



DEPARTMENT OF INFORMATION TECHNOLOGY

FACULTY OF MANAGEMENT STUDIES AND COMMERCE

UNIVERSITY OF SRI JAYEWARDENEPURA

ITC 1370

Information Technology for Business

Chapter 05

Networking and Communication



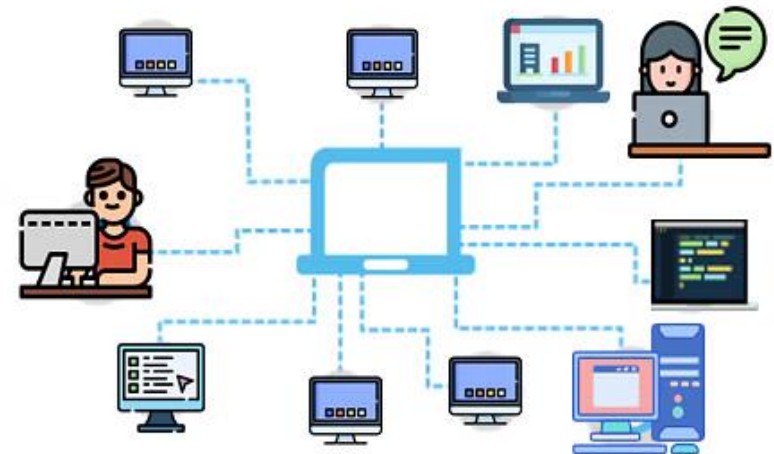
Learning objectives

Upon successful completion of this chapter, you will be able to:

- Define a computer network and its application.
- Identify the data transmission characteristics.
- Outline the types of wired and wireless networking media.
- Identify the networking architecture and network types.
- Describe several types of networking devices with their purpose.
- Identify the most common communication protocols and networking standards used with networks today.
- Identify the trends in networking.

What is a Computer network?

- A collection of computers and other hardware devices connected together so that users can share hardware, software, and data, as well as electronically communicate with each other.
- Computer networks range from small private networks to the Internet and are widely used by individuals and businesses today.





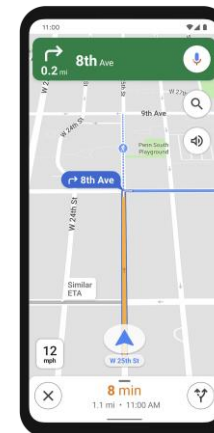
Networking Applications

- **The Internet** – The largest computer network in the world
- **Telephone Service**
 - POTS Network (Plain Old Telephone Service)
 - Mobile phones (wireless phones) - use a wireless network for communications instead of the regular telephone network.
 - Cellular Phones -> communicates via cellular technology
 - Satellite phones -> communicate via satellite technology. Used where cell service isn't available
 - Dual mode phones -> cellular technology and Wi-Fi or cellular technology and satellite technology

Networking Applications (Contd.)

- **Global positioning system (GPS)** - Uses satellites and a GPS receiver to determine the exact geographic location of the receiver.

Used in Cars and smartphones, Google Maps to find out real-time traffic situations to avoid congested roads, Consumer devices that are designed for specific purposes (eg: Wearable fitness devices)





Networking Applications (Contd.)

- **Monitoring systems** – Monitor the status or location of individuals, vehicles, objects, etc.
 - **RFID-based systems:** To locate shipping boxes, livestock, expensive equipment, etc. (Ex: Tracking books at the university library)
 - **GPS-based systems:** record location history and allow tracking of real-time location of vehicles/people/objects
 - **Electronic health monitors:** Take the vital signs of an individual (such as weight, blood-sugar readings, or blood pressure) and transfer readings to a healthcare provider via the Internet or a telephone network for evaluation and feedback and to detect potential problems as early as possible. (Ex: FitBit)
- **Wireless Power Transmission**
 - The first wireless power application to become available is wireless charging, which allows your smartphone or other mobile device to be charged by just placing it on a charging surface.
 - It uses magnetic induction to transfer power wirelessly from the charging device to the target device.

Networking Applications (Contd.)

- **Multimedia Networking**

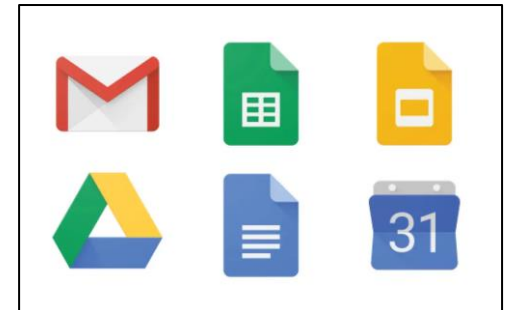
- Home Networks are used to connect smart TVs to the Internet
- In-built networking capabilities with wireless technology in smart TVs
- A streaming media player can be used to connect a conventional TV to the home network

Ex: Dialog ViU Mini, Chromecast with Google TV



Networking Applications (Contd.)

- **Videoconferencing** - Use of networking technology to conduct real-time, face-to-face meetings between individuals physically located in different places.
- **Collaborative computing/Workgroup computing** - Use of collaborative software tools to enable individuals to work together on documents and other project component
- **Telecommuting/teleworking** - Individuals work at home and communicate with their place of business and clients via communications technologies





Networking Applications (Contd.)

- **Business process outsourcing** - contracting out the operations of a specific business process to a third-party service provider specialized in it.
Ex: Establish call centers in other countries.
- **Remote Freelance working** - doing specific work for clients without committing to full-time employment.
- **Crowdsourcing** - collecting services, ideas or content through the contributions of a large group of people.
Ex: Google maps, Netflix, Amazon
- **Telemedicine** - Use of networking technology to provide medical information and services.
Ex: Remote monitoring and consultations, Remote diagnosis, Tele-surgery (robot-assisted surgery)



Data Transmission Characteristics

- **Bandwidth:** bandwidth refers to the amount of data that can be transferred (such as via a bus or over a certain type of networking medium) in a given time period.
 - Text data requires the least amount of bandwidth; video data requires the most.
 - Bandwidth is usually measured in the number of bits per second (bps)
 - Performance measurement
- **Analog Vs. Digital Signals:** Data can be represented as either analog or digital signals.
 - Voice and music data in its natural form, for instance, is analog, and data stored on a computer is digital.
 - Most networking media send data using digital signals, in which data is represented by only two discrete states: 0s and 1s.
 - Analog signals, such as those used by conventional telephone systems, represent data with continuous waves.



Networking Media

- **Wired network connection (Guided Media):** the computers and other devices on the network are physically connected (via cabling) to the network.
Ex: conventional telephone networks, cable TV networks
- **Wireless network connection (Unguided Media):** wireless (usually radio) signals are used to send data through the air between devices, instead of using physical cables
Ex: Wi-Fi, Satellite TV connection, Bluetooth



Wired Networking Media

- **Twisted-pair Cable:** A twisted-pair cable is made up of pairs of thin strands of insulated wire twisted together.
 - Twisted-pair is the least expensive type of networking cable and has been in use the longest.
- **Coaxial Cable:** Coaxial cable was originally developed to carry a large number of high-speed video transmissions at one time, such as to deliver cable TV service.
- **Fiber-optic Cable:** the newest and fastest of these three types of wired transmission media.
 - It contains multiple (sometimes several hundred) clear glass or plastic fibers, each about the thickness of a human hair.

Wired Networking Media (Contd.)

The entire cable is covered by a plastic covering.



TWISTED-PAIR CABLES

Pairs of copper wires are insulated with a plastic coating and twisted together; most cables contain at least two pairs.

Twisted-pair cable connector.



The entire cable is covered by a plastic covering.



COAXIAL CABLES

Outer conductor is made out of woven or braided metal.

White insulating material surrounds the copper wire.

The innermost part of the cable is a single copper wire.

Coaxial cable connector.



The entire cable is surrounded by strengthening material and covered by a plastic covering.



FIBER-OPTIC CABLES

The core of each fiber is a single glass or plastic tube, which is surrounded by a reflective cladding.

A protective plastic coating protects each fiber; a cable contains multiple fibers.

Fiber-optic cable connector.





Wireless Networking Media

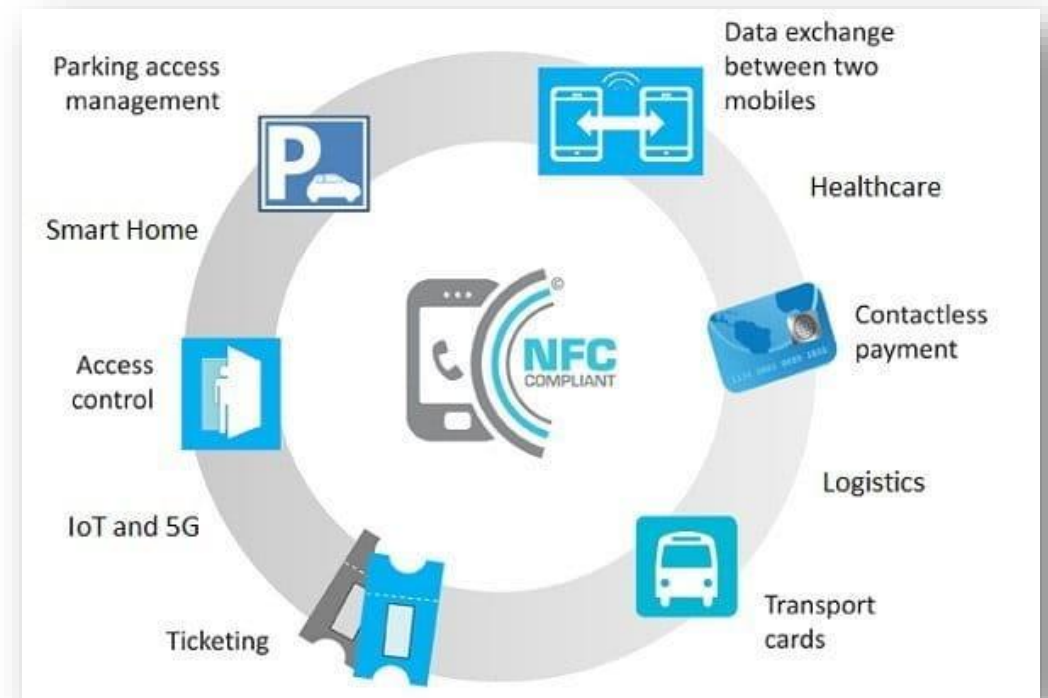
Radio signals:

- Send data through the airwaves
- Short range (such as Bluetooth) can connect a wireless keyboard or mouse to a PC
- Medium range (such as Wi-Fi) are used for wireless LANs and to connect portable PC users to the Internet at public hotspots
- Radio frequencies are measured in Hertz (Hz)

Wireless Networking Media (Contd.)

What is NFC?

NFC stands for “**Near Field Communication**” and, as the name implies, it enables short-range communication between compatible devices. This requires at least one transmitting device and another to receive the signal.



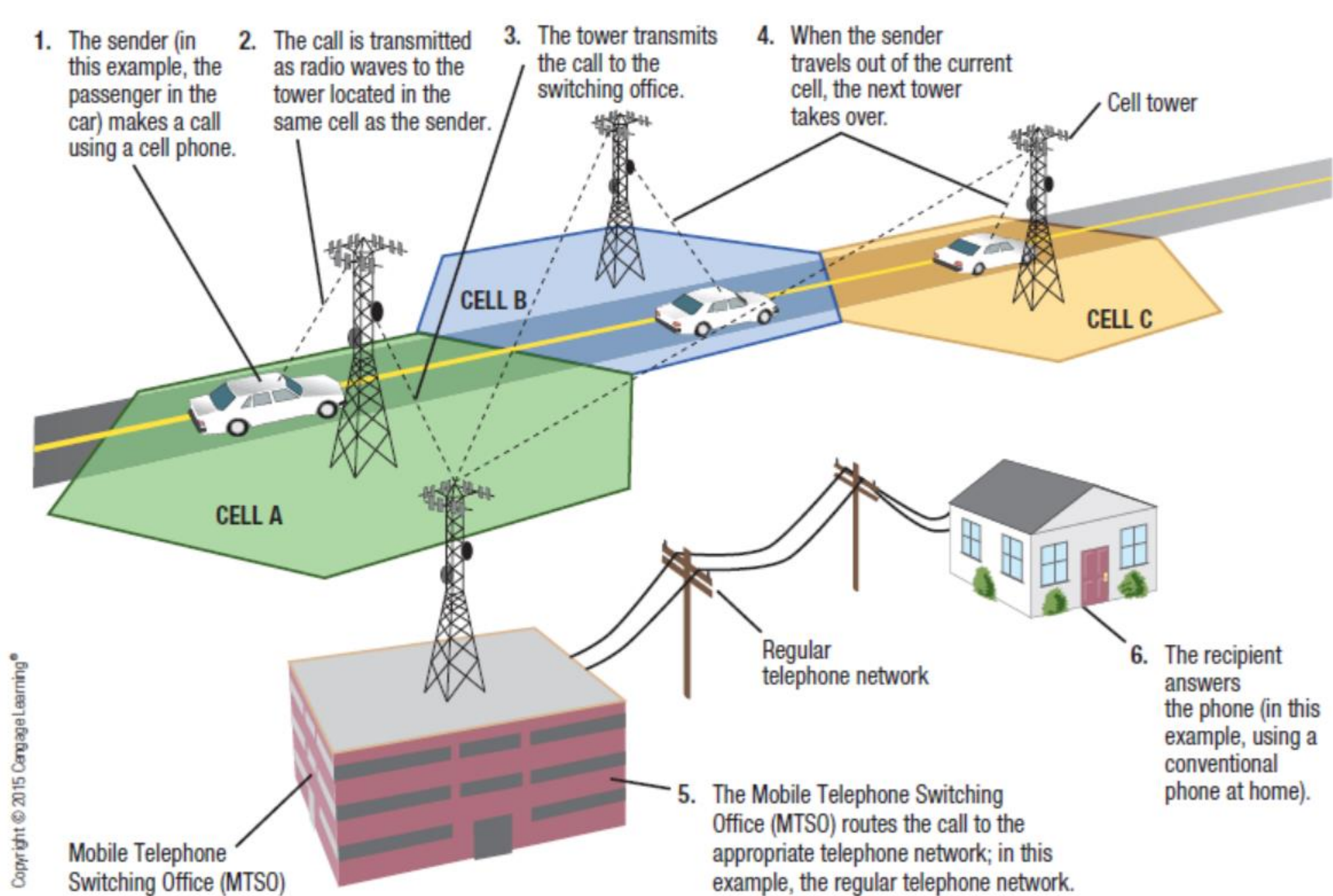
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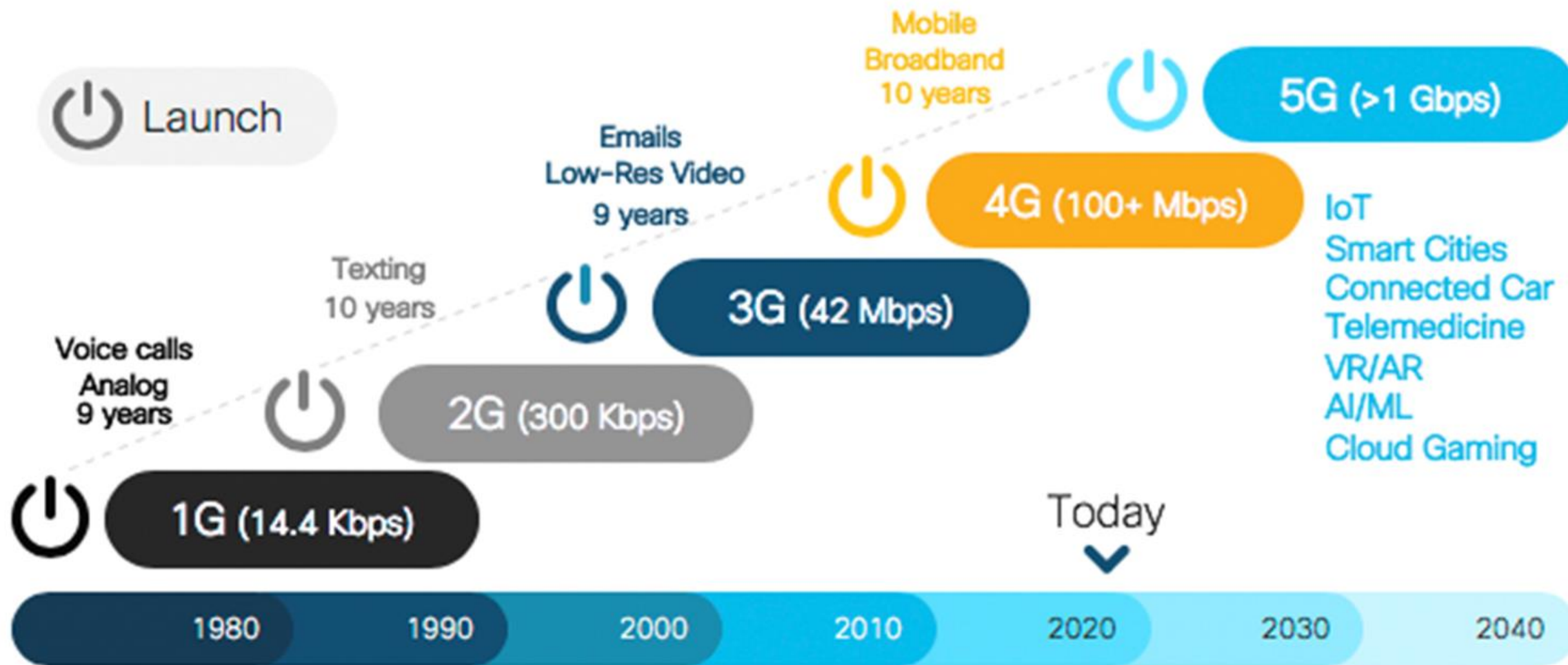
Wireless Networking Media (Contd.)

Cellular Radio Transmissions:

- Use cellular towers within cells
- Calls are transferred from cell tower to cell tower as the individual moves
- Different transmission frequencies are used to avoid interference and allow multiple conversations to take place via a single tower at one time
- Widely used, but cell service is not available everywhere



1G to 5G



Source: Cisco VNI Global Mobile Data Traffic Forecast, 2017-2022



Wireless Networking Media (Contd.)

Microwave and Satellite Transmissions:

- Can send large quantities of data at high speeds over long distances.
- Microwave signals can be sent or received using microwave stations or communications satellites.
- Microwave stations are earth-based stations that can transmit microwave signals directly to each other over distances of up to about 30 miles.
- Communications satellites are space-based devices launched into orbit around the earth to receive and transmit microwave signals to and from earth.
- **Applications:** satellite television and Internet service, GPS receivers, satellite radio receivers, and satellite phones.

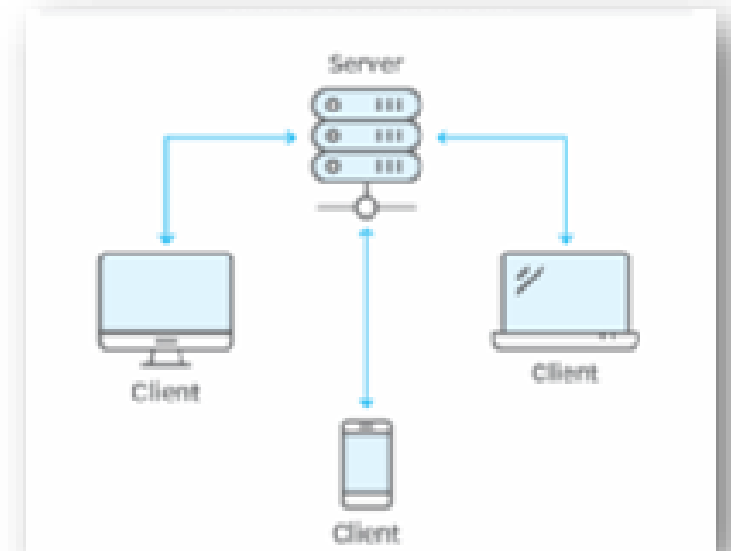
Networking Architecture

- The configuration of computers, devices, and media on a network is sometimes called the network architecture (The way they are designed to communicate).

1. Client-server networks

Client: PC or other device on the network that requests and utilizes network resources

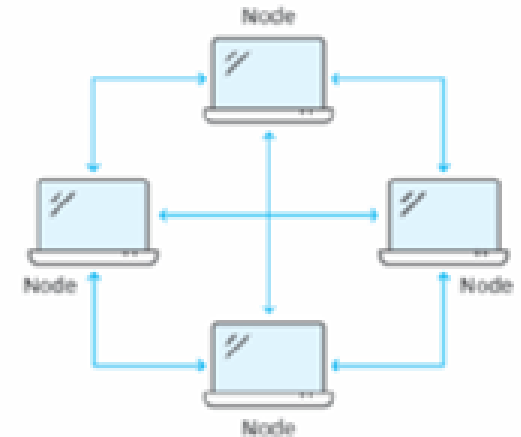
Server: Computer dedicated to processing client requests



Networking Architecture (Contd.)

2. Peer-to-Peer networks

- A central server is not used
- All computers on the network work at the same functional level
- Users have direct access to the computers and devices attached to the network
- Less complicated and less expensive to implement than client-server networks
- Content is exchanged over the Internet directly between users instead of placing content on a Web server for others to view via the Internet.



Network Types (Based on Size and Coverage Area)

Personal Area Network (PAN):

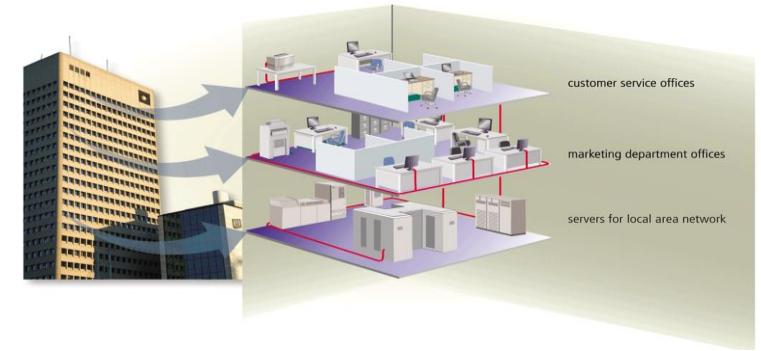
- A network that connects computers and devices in an individual's workspace with wired and/or wireless technology.
- This is designed to enable those connected devices to communicate and share resources



Network Types (Based on Size and Coverage Area)

Local Area Network (LAN):

- A network that connects computers and devices in a limited geographical area such as a home, an office building, or a school



Wireless LAN (WLAN):

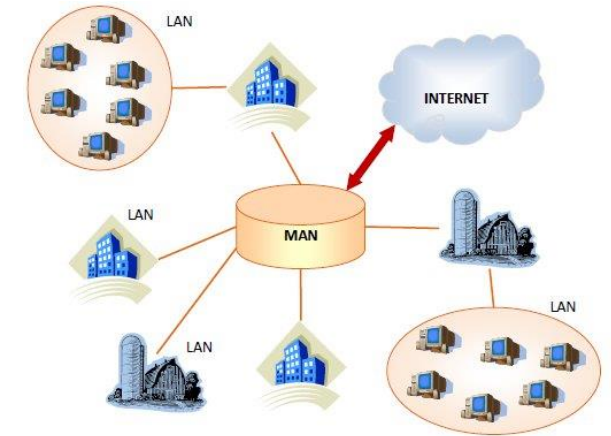
- A LAN that uses no physical wires



Network Types (Size and Coverage Area)

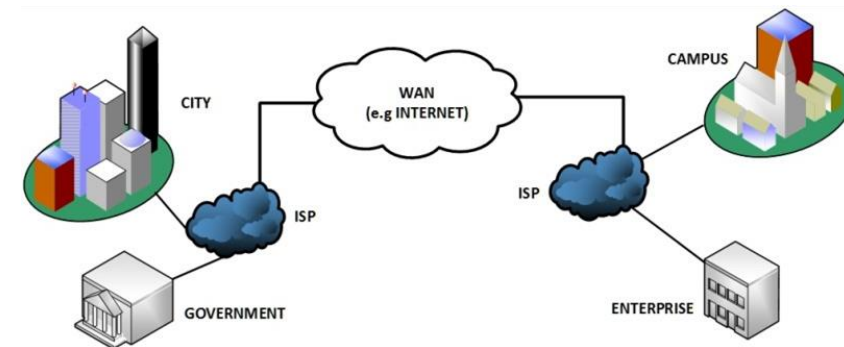
Metropolitan Area Network (MAN):

- A network that connects LANs in a metropolitan area



Wide Area Network (WAN):

- A network that covers a large geographic area. WAN consists of two or more LANs that are connected using communications technology.
- WAN may be publicly accessible or privately owned and operated





Organizational Networking

Intranet: A private network (such as a company LAN) that is designed to be used by an organization's employees and is set up like the Internet

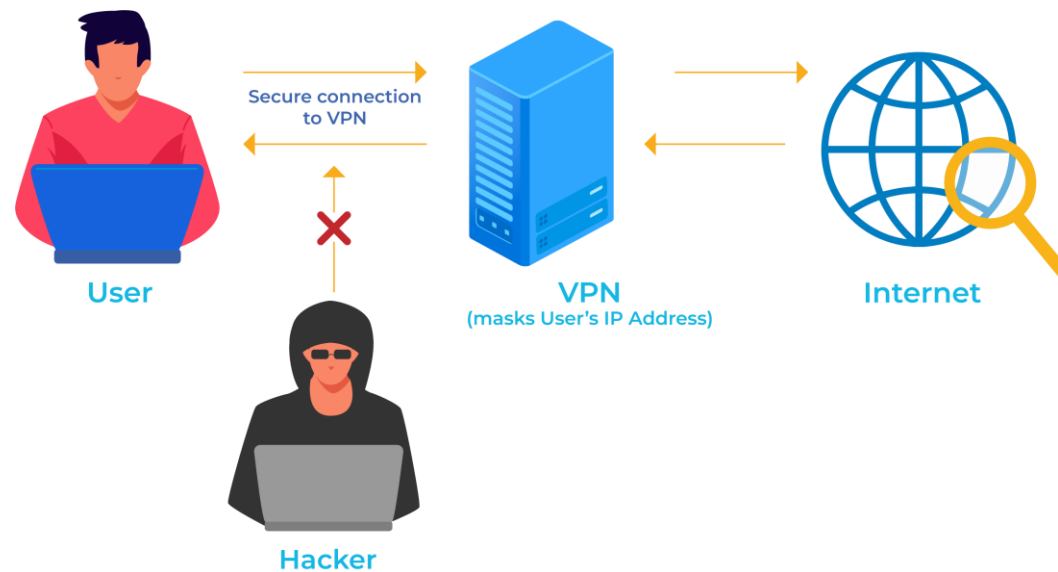
Extranet: A company network (Intranet) that is accessible to authorized outsiders like customers and business partners (Ex: Credit Information bureau (CRIB))

Internet: The Internet is a worldwide collection of separate, but interconnected, networks accessed daily by billions of people using a variety of devices.

Organizational Networking (Contd.)

Virtual Private Networks (VPNs):

- A private, secure path across a public network that is set up to allow authorized users.
- VPN is necessary for setting up both intranet and extranet environments to establish secure connections over the internet.



Networking Devices

- **Network adapter** – Used to connect a PC to a network or the Internet
 - Also called network interface card (NIC) when in the form of an expansion card
 - Available in a variety of formats
 - Adapter must match the type of network being used (Ethernet, Wi-Fi, Bluetooth, etc.)
 - Are often built into portable computers



Networking Devices (Contd.)

- **Switches** – Connects multiple devices together and forwards packets based on their destination within the local network.



Switch

- **Router** – A device that receives and analyzes set of data (packet) and then routes them towards their destination device.



Router

Networking Devices (Contd.)

- **Wireless Access Points (WAPs):** facilitate the connection of wireless devices to an existing wired local area network (LAN) and allow them to access resources on that network.
- WAPs provide wireless connectivity, while a router manages the flow of data between different networks.
- In many home and small office scenarios, these functionalities are often combined in a single device called a **wireless router**.



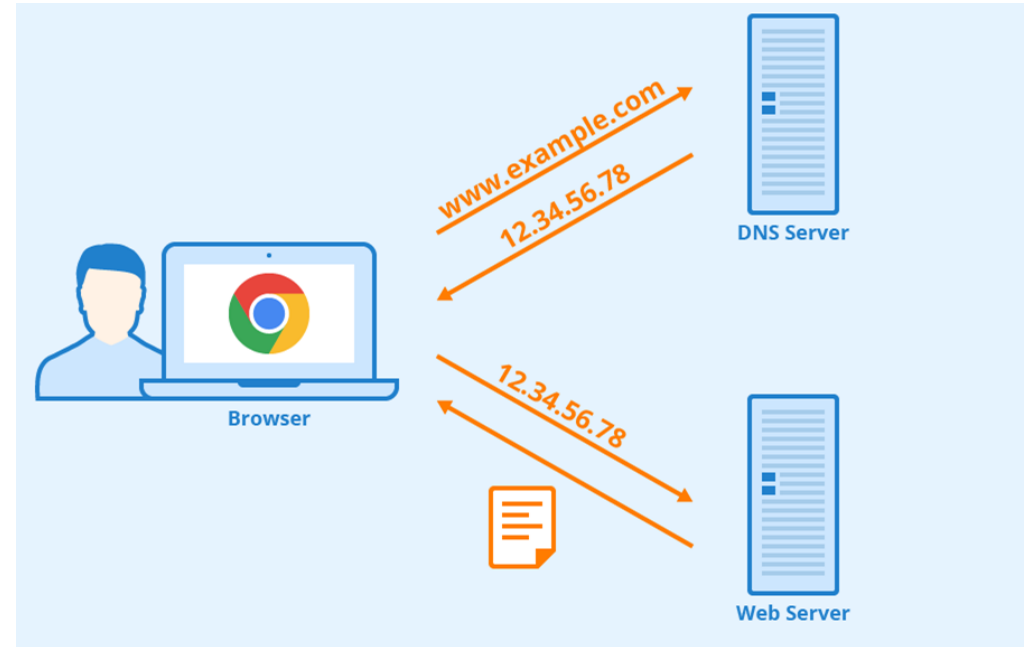


Networking Terms

- **Internet Protocol (IP) Address** – A unique identification number assigned to every device on the Internet.
 - **IPv4:** format of four numbers with values ranging from 0 and 255 separated by a period. (Ex: 192.158.1.38)
 - *Full IP addressing range goes from 0.0.0.0 to 255.255.255.255*
 - *Limit 4,294,967,296 addresses*
 - **IPv6:** Eight groups of four hexadecimal digits (Ex: 2001:0db8:85a3:0000:0000:8a2e:0370:7334)
 - *Hexadecimals are base 16 (0 1 2 3 4 5 6 7 8 9 a b c d e f)*
 - *Limit 3.4×10^{38} addresses*

Networking Terms (Contd.)

- **Domain Name** – common name for a Website so you don't have to remember the IP address.
- **Domain Name System (DNS)** – Acts as the directory of websites on the Internet. Translates domain names to IP addresses.



- **Packet** – The fundamental unit of data transmitted over the Internet



Communication Protocols

Protocol – Set of rules that allow devices to exchange information.

- **TCP/IP:** TCP/IP is the protocol used for transferring data over the Internet and consists of two protocols:
 - Transmission Control Protocol (TCP), which is responsible for the delivery of data, and
 - Internet Protocol (IP), which provides addresses and routing information.
- **HTTP:** HTTP (Hypertext Transfer Protocol) and HTTPS (Secure Hypertext Transfer Protocol) are protocols used to display Web pages.
- **FTP:** FTP (File Transfer Protocol) and SFTP (Secure File Transfer Protocol) are protocols used to transfer files over the Internet.
- **SMTP:** Protocols used to send and receive e-mail over the Internet (Simple Mail Transfer Protocol)

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Network Standards

A networking standard specifies technical requirements, specifications, and guidelines that must be employed to ensure consistency, efficiency, and quality of service of all networking devices.

Ethernet: the most widely used standard for wired networks. It is typically used with LANs.

- Can be used in conjunction with twisted-pair, coaxial, or fiber-optic cabling.
- the most common today are Fast Ethernet, Gigabit Ethernet, and 10 Gigabit Ethernet.
- A relatively new Ethernet development is Power over Ethernet (PoE), which allows electrical power, in addition to data, to be sent over the cables in an Ethernet network (often referred to as Ethernet cables).



Network Standards (Contd.)

Wi-Fi: One of the most common networking standards used with wireless LANs is Wi-Fi - a family of wireless networking standards that use the IEEE 802.11 standard.

- Wi-Fi is the current standard for wireless networks in the home or office, as well as for public Wi-Fi hotspots. Wi-Fi hardware is built into virtually all portable computers and most mobile devices today.
- The speed of a Wi-Fi network and the area it can cover depend on a variety of factors, including the Wi-Fi standard and hardware being used, the number of solid objects between the access point and the computer or other device being used.
- **Wi-Fi6** is the latest generation and standard for wireless networking.

Trends in Networking

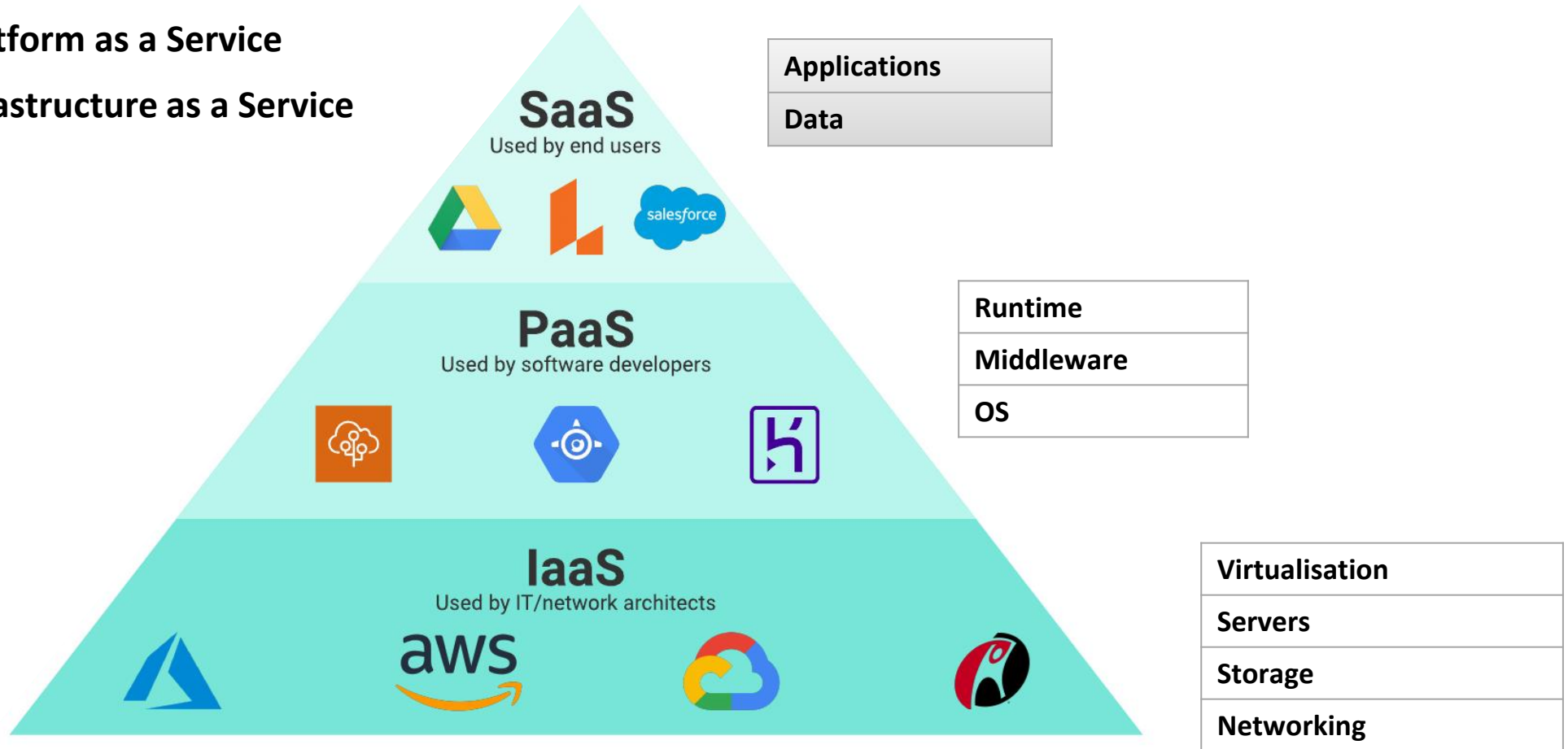


Cloud Computing

- The “cloud” refers to applications, services, and data storage located on the Internet.
- Cloud service providers rely on giant server farms and massive storage devices that are connected via the Internet.
- Cloud computing allows users to access software and data storage services on the Internet.

Cloud Computing Models

1. SaaS: Software as a Service
2. PaaS: Platform as a Service
3. IaaS: Infrastructure as a Service



Data Centers

- A data center is a facility used to house computer systems and associated components, such as telecommunications and storage systems.
- They are built with
 - redundant or backup power supplies
 - redundant data communications connections,
 - environmental controls
(e.g., air conditioning, fire suppression)
 - security controls
- Cloud data centers have become a trend with the IaaS model of cloud computing (Ex: AWS)





Cloud Computing Benefits

- No software to install or upgrades to maintain
- Available from any computer that has access to the Internet
- Can scale to a large number of users easily
- New applications can be up and running very quickly
- Services can be leased for a limited time on an as-needed basis
- Your information is not lost if your hard disk crashes or your laptop is lost or stolen
- You are not limited by the available memory or disk space on your computer

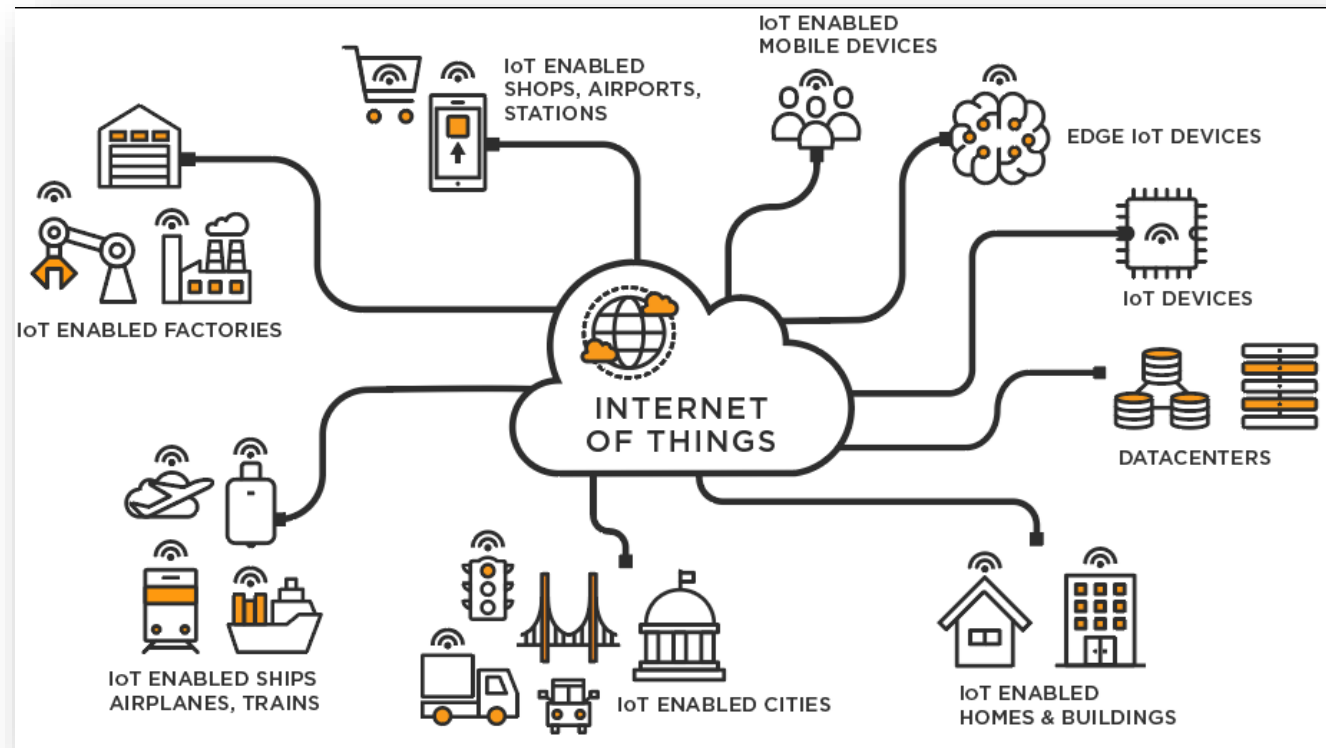


Cloud Computing Problems

- Security
- Access – if you lose Internet, it's over
- Isn't always as easy as it seems
- Service from a giant host might not be as good as what you get in-house
- Locked into a specific service provider

Internet of Things (IoT)

- A network of billions of devices, each with their own unique network address, around the world with embedded electronics allowing them to connect to the Internet for the purpose of collecting and sharing data, all without the involvement of human beings.



Edge Computing

- Edge computing relocates certain storage and computation resources away from the central data center and closer to the source of the data itself.
- It is an emerging technology that enables processing data at higher rates and volumes, leading to more action-oriented outcomes in real-time.



Thank You