CHAPTER 8 : COMMUNICATIONS AND NETWORKS

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LEARNING OBJECTIVES

Explain connectivity, the wireless revolution and communication systems.

Describe physical and wireless communications channels.

Differentiate between connection devices and services.

Describe data transmission factors.

Define networks and key network terminology.

Describe different types of networks.

Describe network architectures.

Explain the organization issues related to Internet technologies and network security.

INTRODUCTION

- We live in a truly connected society.

- Increased connectivity potentially = increased productivity, especially in business.

- Learn more about the concept of connectivity and the impact of the wireless revolution.

COMMUNICATIONS

Computer Communications

- The process of sharing data, programs and information between two or more computers.

Numerous applications depends on communication systems

- E-mail
- Texting
- Video conferencing
- Electronic commerce

CONNECTIVITY

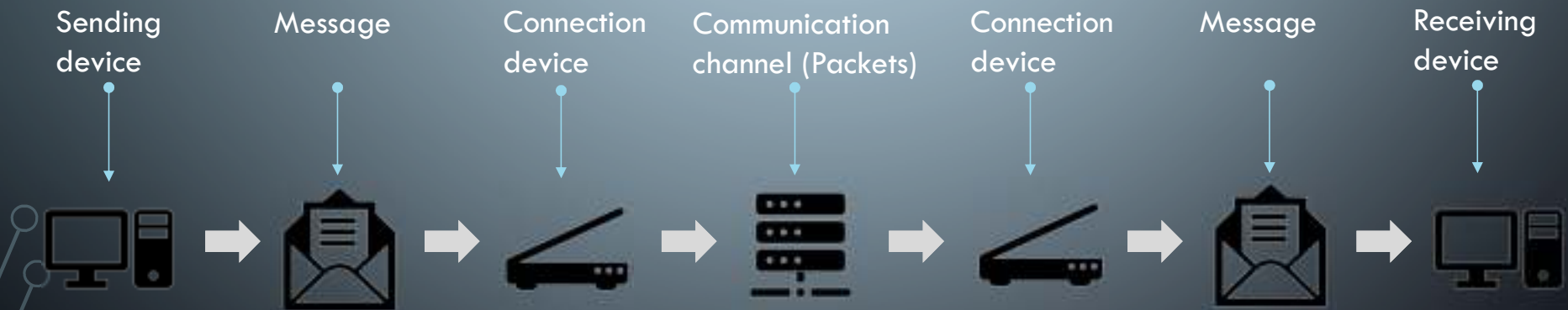Connectivity uses computer networks to link people and resources.

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.

COMMUNICATION SYSTEMS

Electronic systems that transmit data from one location to another.

| Sending device | Message | Connection device | Communication channel (Packets) | Connection device | Message | Receiving device |

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 devices

Data transmission specifications

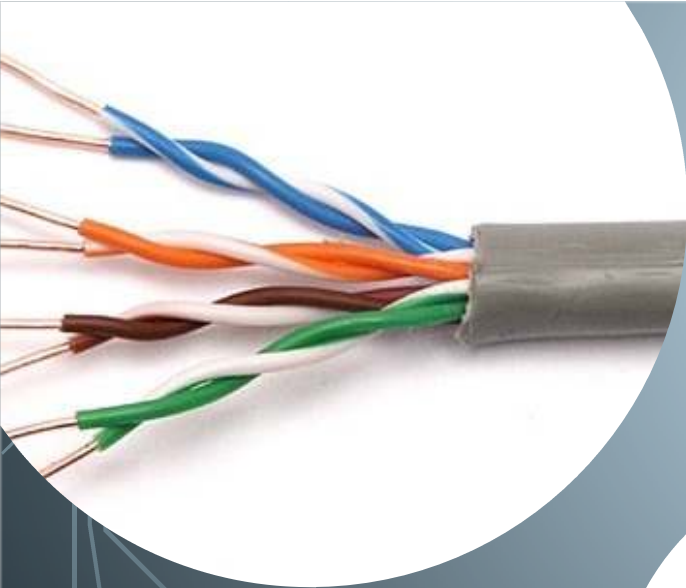- Rules and procedures that coordinate the devices

Communication channel

- Carries the message

COMMUNICATION CHANNELS

- Carry the data from one computer to another; essential element of every communication system.

- Two categories of communication channels :

  i.   Physical Connections using wire or cable
  ii. 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

WIRELESS CONNECTIONS

WIRELESS CONNECTIONS DO NOT USE A SOLID SUBSTANCE TO CONNECT, IT 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

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 infra red light wants to communication over short distances
GPS	Determine geographic location of the devices
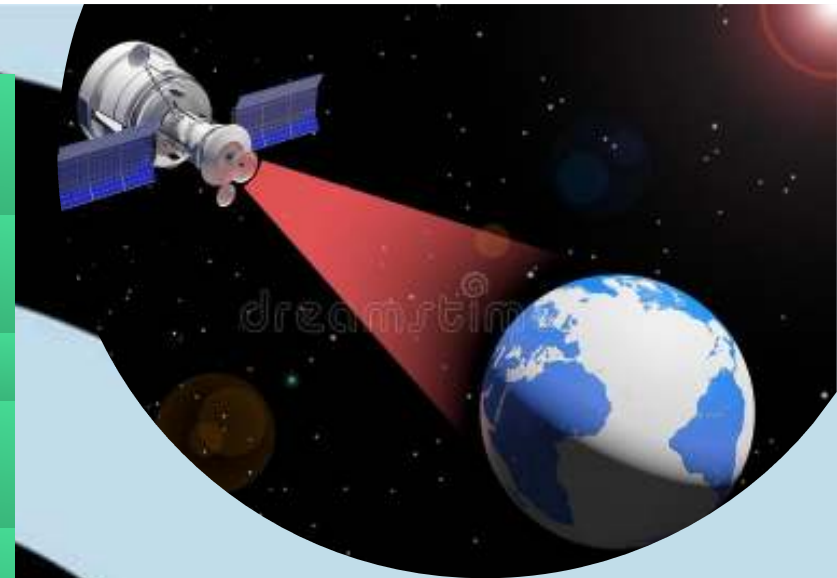
CONNECTION DEVICES

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)
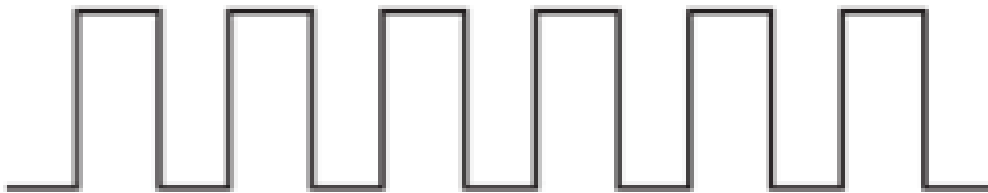
TYPES OF MODEMS

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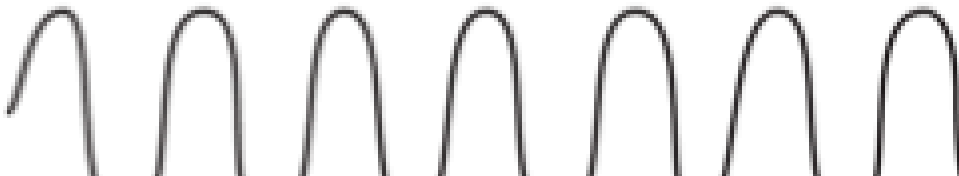   - Wireless
        - Also known as WWAN
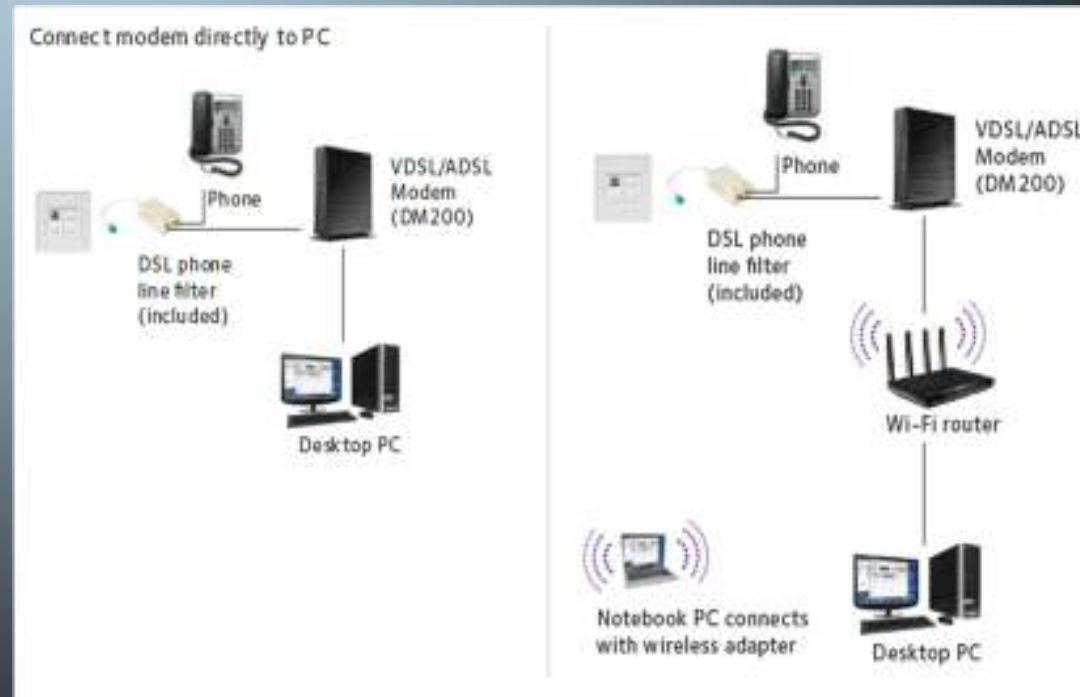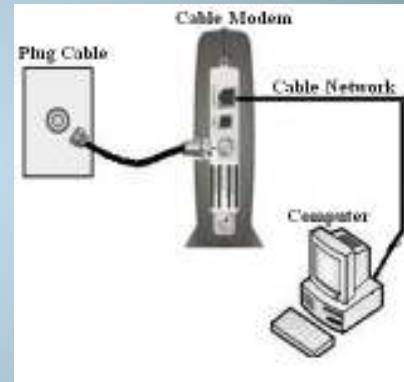
CONNECTION DEVICE SIGNALS

DIGITAL SIGNAL

ANALOG SIGNAL

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

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 and 4G 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
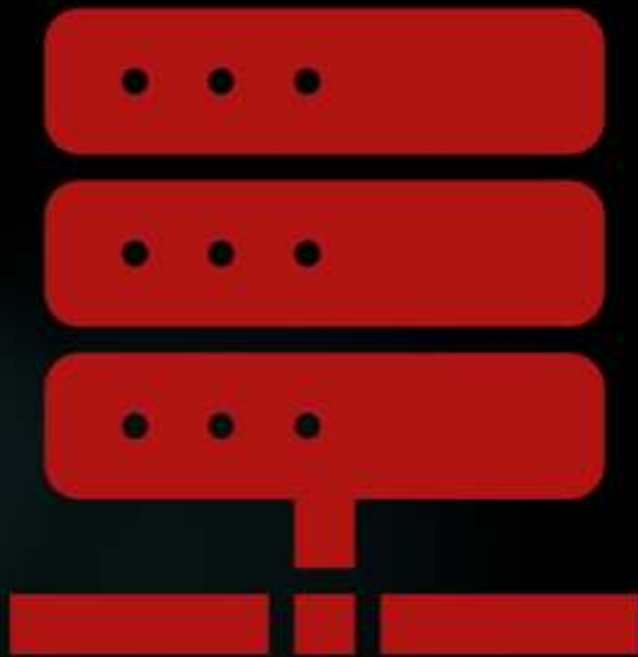
PROTOCOLS –

Communication rules for exchanging data between computers

HTTPS – Hypertext Transfer Protocol Secure

❖ *Widely used to protect the transfer of sensitive data*

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 resolve IP addresses to names

❖ Packetization – information broken down into small parts (packets) and then reassembled

NETWORKS -

A communication system that connects two or more computers so they can exchange information and share resources
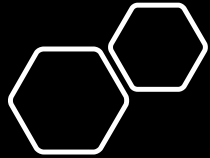
Specialized Terms in a Network

Nodes	✦ any device connected
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 manage 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

🖥️	**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

NETWORK TYPES

PAN
- **Personal area network; connects digital devices, such as PDAs**

MAN
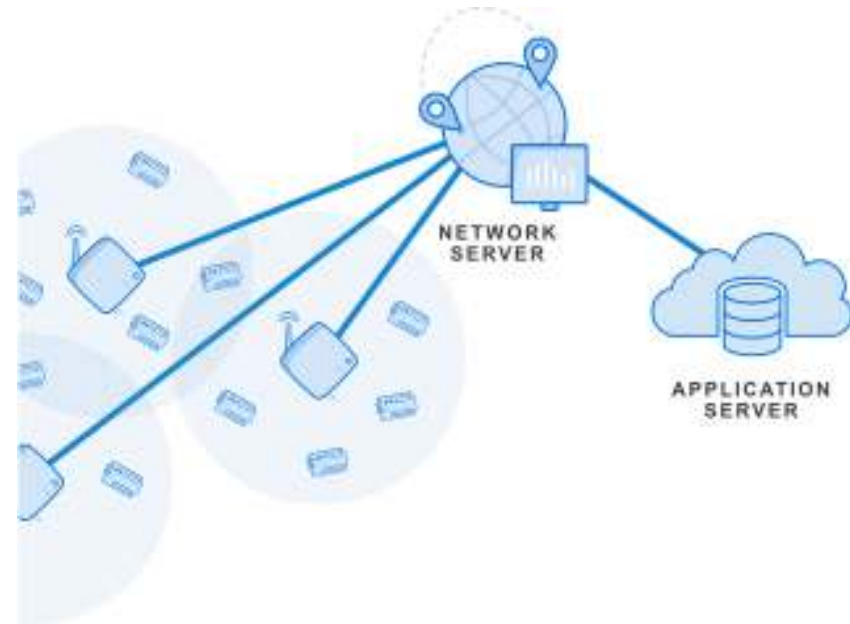- **Metropolitan area network; typically spans cities with coverage up to 100 miles**
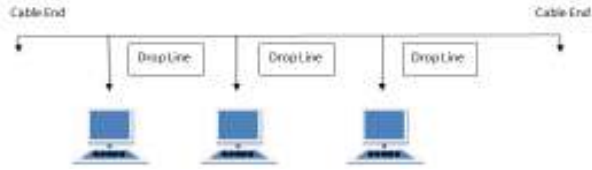
WAN
- **Wide area network for countrywide or worldwide coverage**
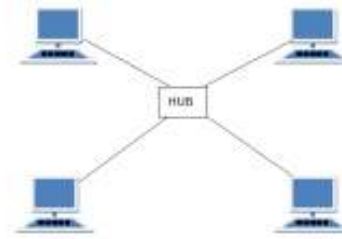
NETWORK ARCHITECTURE

How the network is arranged and resources are shared

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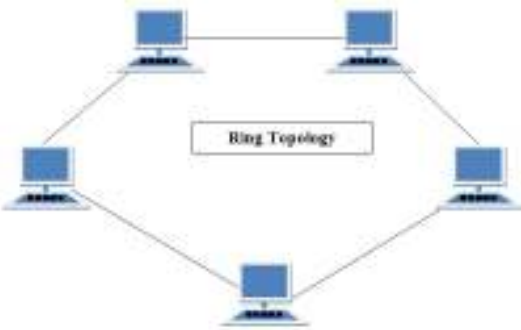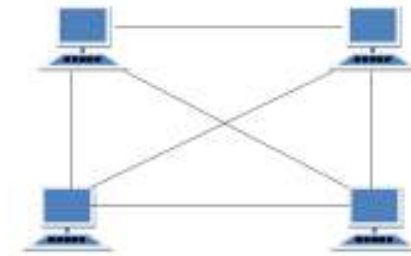 - ■ *How the information and resources are shared*
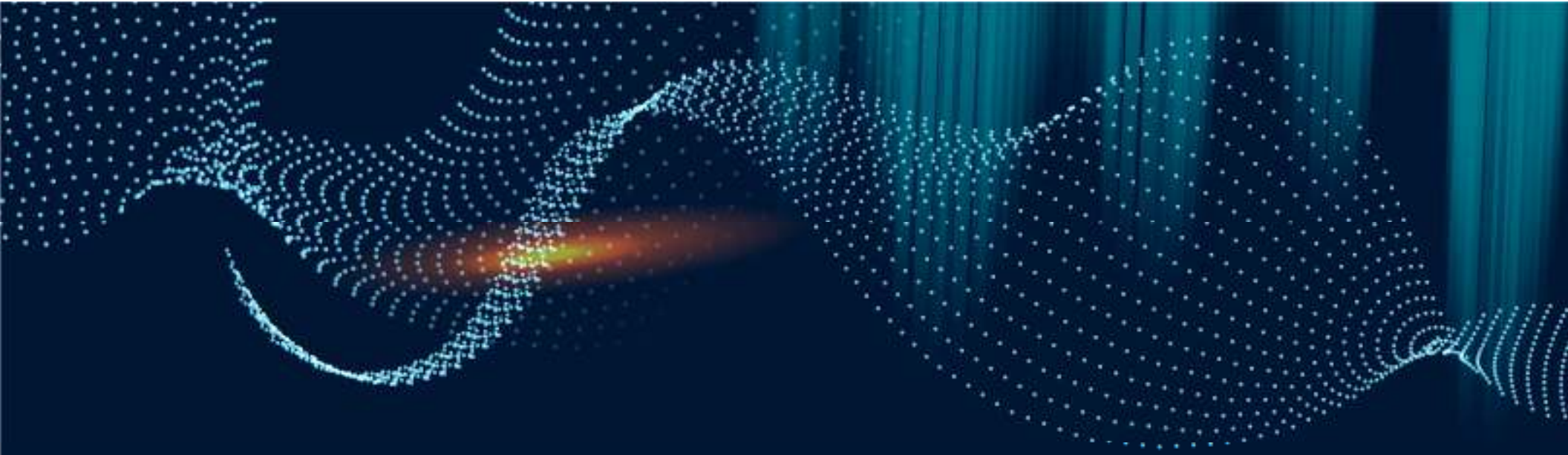
Network Topology

Tree Network

Star Network

Bus Network

Ring Network

Mesh Network

01 | ORGANIZATIONAL NETWORKING

ORGANIZATIONAL NETWORKING

Local Area Network (LAN): a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.

Wide Area Network (WAN): a telecommunications network that extends over a large geographic area for the primary purpose of computer networking.

COMPARISON BETWEEN LAN AND WAN

|	LAN	WAN
Coverage	Local areas only (e.g., homes, offices, schools)	Large geographic areas (e.g., cities, states, nations)
Speed	High speed (1000 mbps)	Less speed (150 mbps)
Fault Tolerance	Higher fault tolerant	Lower fault tolerant
Security	Higher security	Lower security

02

INTRANET, EXTRANET, FIREWALL AND PROXY SERVER

INTRANET AND EXTRANET

Intranet: A private computer network using Internet technology, in which access is restricted to members of a particular organization, company, etc.

Extranet: a private network that uses Internet technology and the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses
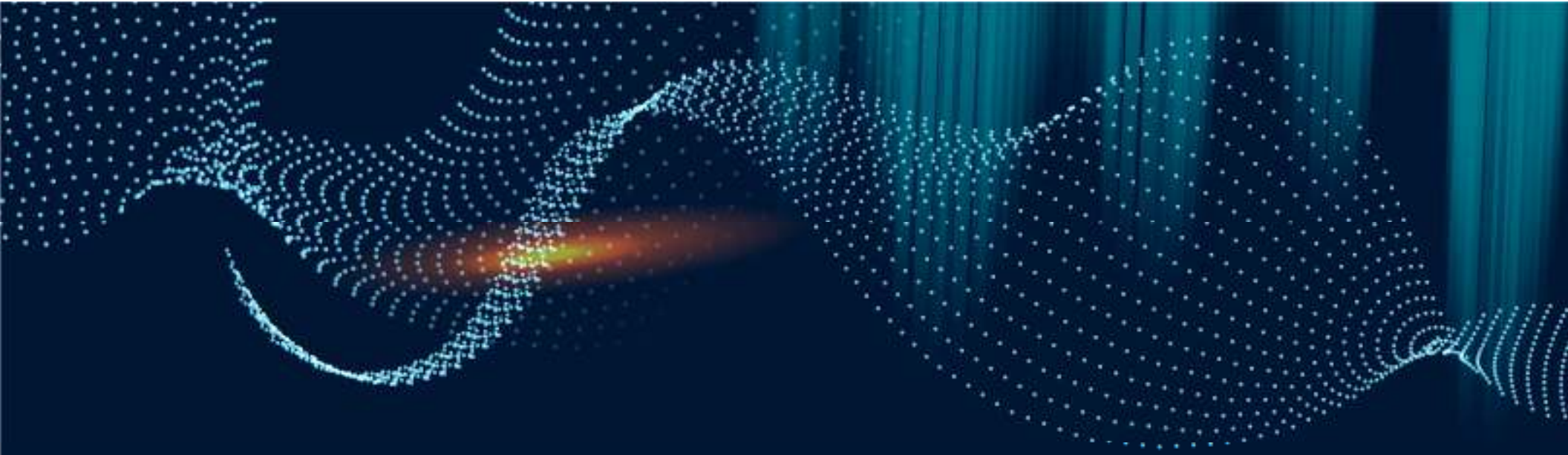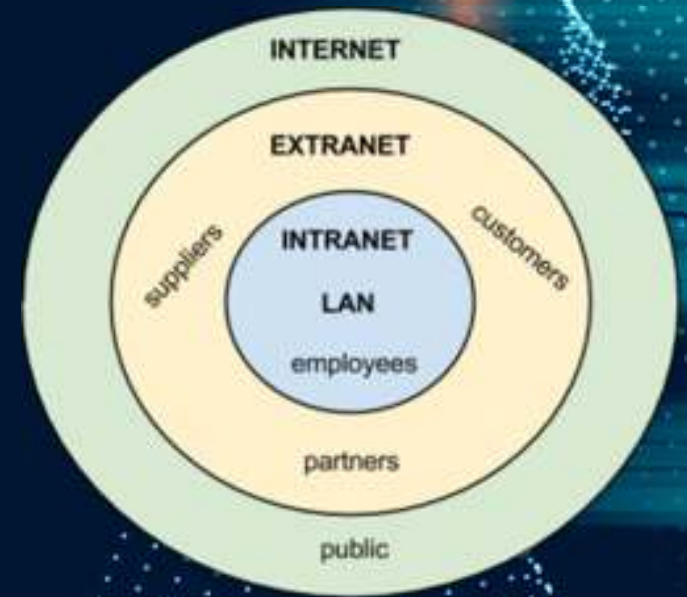
FIREWALL

Firewall: a system designed to prevent unauthorized access to or from a private network
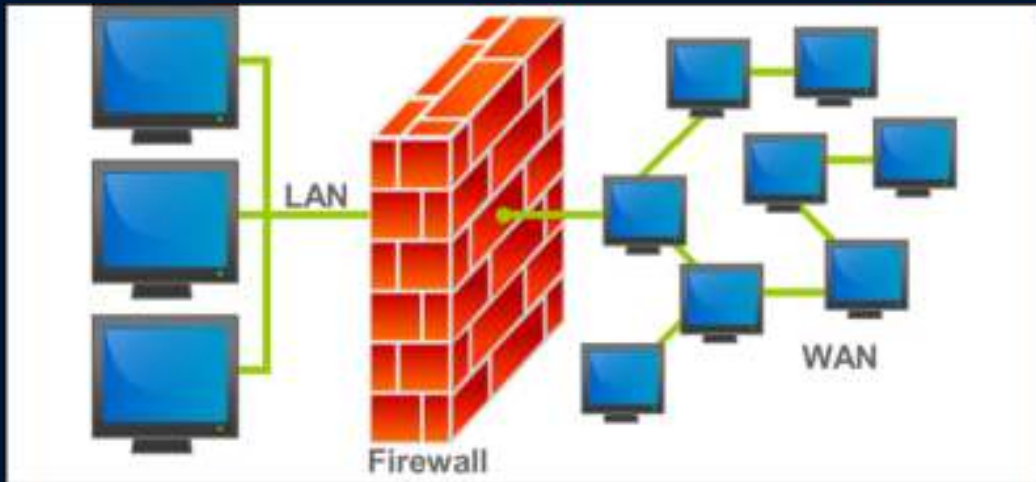
PROXY SERVER

Proxy server: a computer system or router that functions as a relay between client and server. It helps prevent an attacker from invading a private network and is one of several tools used to build a firewall

03 | NETWORK SECURITY

NETWORK SECURITY

Network security is a broad term that covers a multitude of technologies, devices and processes

Controls

There are many layers to consider when addressing network security across an organization. Attacks can happen at any layer in the network security layers model, so your network security hardware, software and policies must be designed to address each area.

Network security typically consists of three different controls:

- **physical**
- **technical**
- **administrative**

NETWORK SECURITY

Types of network security

- Network Access Control

- Antivirus and Antimalware Software

- Firewall Protection

- Virtual Private Networks

NETWORK SECURITY

Network Access Control

     To ensure that potential attackers cannot infiltrate your network, comprehensive access control policies need to be in place for both users and devices. Network access control (NAC) can be set at the most granular level. For example, you could grant administrators full access to the network but deny access to specific confidential folders or prevent their personal devices from joining the network.

NETWORK SECURITY

Antivirus and Antimalware Software

Antivirus and antimalware software protect an organization from a range of malicious software, including viruses, ransomware, worms and trojans. The best software not only scans files upon entry to the network but continuously scans and tracks files.

NETWORK SECURITY

Firewall Protection

     Firewalls, as their name suggests, act as a barrier between the untrusted external networks and your trusted internal network. Administrators typically configure a set of defined rules that blocks or permits traffic onto the network. For example, Forcepoint's Next Generation Firewall (NGFW) offers seamless and centrally managed control of network traffic, whether it is physical, virtual or in the cloud.
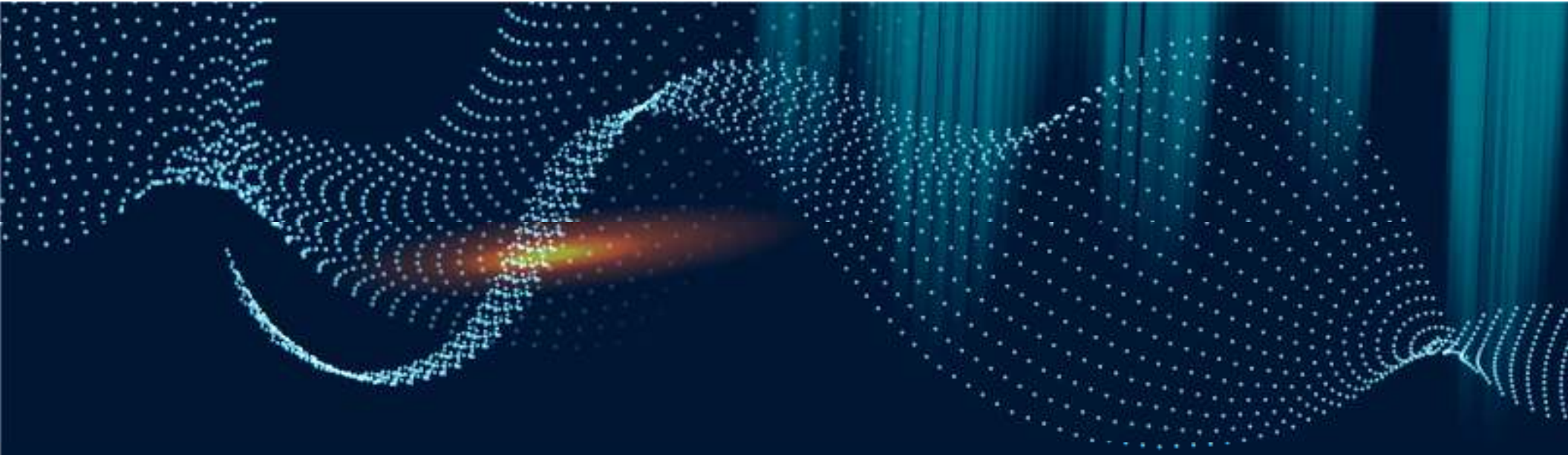
NETWORK SECURITY

Virtual Private Networks

Virtual private networks (VPNs) create a connection to the network from another endpoint or site. For example, users working from home would typically connect to the organization's network over a VPN. Data between the two points is encrypted and the user would need to authenticate to allow communication between their device and the network. Forcepoint's Secure Enterprise SD-WAN allows organizations to quickly create VPNs using drag-and-drop and to protect all locations with our Next Generation Firewall solution.

04

CAREERS IN IT

EXAMPLES OF CAREERS IN IT

COMPUTER
PROGRAMMER

QUALITY ASSURANCE
TESTER

NETWORK
ENGINEER

IT TECHNICIAN

SOFTWARE ENGINEER

IT SECURITY SPECIALIST

EXAMPLES OF CAREERS IN IT

SYSTEMS ANALYST

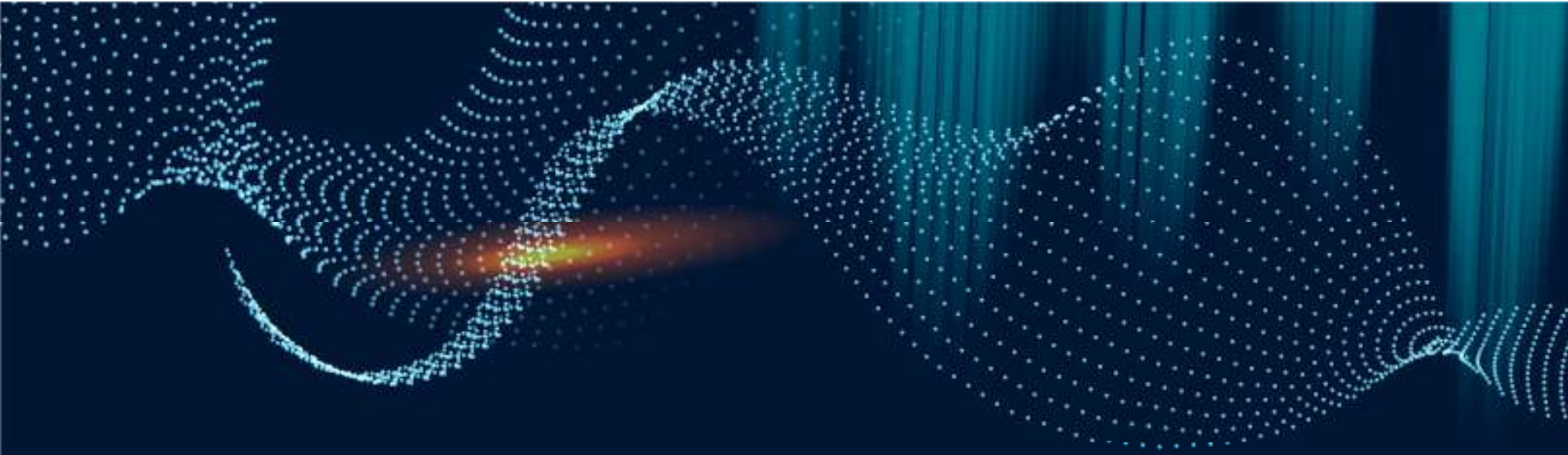DATABASE
ADMINISTRATOR

COMPUTER
SCIENTIST

WEB DEVELOPER

SUPPORT SPECIALIST

USER EXPERIENCE
DESIGNER

A LOOK TO THE FUTURE

05

Are IT careers still relevant in the future?

YES !

In fact, most predicted high in-demand jobs in the future are projected to be related to IT in someway

A LOOK INTO THE FUTURE

Innovation of Virtual Reality

A LOOK INTO THE FUTURE

Innovation of Augmented Reality

A LOOK INTO THE FUTURE

Internet for Everyone

THANKS!

Any questions?