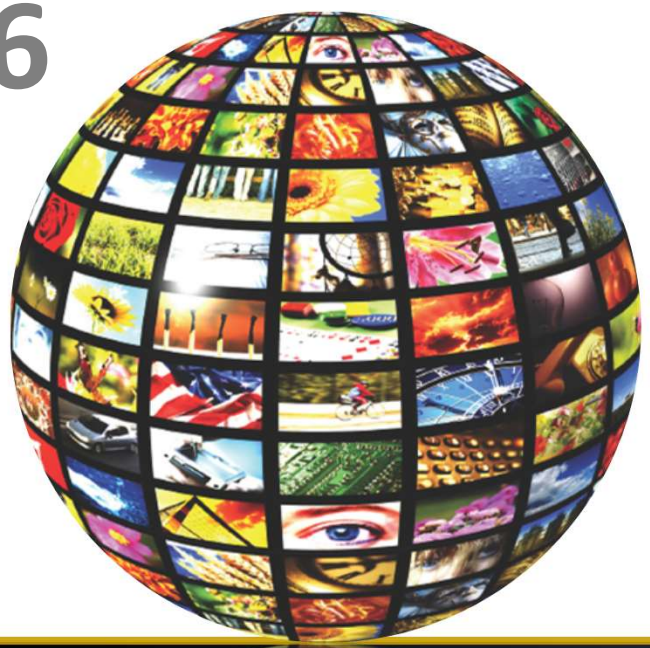
Chapter 6



Networks and Communications

Chapter 6

Chapter 6 Overview

Part 1 : Communications

- Communication Systems
- Connectivity
- Channels

Part 2: Network

- Terminologies
- Types of network
- Network strategies

Part 3: Careers in IT

Part 4: Trends in Network

System Software

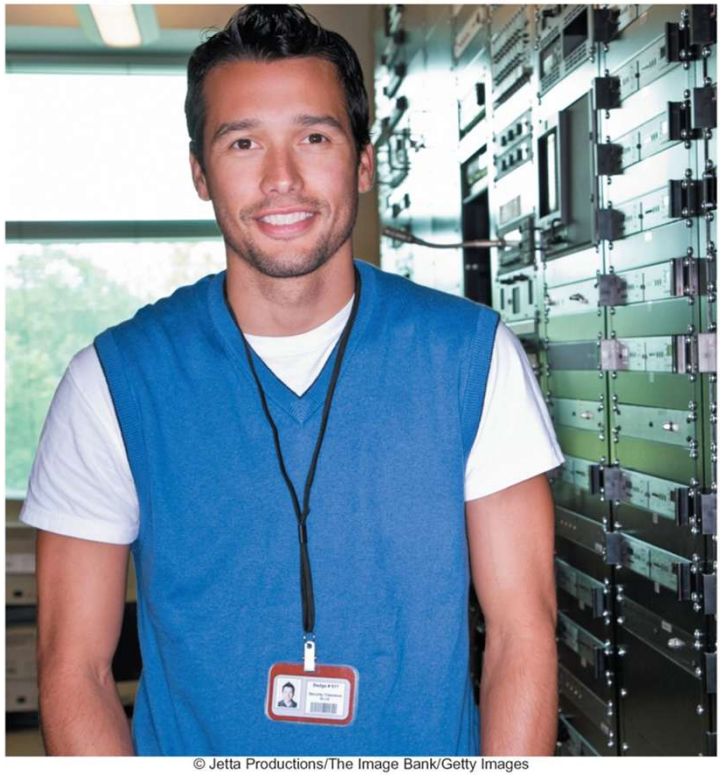
Learning Objectives

1. Explain connectivity, the wireless revolution, and communication systems.
2. Describe physical and wireless communications channels.
3. Differentiate between connection devices and services, including dial-up, DSL, cable, satellite, and cellular.
4. Describe data transmission factors, including bandwidth and protocols.
5. Define networks and key network terminology including network interface cards and network operating systems.
6. Describe different types of networks, including local, home, wireless, personal, metropolitan, and wide area networks.
7. Describe network architectures, including topologies and strategies.
8. Explain the organization issues related to Internet technologies and network security.
9. Explain related careers in IT networking.
10. Explain trends in computer networking.

Part 1: Communication

Introduction

- We live in a truly connected society.
- Increased connectivity potentially means increased productivity, especially in business.
- You will learn more about the concept of connectivity and the impact of the wireless revolution in this chapter.



Communications

- Computer communications is the process of sharing data, programs, and information between two or more computers
- Numerous applications depend on communication systems, including
  - E-mail
  - Texting
  - Video Conferencing
  - Electronic commerce

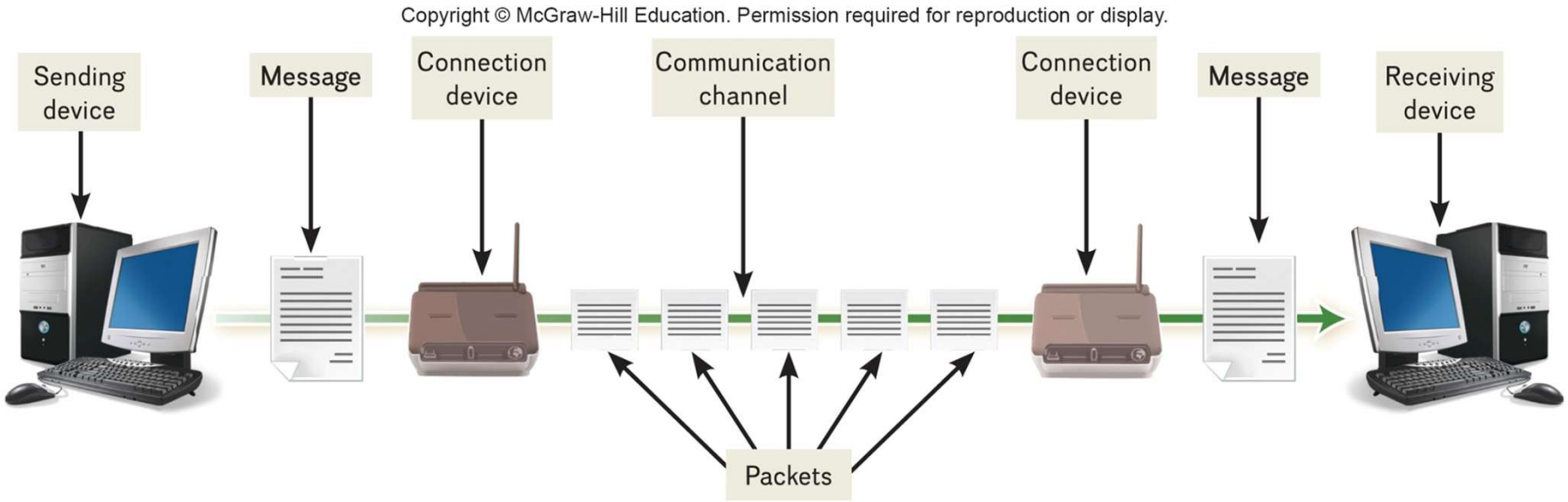
Connectivity

- Connectivity uses computer networks to link people and resources
- Connects your personal computer to other computers and resources on a network and the Internet
- The Wireless Revolution
  - Single most dramatic change in connectivity in the past decade
  - Allows connectivity with anyone from almost anywhere at any time

The Revolution is just beginning

Communication Systems

Electronic systems that transmit data from one location to another



Basic Elements of Communication

- Four basic elements of communication systems
  - Sending and receiving devices
    - Computer or a specialized communication device
  - Connection devices
    - Interface between sending and receiving device
  - Data transmission specifications
    - Rules and procedures that coordinate the devices
  - Communication channel
    - Carries the message

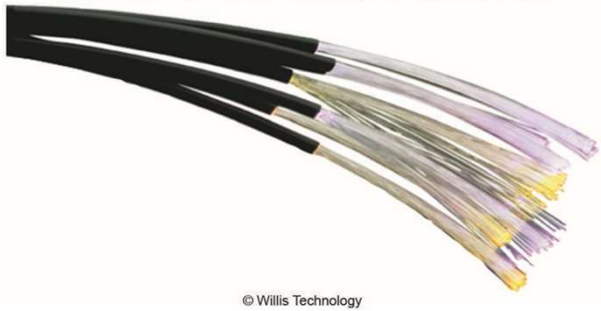
Communication Channels

- Communication channels carry the data from one computer to another; essential element of every communication system
- Two categories of communication channels
  - Physical Connections using wire or cable
  - Wireless Connections

Physical Connections

Physical connection between sending and receiving device include

- Twisted pair cable: two pairs of copper wire twisted together
  - Telephone lines
  - Ethernet cables
- Coaxial cable: single solid copper core
  - Cable TV
- Fiber-optic cable: tiny glass tubes
  - Faster and more reliable than coax
  - Rapidly twisted pair



Wireless Connections

Wireless connections do not use a solid substance to connect; uses the air itself. Most use radio waves to communicate

Standard	Maximum speed
802.11g	54 Mbps
802.11n	600 Mbps
802.11ac	2.6 Gbps
802.11ax	10.5 Gbps

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Primary Wireless Technology

- Bluetooth (short-range)
  - Radio communication standard
- Wi-Fi (wireless fidelity)
  - Uses high frequency radio
- Microwave
  - Uses high frequency radio wave signals
- WiMax (extends Wi-Fi)
  - New standard that uses microwave to extend WiFi range
- Cellular
  - Use multiple antennae to communication
- Satellite
  - Uses satellites as microwave relay stations
- Infrared
  - Use infrared light wants to communication over short distances
- GPS
  - Determine geographic location of the devices

Connection Devices

Devices need to convert digital signal to analog

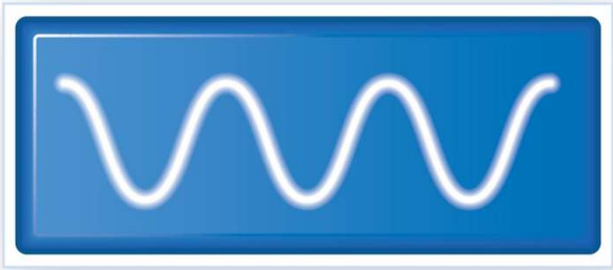
- Modem – *modulator-demodulator*
  - Modulation is the process of converting from digital to analog
  - Demodulation is the process of converting from analog to digital
- Transfer rate
  - Speed in which modems transfer data
  - Usually measured in megabits per second (Mbps)

Types of Modems

- Types of Modems
  - Digital subscriber line (DSL)
    - High speed telephone lines
  - Cable
    - Uses coaxial cable
  - Wireless
    - Also known as WWAN

Connection Device Signals

- Types of signals
  - Analog
  - Digital
- Transfer rates
  - Mbps – million bits per second
  - Gbps – billion bits per second
  - Tbps – trillion bits per second



Analog

Digital

Connection Services - Corporations

- Leased lines
  - T1 combined to form T3 and DS3
  - Have been replaced by OC lines
    - Faster optical carrier lines
  - Higher capacity
    - Not affordable for individuals

Connection Services - Individuals

- Digital subscriber line (DSL)
  - Uses phone lines
  - ADSL is most widely used type of DSL
- Cable
  - Uses existing TV cable
  - Faster than DSL
- Satellite connection services
  - Use almost anywhere
  - Slower than DSL and cable modem
- Cellular Services
  - 3G, 4G and 5G cellular network connectivity
- Fiber Optic Service (FiOS)
  - New technology
    - Google and Verizon

Data Transmission

Factors that affect data transmission

- Bandwidth is how much information can move across the communication channel in a given amount of time
  - Measurement of the width or capacity of the communication channel
  - Categories of bandwidth
    - Voiceband (or low bandwidth) – standard telephone
    - Medium band – leased lines for high-speed
      - Mid-range computer and mainframes
    - Broadband for DSL, cable, satellite connections to the Internet
    - Baseband for individual connections for computers in close range

Making IT Work for You ~ Mobile Office

- Have an "always-on" connection to access e-mail, websites, cloud services, and apps.
  - Devices that can keep you always connected
    - Mobile Hotspot Device
    - Personal Hotspot
    - Public Wi-Fi
  - Devices that can keep you always like home
    - Cloud Storage
    - Video conferencing

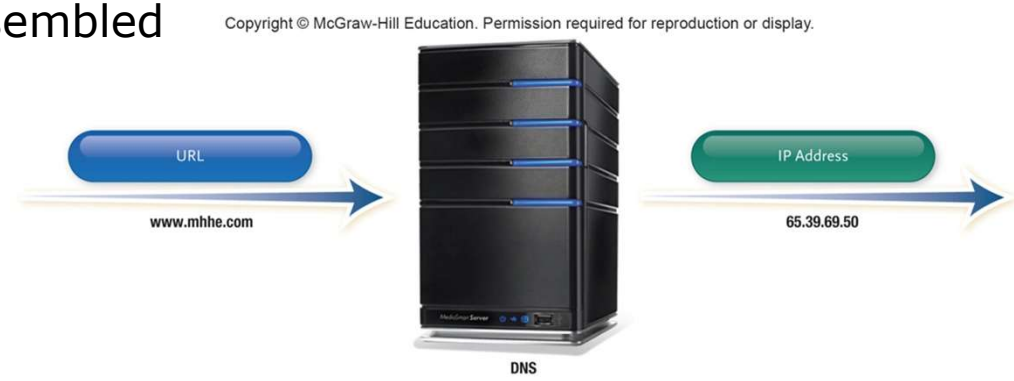
Protocols

Communication rules for exchanging data between computers

- HTTPS – Hypertext Transfer Protocol Secure
  - Widely used to protect the transfer of sensitive data

TCP/IP

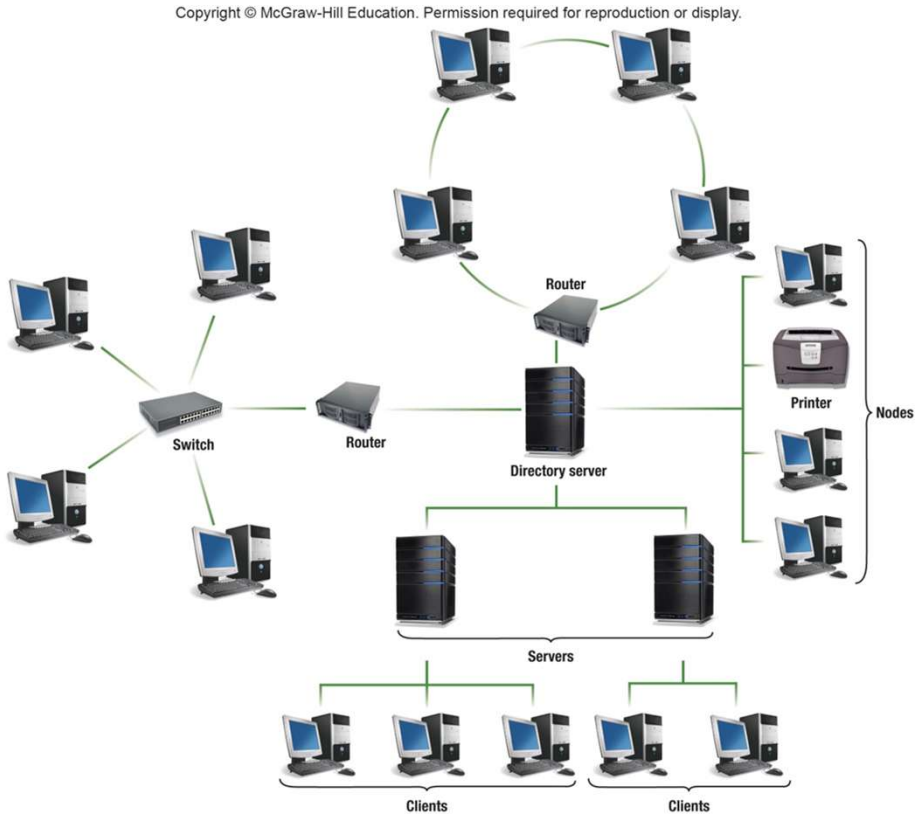
- TCP/IP (Transmission control protocol/Internet protocol)
  - Most widely used protocol
  - Each computer is identified with unique IP (Internet Protocol) address
  - DNS – Domain name service resolves IP addresses to names
  - Packetization – information broken down into small parts (packets) and then reassembled



Part 2: Network

Networks

A communication system that connects two or more computers so they can exchange information and share resources



Specialized Terms in a Network

- Nodes
  - Any device connected to a network
- Client
  - A node that requests and uses resources from other nodes
- Server
  - A node that shares resources with other nodes
- Directory Server
  - Specialized server that managers resources
- Host
  - Computer system that can be accessed over a network
- Router
  - Node that forwards or routes data packets
- Switch
  - Central node that coordinates the flow of data
- Network Interface Cards (NIC)
  - Expansion card that connects a computer to a network
- Network Operating System
  - Control activities of all computers on the network
- Network Administrator
  - Computer specialists responsible for network operations

Network Types

Type	Description
LAN	Local area network; located within close proximity
Home	Local area network for home and apartment use; typically wireless
WLAN	Wireless local area network; all communication passes through access point
PAN	Personal area network; connects digital devices, such as PDAs
MAN	Metropolitan area network; typically spans cities with coverage up to 100 miles
WAN	Wide area network for countrywide or worldwide coverage

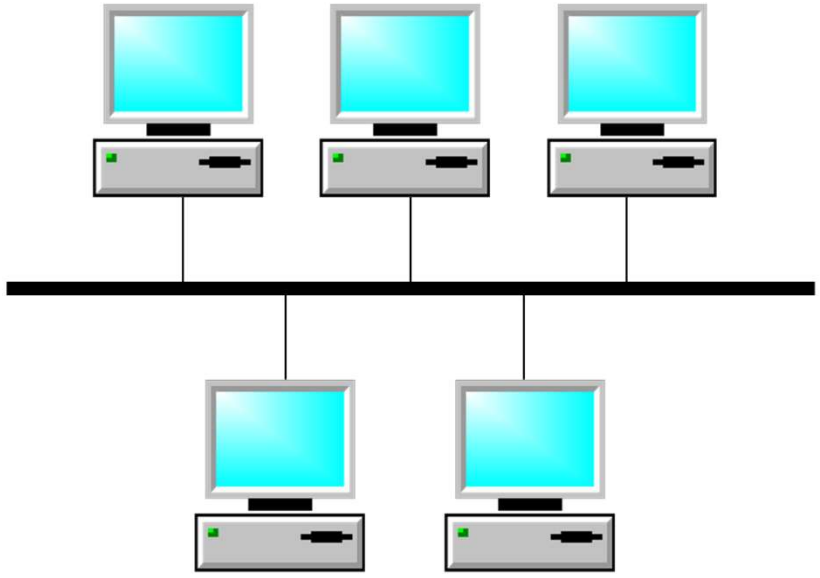
Network Architecture

How the network is arranged and resources are shared

- Network Topology
  - Physical arrangement of the network
- Network Strategy
  - How the information and resources are shared

Bus Network

- Topology where each device connected to a common cable called a bus or backbone

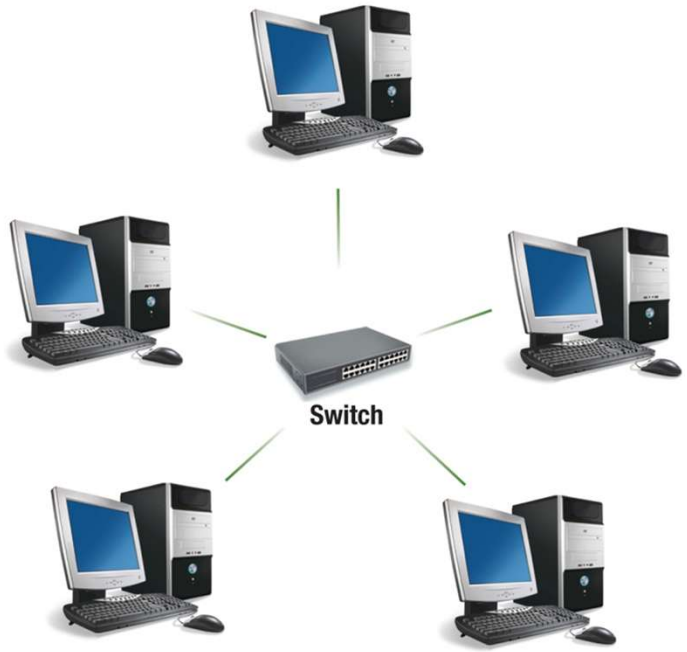


Ring Network

- Topology where each device connected directly to every others network switch

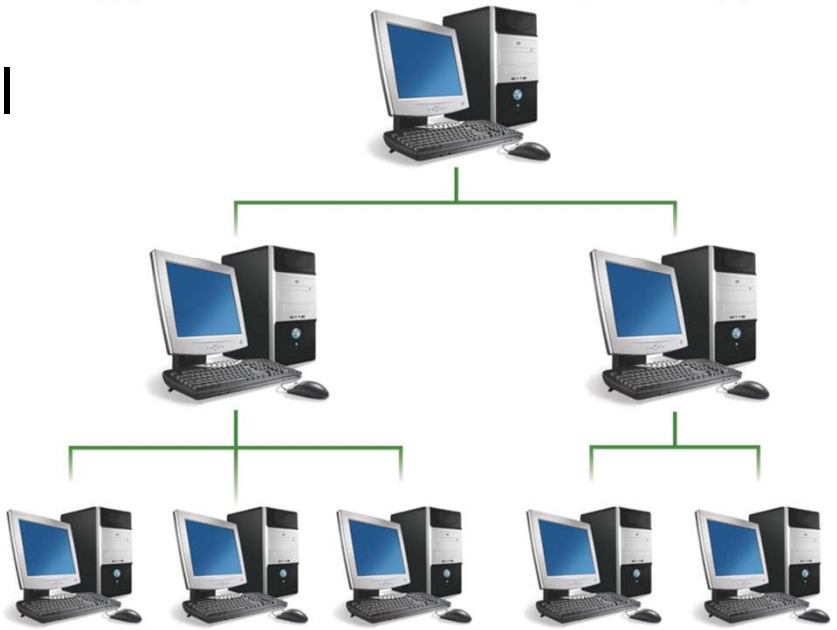
Star Network

- Topology where each device connected directly to a central network switch



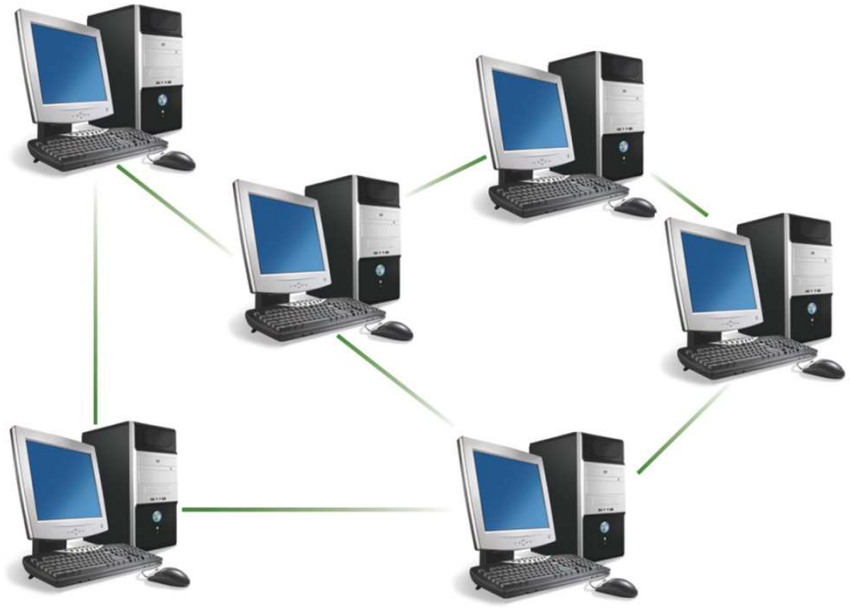
Tree Network

- Topology where each device connected to a central node either directly or through subordinate nodes
- Also called hierarchical



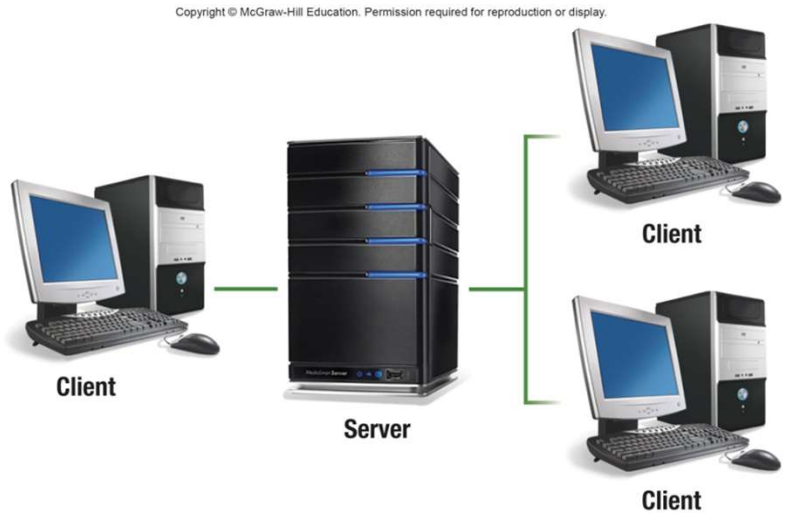
Mesh Network

- Topology that does not use a specific physical layout, but requires that each node have more than one connection to other nodes
- Wireless technologies are frequently used



Network Strategies

- Client/Server Network
  - Central computers coordinate and supply services to other nodes on the network
  - Server provides access
- Peer-to-Peer (P2P) Network
  - All nodes have equal authority
  - Can act as both client and server



Organizational Networks

Internet technologies support effective communication within and between organizations

- Intranet
  - Private network within an organization
  - Works like the Internet
- Extranet
  - Private network that connects more than one organization
  - Works like the Internet, but provides suppliers and other trusted partners with limited access to the organization's networks

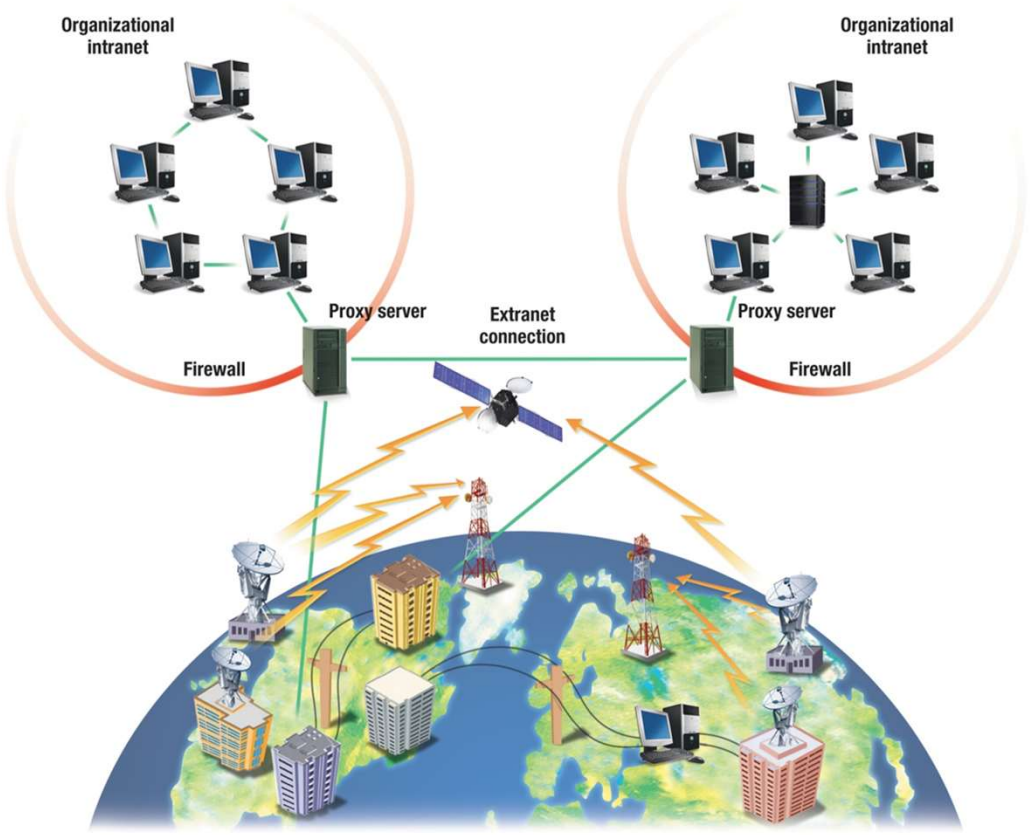
Network Security

Commonly used technologies to ensure network security

- Firewall
  - Hardware and software that controls access to network
  - Proxy server provides pass-through access
  - Protects against external threats
- Intrusion detection system (IDS)
  - Works with firewall to protect organization's network
  - Analyzes all incoming and outgoing network traffic
- Virtual private network (VPN)
  - Creates a secure private network connection between your computer and the organization

See the graphic on the next slide demonstrating network security

Intranet, Extranet, Firewall, Proxy Server



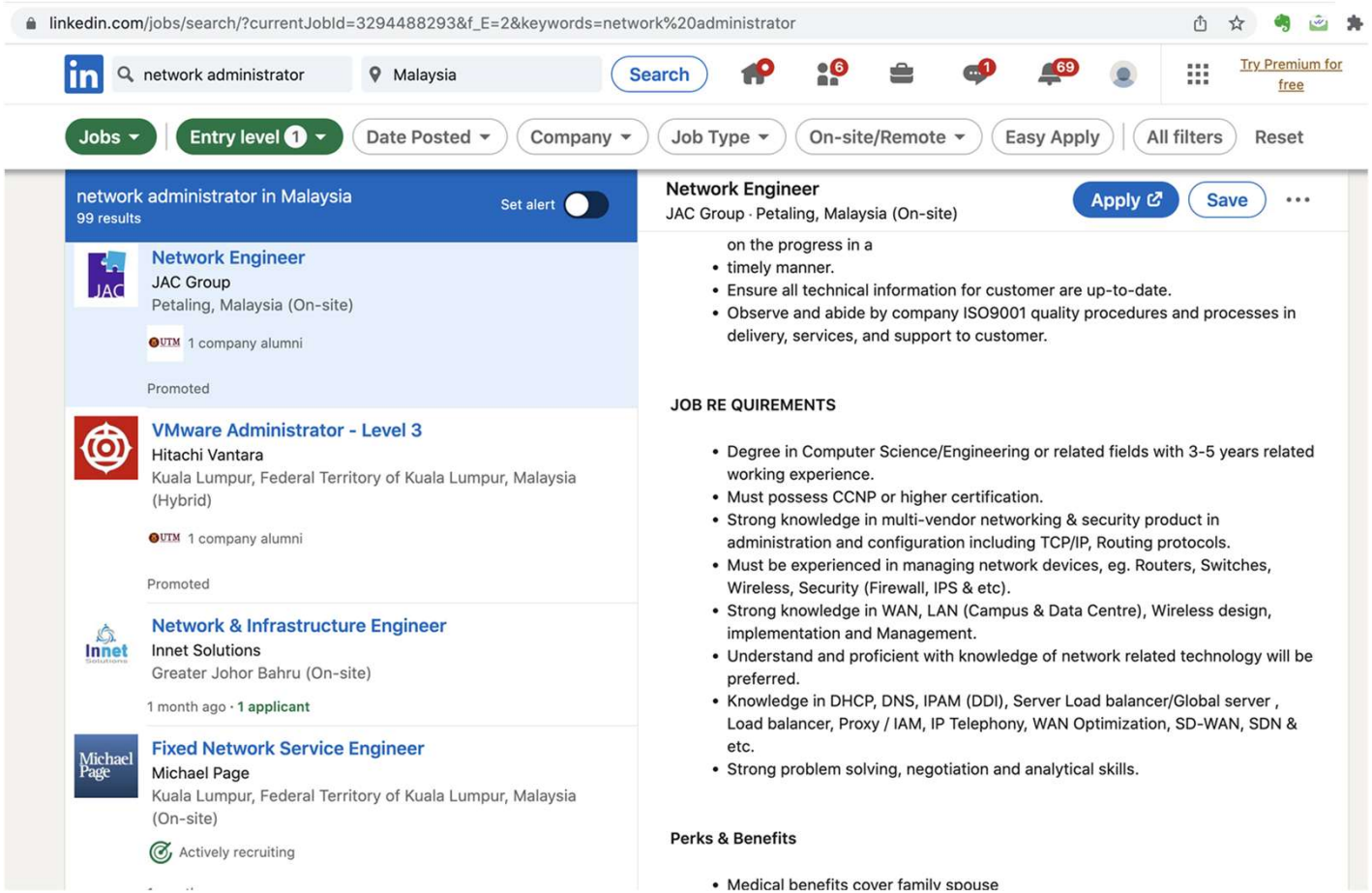
System Software

Part 3: Careers in Network

Careers In Network

- Network Administrator
  - Manages a company's LAN and WAN networks
  - Maintains networking hardware and software, diagnosing and repairing problems that arise
  - Candidates usually have a bachelor's or associate's degree in computer science, computer technology or information systems
  - Practical networking experience
  - Annual salary is typically between $47,000 and $64,000

Careers In Network (LinkedIn)



System Software

Careers In Network (LinkedIn)

System Software

Network Engineer - Malaysia (Hybrid)
· Johor Bahru, Johore, Malaysia (Hybrid)

Apply Save ...

Responsibilities

- Analyze business requirements to develop technical networking solutions and their framework.
- Deploy network and voice infrastructures in new and existing offices worldwide.
- Proactive management, monitoring, troubleshooting, and technical analysis of the global voice and data infrastructure.
- Help with the development and implementation of global network technology roadmaps.
- Perform troubleshooting to isolate and diagnose voice and network problems.
- Design and test network systems to support disaster recovery and BCP initiatives.
- Evaluate and recommend changes to meet current and future business and regulatory compliance needs across Insulet's ever-expanding global footprint.
- Be a project manager on IT projects as needed, and work closely with IT leadership and other departments to meet goals and objectives.
- Consult with business units to provide workable, creative solutions to problems presented.
- Create, update, and maintain documentation.
- Manage worldwide data vendors to obtain the best network services.
- Work with the Infrastructure Systems team to assist them with their services and systems and support as needed.
- Interface with the Cyber Security team to design and continuously deliver security-related enhancements.

Education And Experience

- Cisco CCNA Routing and Switching and/or CCNA Wireless certification preferred.
- Bachelor's Degree and/or equivalent combination of education and experience.
- 4+ years related work experience.

Skills/Competencies

- Must be able to set up computer hardware and workstations.
- Cisco Wi-Fi, including Wireless LAN Controllers and Cisco ISE.
- Hands-on experience with Cisco switches and routers.
- Cisco CUBE experience is a plus.
- Working knowledge of SIP, MPLS, and OSPF is a plus.
- Working knowledge of QoS and its use in Cisco voice and video.
- Multisite network design, configuration, and management.
- Palo Alto Networks firewall configuration and management.
- Network monitoring, reporting, and outage response.

Physical Requirements

- Must be able to lift and transfer up to 30 pounds.
- Domestic and Global travel required – up to 20%.

NOTE: This position is eligible for hybrid working arrangements (requires on-site work from an Insulet office at least 1x/week; may work remotely other days).

Part 4: Trends in Network

System Software

Trends in Network Technologies

AI & ML

5G & WI-FI 6

AR & VR

IOT

DIGITAL TRANSFORMATION

CLOUD COMPUTING

DATA SECURITY

DEVOPS

System Software

5G and Wi Fi 6 Technology

- 5G or fifth generation cellular technology.
  - Characteristics:
    - increased speed, reduced latency and improve flexibility in wireless services.
  - Helps organizations to mobilize workforces, extend automation, supporting new applications with increased network capacity and high data rates.
  - Solve the issue of many wireless devices connected at once.
- Wi Fi 6
  - Infrastructure.
  - Computers and mobile phones manufacturers need to adopt new standards.

Artificial Intelligence (AI) and Machine Learning (ML)

- Addressed complex network and business problems in real time.
- ML
  - Make predictions based on network data.
- AI
  - Can take intelligent actions based on those prophecies.
- Advanced analytics into automation systems will bring in self-operating networks.

Augmented Reality and Virtual Reality

- Technologies empower the applications and customer experiences.
- Mainly used on smartphone and tablets.
- E.g. to present interior design, allowing shopkeepers to have virtual presentation of furniture.

Cloud Computing

- Allows faster transition to remote work.
- Help to organize remote workplace more efficiently.
- Contributed to business continuity during any crisis.
- Maintaining consistent network and security policies across multiple clouds using multi cloud policy management.

DevOps

- Tied up to software development and IT.
- Improve relationship between network service designers and engineers to make operational changes to the services.

Digital Transformation

- Enables adoption of digital technology to transform services or businesses.
- Replacing on digital or manual processes with digital processes.
- E.g. digital forms that are processed, stored, and transmitted via digital devices and networks.

Internet of Things (IoT)

- Connecting the unconnected.
- Capable to communicate and connect with other devices and people.

Data Security

- Usability and integrity of network is crucial to security.
- Effective network security manages network access effectively and stops a variety of threats entering or spreading within the network