# PC-2209 Networking 1

Christian Jay B.Tantan
Ronnie V. Edec

Bachelor of Science in Information Technology
College of Arts, Sciences and Technology

# VISION

Laguna University shall be a socially responsive educational institution
of choice providing holistically developed individuals
in the Asia-Pacific Region

# MISSION

Laguna University is committed to produce academically prepared
and technically skilled individuals who are socially
and morally upright

**Course Code:** **PC 2209**

Course Description: Builds a deeper understanding of how networks work, including the topics of LANs,WANs, service providers, packets, hubs, routers, switches, Internet protocols. Introduces students to the fundamentals of networks and networking in IT. Includes routing, switching, physical layer, security, and application areas.

**Course Intended Learning Outcomes (CILO):**

At the end of the course, students should be able to:

1. Explain analysis of algorithms;
2. Construct proofs using Mathematical techniques;
3. Compute the running time of a program;
4. Analyze different sorting algorithms;
5. Develop efficient algorithms;

**Course Requirements:**

- **Class Standing (CS)** **- 60%**
- **Major Exam (ME)** **- 40%**

**Term Grade** **100%**

**Grade Computation**

**Prelim Grade (PG)** = (CS x 60%) + (ME x 40%)

**Midterm Grade (MG)** = ((CS x 60%) + (ME x 40%)) x 70%)+(PG x 30%)

**Final Grade** = ((CS x 60%) + (ME x 40%)) x 70%)+(MG x 30%)

# Table of Contents


Module 1: Introduction Data Communication and Computer Networking
Introduction
Learning Outcomes
Lesson 1. What is Data Communication? 1
Lesson 2. Data Representation 2
Lesson 3. What is a Computer Network? 3
Lesson 4. Classification of Computer Network 4
Assessment Tasks 5
Summary 6
References

Module 2: Network Application and Physical Structures 7
Introduction 8
Learning Outcomes 9
Lesson 1. Network Application 10
Lesson 2. Physical Structures 11
Network Topologies 12
Assessment Tasks 13
Summary 14
References 15
16
Module 3:Types of the Computer Network and the Internet 17
Introduction 18
Learning Outcomes 19
Lesson 1. Types of Computer Network 20
Lesson 2. The Internet 21
Assessment Tasks 22
Summary 23
References 24

Module 4:Data Flow, Access Networks and Physical Media 25
Introduction 26
Learning Outcomes 27
Lesson 1. Data Flow 28
Lesson 2. Accessing the Network 29
Lesson 3. Physical Media 30
Assessment Tasks 31
Summary 32
References 33

# MODULE 1
# OVERVIEW OF DATA COMMUNICATION AND COMPUTER NETWORKING

## Introduction

We have moved into an information society dominated by computers, data communications, and highly skilled individuals. At no other time in our history, has success (whether individual, corporate, or national) depended so heavily on intelligence and information.

Nowadays, with the use of modern technology, we can now easily communicate with someone miles away from us. We can have a real-time communication, video conferencing, phone calls and almost every kind of communication. But how does this information travels? How is the process of communication reach its destination? (Ramakrishhan, Raghu and Gehrke,Johannes,2018).

## Learning Outcomes

At the end of this lesson, the student should be able to:

- ✓ Understand the data communication and its concept
- ✓ Differentiate different types of data representation
- ✓ Classify a network within their point of view

## Lesson 1. What is Data Communication?

Data communication is the exchange of data between two devices via some form of transmission medium. For data communication to occur, the communicating devices, must be part of a communication system made up of a combination of hardware (physical component) and software.

## History of Data Communication

**1940. SMALL STEP FOR MAN, GREAT LEAP FOR COMMUNICATIONS.** With morse code, the telephone, and radio signals behind him, George Stibitz took networking technology a great leap forward when he sent computing commands over a teletype machine from his model at Dartmouth College to his Complex Number Calculator in New York.

**1943. TELETYPE COMPUTATION.** Stibitz's successful telegraph prompted a new method of computation, which was quickly used for loop-based teleprinters and automated telegraphs. An IBM adaptation of this technology was able to transmit punched cards at whooping 25 bits per second (bps)

**1948. TELETYPE MODEMS TO SAGE.** Telephone systems using early teletype communication modems were used to transmit multiple images across the United States to Semi-automatic Ground Environment (SAGE) computers. This increased the amount of data being transferred but also resulted in slower speeds at the receiving end.

**1958. AMERICAN TELEPHONE & TELEGRAPH BRINGS THE DIGITAL SUBSET.** Speed was boosted by over 4 times, sending a new record of 110 bits per second through American Telephone & Telegraph (AT&T) computer modems, called Digital Subsets. This Digital Subsets linked SAGE computers across the United States and Canada

**1962. AT&T RELEASES BELL 103 DATA PHONE**. The first civilian commercial computer modem, the Bell 103 Data Phone, allowed digital data to be transmitted over a regular unconditioned telephone lines. These modems were extremely expensive and were not typically used for personal communications.

**1962. INTERGALACTIC COMPUTER NETWORK.** J. C. R. Licklider leads the Advanced Research Projects Agency (ARPA) to create and link a network of computers across the world, effectively known as the Intergalactic Computer Network. This would allow the data and programs to be shared by any of the connected computers.

**1965. WIDE AREA NETWORK.** The first wide area computer network is created by Thomas Marill and Lawrence G. Roberts, linking PC's across multiple systems. This served as a precursor to ARPANET, a project which Roberts would manage.

**1977. THE HAYES 80-130A**. The first personal computer modem, the Hayes 80-130A, was designed by Dennis Hayes and Dale Heatherington. The device allowed computer users to connect directly to their phone lines to create a personal network, something never experienced before.

**1981. THE HAYES SMARTMODEM.** An improved iteration, the Hayes Smartmodem, is released. This device offered 300 bits per second in an affordable body. It also enabled users to perform function like initializing, hanging-up, and auto-dialing. A 1200 bits per second version of the Hayes Smartmodem was released soon after.

**MID 80's MODEMS HIT THE FAST LANE.** IBM PC clones dominated the PC market, leading to a new era of internal Industry Standard Architecture (ISA). Peripheral Component Interconnect (PCI) modem cards were designed for additional PC compatibility, extending WAN reach. This marked the era of Broadband Services.

**1989. THE WORLD WIDE WEB.** Consumer demand for more visual imagery, a better web-browsing interface, and more online content prompted Sir Tim Berners-Lee to create an Information Management proposal. This would eventually become the foundation for what we use today, the World Wide Web.

**MID 90's. LOWER COSTS AND FASTER SPEEDS.** Home broadband entered the market in 1991, and people all over the world began accessing the Internet using Berner's Lee's World Wide Web. Prices for commercial PCI modems plunged and vendors began to ship out modems as standard components of PCs and laptops.

**1996. THE 56K.** Brent Townshend created the technology for the first 56k modem, a model which used a bitrate of 56. 0/33.06 kilobytes per second, doubling the speed and power of previous modems. The 56K gained immediate popularity due to its price point. Local Area Network (LANs) started becoming popular in commercial businesses.

**EARLY 2000's. ANALOG OUT, ISDN, ADSL & CABLE IN.** Major companies began moving toward new approaches to gain faster modem speeds. All digital phone lines (ISDN) surfaced as an alternative to analog. Cable TV modems gather a great amount of attention. Phone companies soon figured out how to deliver digital data more economically through Asymmetric Digital Subscriber Lines (ADSL), boosting speeds over existing telephone copper deployments.

**2002. 3G ARRIVES.** Commercial third generation wireless connection (3G) was launched, offering application services like wide-area wireless voice, mobile internet (a fascinating feature), video calling, and on-the-go TV. LANs were commonly used in business and in customer homes. To meet the standards for 3G, a system was required to provide peak data rates of at least 200 kilobits per second (kbps).

**MID 2000's. THE WIRELESS AGE MATURES.** Broadband Internet services and wireless access networks quickly became mainstream technology due to the convenience and ease of access. Users no longer required two phone lines to connect to the Internet. File sizes for videos, video games, music, and pictures increased, and more vendors released hardware models that could connect wirelessly to user devices, like early iPhones and tablets.

**2009. ENTER 4G/LITE.** 4G and LTE represented the new generation of cellular standards, satisfying the speeds required by heavily file sizes. New features were constantly introduced into customer premises equipment to enable functions for Internet service providers and end users. The 4G standard set peak speeds at 100 megabits per second for high mobility communication and 1 Gigabit per second for low mobility.

## Three Fundamentals of Data Communication

1. **DELIVERY.** The system must deliver data to the correct destination.
2. **ACCURACY.** The system must deliver data accurately.
3. **TIMELINESS.** The system must deliver data in a timely manner.

## Data Communication Concept

- **SENDER.** The one who transmit message.
- **RECEIVER**. The one who receives the message
- **MESSAGE**. The data sent by the sender
- **MEDIUM**. The material used where the message travels.
- **PROTOCOL.** The set of rules that allow electronic devices to communicate with each other

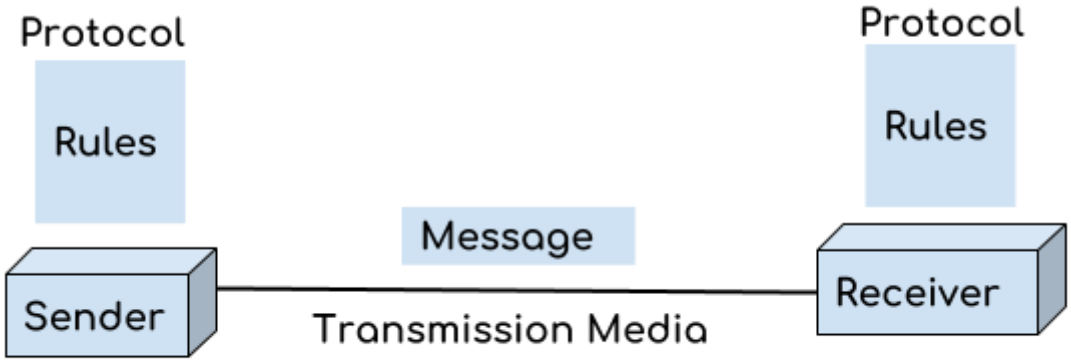



*Figure 1.1.1 Data Communication Concept*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

## Lesson 2. Data Representation

Data refers to the symbols that represent people, events, things, and ideas. Data can be a name, a number, the colors in a photograph, or the notes in musical operation. Data representation refers to the form in which data is stored, processed, and transmitted.

Data can be one of the following:

*Text*

Text is represented as a bit pattern, a sequence of bits. Different set of bit patterns have been designed to represent text symbols. Each set is called a **code,** and the process of representing symbols is called **coding**. Today, the prevalent coding system is called **Unicode,** which uses 32 bits to represent a symbol or character used on any language in the world. The **American Standard Code for Information Interchange (ASCII),** now constitutes the first 127 characters in Unicode and is also referred to as **Basic Latin.**

*Numbers*

Are also represented by bit patterns. The number is directly converted to a binary number to simplify mathematical operation

*Images*

Are also represented by bit patterns. An image is composed of a matrix of pixels, where each pixel is a small dot.

*Audio*

Refers to the recording or broadcasting of sound or music. Audio is by nature different from text, numbers, or images. It is continuous not discrete

*Video*

Refers to the recording or broadcasting of a picture or a movie. It can be produced as a continuous entity, or it ca be a combination of images.

## Lesson 3. What is a Computer Network?

Computer network is an interconnection of various computer systems located at different places.

### Properties of a Network

1. Facilitate communications
2. Permit sharing of files, data, and other types of information
3. Share network and computing resources

### Benefits of Network

- ✓ File Sharing
- ✓ Printer/Peripheral Sharing
- ✓ Internet Connection Sharing
- ✓ Multi-player Games
- ✓ Home Entertainment

## Lesson 4. Classification of Computer Network

Computer networks are classified based on various factors. They include:

- Geographical Span
- Interconnectivity
- Administration
- Architecture

**Geographical Span.** Geographically a network can be seen in one of the following categories:

- It may be spanned across your table, among Bluetooth enabled devices, ranging not more than few meters.
- It may be spanned across a whole building, including intermediate devices to
- connect all floors.
- It may be spanned across a whole city.
- It may be spanned across multiple cities or provinces.
- It may be one network covering whole world.

**Interconnectivity.** Components of a network can be connected to each other differently in some fashion. By connectedness we mean either logically, physically, or both ways.

- Every single device can be connected to every other device on network, making the network mesh.
- All devices can be connected to a single medium but geographically disconnected, created bus-like structure.
- Each device is connected to its left and right peers only, creating linear structure.
- All devices connected together with a single device, creating star-like structure.
- All devices connected arbitrarily using all previous ways to connect each other, resulting in a hybrid structure

**Administration.** From an administrator's point of view, a network can be private network which belongs a single autonomous system and cannot be accessed outside its physical or logical domain. A network can be public, which is accessed by all.

**Architecture.** Computer networks can be discriminated into various types such as Client-Server, peer-to-peer or hybrid, depending upon its architecture.

- There can be one or more systems acting as Server. Other being Client, requests the Server to serve requests. Server takes and processes request on behalf of Clients.
- Two systems can be connected Point-to-Point, or in back-to-back fashion. They both reside at the same level and called peers.
- There can be hybrid network which involves network architecture of both the above types.

## Assessment Task

### Activity No. 1:

Choose the answer from the box below. Write the letter of the correct answer on the space provided.

| | |
|---|---|
| A. Message | F. Receiver |
| B. Data Communication | G. Accuracy |
| C. Data | H. Geographical-Span |
| D. Hardware | I. Timeliness |
| E. Computer Network | J. Peer to Peer |

_____1. An interconnection of various of computers.

_____2. Contains nodes that are equal participants in data sharing.

_____3. The one who receives the message.

_____4. The system must deliver data accurately.

_____5. The exchange of data between two devices.

_____6. It may span within your table.

_____7. Refers to information presented in whatever form is agreed.

_____8. The data sent by the sender.

_____9. The system must deliver data in a timely manner.

_____10. Physical Component

## Activity No. 2

Explain each.

1. What is the process of the data communication concept?

2. In your own understanding, what is a protocol? Explain.

3. Elaborate the fundamentals of data communication.

4. What is the importance of a computer network?

5. For you, what is the best benefit of a network? And why?

_____

_____

_____

_____

_____

## Summary

This module has covered the overview of the Data Communication – an active process of transporting data from one point to another. Data communication has three fundamentals in order to be reliable; which is delivery, accuracy and timeliness. Data can be represented into different forms. It can be a text, number, audio, image or video.

Computer network is a group of connection of various computer that use a set of common communication protocols for the purpose of sharing resources. Network can be classified into different structure; which is geographical span which focuses on the range of a network, interconnectivity which focuses on the connectedness of a network, administration which focuses on the administrator's point of view, and architecture which focuses on the application of a network whether it is a client/server or a peer-to-peer connection(Ramakrishhan, Raghu and Gehrke,Johannes,2018).

# References

(Ramakrishhan, Raghu and Gehrke,Johannes,2018)

Source :SQL for beginners: A guide to study SQL programming and database management systems

Database management systems Gupta, G. K.,2018

# MODULE 2
# NETWORK APPLICATION AND PHYSICAL STRUCTURES

## Introduction

Technologies related to data communication and networking may be the fastest growing in our culture today. The appearance of some new social networking applications every year is a testimony to this claim. Every year, the communication grows bigger, became more accessible almost to anywhere.

In this lesson, let's start with the small ones, the small types of a network. All big comes from something small, and small can be something bigger, so let's tackle the physical structures of a network. (Ramakrishhan, Raghu and Gehrke,Johannes,2018).

## Learning Outcomes

At the end of this lesson, the student should be able to:

- ✓ Categorize different kinds of topologies based on their physical structures.
- ✓ Understand the flow of the data within the network.
- ✓ Recognize a network applications uses and differences.

### Lesson 1. Network Application

Network applications are network software applications that utilize the Internet or other network hardware infrastructure to perform useful functions. Network application can be defined as:

- Pure Network Application
- Stand-Alone Application

## Pure Network Applications

These are the applications created to be used in networks; they help us to transfer data and communicate within a network. Such applications have a separate and dis user interface that users must learn for instance.

- **Email Programs.** They allow users to type messages at their local nodes and then send to someone on the network. It is a fast and easy way of transferring mail from one computer to another.
- **File Transfer Protocol (FTP).** This application facilities transfer of files from one computer to another e.g. from a client to a server.

  There are 2 common processes involved in FTP

  - **Downloading:** This is the process of obtaining files from a server to a workstation or a client (for example when you download programs and music from a server).
  - **Uploading:** This is obtaining of files from a workstation to a server (for instance when you attach documents and upload them to a server, a good example being when you upload photos to Facebook).
- **Groupware.** These applications are used to automate the administrative functions of a modern office for instance **video conferencing** and **chatting**. They facilitate the work of groups and improve on their productivity; they can be used to communicate, co-operate, coordinate, solve problems, compete, negotiate among others.

## Stand-Alone Applications

These are applications that run on standalone computers (computers not connected to any other).

- Notepad
- Chrome
- Calculator
- Office

## Network

A **network** is the interconnection of a set of devices capable of communication. A device can be a **host** such as large computer, desktop, laptop, workstation, cellular phone or security system. A device can also be a **connecting device** such as router, switch, modem.

## Network Criteria

A network must be able to meet a certain number of criteria. The most important of these are **performance, reliability,** and **security.**

### Performance

Can be measured in many ways, including transit time and response time. The performance of a network depends on a number of factors, including the number of users, the type of transmission medium, the capabilities of the connected hardware and the efficiency of the software.

### Reliability

Can be measured by the frequency of failure, the time it takes a link to recover from a failure, and the network's robustness in catastrophe.

### Security

Network security issues include protecting data from unauthorized access, protecting data from damage and development.

## Lesson 2. Physical Structures

Physical structures or known as **Network Topology** refers to the way in which a network is laid out physically. Two or more devices connect to a link; two or more link links form a topology. The topology of a network is the geometric representation of the relationship of all the links and linking devices (usually called **nodes**) to one another.

## Network Topologies

- Point to Point
- Bus Topology
- Mesh Topology
- Star Topology
- Ring Topology
- Tree Topology
- Hybrid Topology

## Point-to-Point Topology

Point to point topology is the simplest topology that connects two end system directly together with a common link. The entire capacity of the link is reserved for transmission between two devices.

### Advantage of Point to Point Topology

- Very fast compared to other network topologies because it can access only two nodes.
- Very simple connectivity
- Easy to handle and maintain

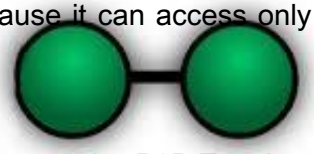


*Figure 2.2.1 P2P Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

### Disadvantages of Point-to-Point Topology

- There is major drawback of this topology there are only two nodes if any of the node stops working, data cannot be transfer across the network

## Bus Topology

A **multipoint** (also called **multidrop**) connection in which more than two specific devices are strung together in a line or share a single link. Commonly used in LAN. The capacity of the channel is shared, either spatially or temporally. If several devices can use

the link simultaneously, it is **spatially shared.** If users must take turns, it is a **timeshared** connection.

### Advantages of Bus Topology

- It is easy to connect a device to the network.
- It is cheaper than other network options.
- No hubs or switches are required

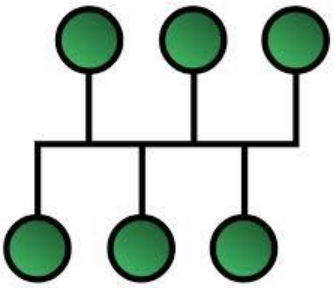


*Figure 2.2.2 Bus Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

### Disadvantages of Bus Topology

- Additional devices slow the network down.
- A break in the backbone can cause an entire network to collapse.

## Ring Topology

Packets are sent around the circle from computer to computer. Each computer looks at each packet to decide whether the packet was intended for it. Each device in the ring incorporates a repeater. When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.

### Advantage of Ring Topology

- All data flows in one direction, reducing the chance of packet collisions.

### Disadvantage of Ring Topology

- All data being transferred over the network must pass through each workstation on the network, which can make it slower.
- The entire network will be impacted if one workstation shuts down.
- If the main cable breaks then the whole network will fail.

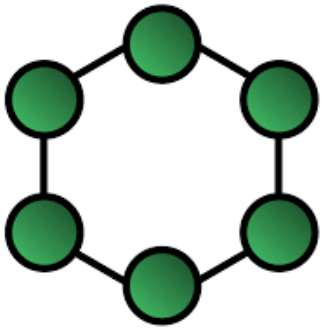


*Figure 2.2.3 Ring Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

## Mesh Topology

Mesh topology has multiple connections between each of the nodes on the network. A type of networking where all nodes cooperate to distribute data amongst each other.

**Mesh Topology can be divided into two types:**

- Fully Connected Mesh Topology
- Partially Connected Mesh Topology

## Fully Connected Mesh Topology

Fully connected mesh has all the computers connected to every other computer. Full Mesh is a network in which devices are organized in a mesh topology. To find the number of physical links in a fully connected mesh network, we need ***n(n-1)/2*** where ***n*** is the nodes.

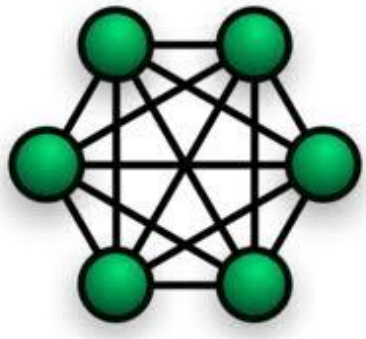


*Figure 2.2.4 Fully Mesh Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

*n = number of nodes/computers* *Formula: n(n-1)/2*

*n = 6*

*= 6(6-1)/2*

*= 6(5)/2*

*= 30/2*

*= 15*

*15 Physical Links are needed in 6 nodes/computers*

### Partially Connected Mesh Topology

In partially connected mesh, all the nodes are not necessary to be connected with each other in a network. This partial mesh topology is less costly compared to full mesh topology.

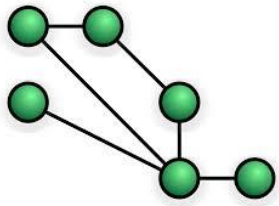


*Figure 2.2.5 Partially Connected Mesh Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

#### Advantage of Mesh Topology

- There is no traffic problem as there are dedicated point to point links for each computer.
- It has multiple links, so if one route is blocked then other can be accessed for data communication.

#### Disadvantage of Mesh Topology

- Installation is very difficult in mesh topology, as each node is connected to every node.
- Mesh topology is costly compared to the other network topologies

## Star Topology

It is a topology for a Local Area Network (LAN) in which all nodes are individually connected to a central connection point. Each network is connected to a central device called a ***hub*** or a ***switch***.

### Advantage of Star Topology

- Easily expanded without disruption to the network
- Cable failure affects only a single user
- Centralized management

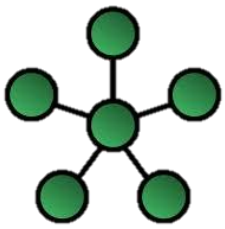


*Figure 2.2.6 Star Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

### Disadvantage of Star Topology

- Too much dependency on central device
- Performance and as well number of nodes which can be added in such topology is depended on capacity of central device

## Tree Topology

In tree topology, all the computers are connected like the branches of a tree. A tree topology is also known as ***star bus topology.*** It incorporates elements of both a bus topology and star topology. This topology divides the network into multiple levels/layers of network. The lowermost is **access-layer** where computers are attached. The middle layer is known as **distribution layer**, which works as mediator between upper layer and lower layer. The highest layer is known as **core layer**, and is central point of the network, i.e. root of the tree from which all nodes fork.

### Advantage of Tree Topology

- Other nodes in a network are not affected, if one of their nodes get damaged.

### Disadvantage of Tree Topology

- Large cabling is required as compared to star and bus topology.
- Tree network is very difficult to configure than other network topologies.

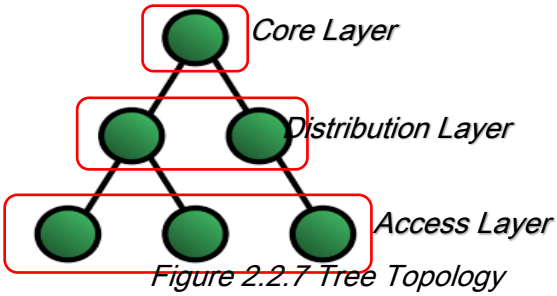



*Figure 2.2.7 Tree Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

## Hybrid Topology

A hybrid topology is a type of network topology that uses two or more differing network topologies.

### Advantage of Hybrid Topology

- Hybrid network combines the benefits of different types of topologies
- It is very reliable.

### Disadvantage of Hybrid Topology

- Complexity of Design
- Costly Infrastructure

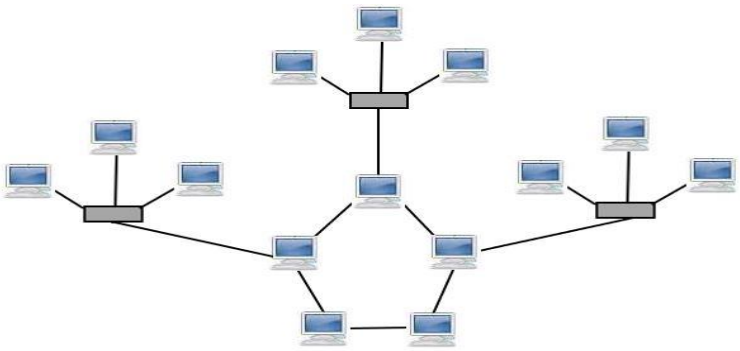


*Figure 2.2.8 Hybrid Topology*

**Source:** TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

## Assessment Task

**Activity No. 1:**

Write **True** if the statement is correct and **False** if the statement is incorrect.

_____1. A tree topology is also known as star bus topology.

_____2. Network Topology refers to the way in which a network is laid out physically.

_____3. End systems are the individual who uses the computer.

_____4. Computer Network is the interconnection of various computer system.

_____5. Star topology uses a single link to transmit data.

_____6. Pure network applications are applications that run on standalone computers.

_____7. Network applications are network hardware that utilize the Internet to perform useful functions.

_____8. Bus is commonly used in LAN.

_____9. Mesh topology has multiple connections between each of the nodes on the network

_____10. N(N*1)-2 is the formula to find the number physical link needed in the mesh topology.

**Activity No. 2:**

Explain each.

6. Why are topologies needed?

_____

_____

_____

7. Name one network topologies and cite an advantage from your own words and understanding.

8. What are the advantages of a multipoint connection over a point to point one?

9. In the bus topology, what happens if one of the stations is unplugged?

10. Assume eight devices are arranged in a mesh topology, how many cables are needed? How many ports are needed?

## Summary

Computer network applications are network software applications that utilize the Internet or other network hardware infrastructure to perform useful functions for example file transfers within a network. They help us to transfer data from one point to another within the network. The network application has defined into two categories; Pure Network Application and Stand-Alone Application.

Pure network applications are the application that created to be used in a network, some examples of pure network applications are Outlook Express, Pegasus Mail, Video Conferencing. Stand-Alone Application are the applications created for a single client, some examples of stand-alone applications are Word Processor, Database Management, Calculator, and System Applications.

Physical Structures of a network or called Network Topologies are the geometrical shape of a network. It can be a point-to-point where two nodes are connected by a single link. It can be a bus topology where all nodes are connected to a single link. A star topology where all nodes are connected to a hub or switch. A ring topology where all nodes are connected in a circular link. A tree topology where there are parent nodes and child nodes. And a hybrid topology where it composed of two or more different network.

# References

(Ramakrishhan, Raghu and Gehrke,Johannes,2018)

Source :SQL for beginners: A guide to study SQL programming and database management systems

Database management systems Gupta, G. K.,2018

# MODULE 3
# TYPES OF THE COMPUTER NETWORK AND THE INTERNET

## Introduction

After defining network in the previous lessons and discussing their physical structures, we need to discuss different types of networks we encounter in the world today. The criteria for distinguishing one type of network from another network is difficult and sometimes confusing. We use a few criteria such as size, geographical coverage, and ownership to make this distinction.

Generally, networks are distinguished based on their geographical span. A network can be as small as distance between your mobile phone and its Bluetooth headphone and as large as the internet itself, covering the whole geographical world**. (**Ramakrishhan, Raghu and Gehrke,Johannes,2018).

## Learning Outcomes

At the end of this lesson, the student should be able to:

- ✓ Classify a network from its geographical range.
- ✓ Understand the history of the Internet
- ✓ Differentiate an internet and the Internet.

## Lesson 1. Types of Computer Network

A **network** consists of two or more computers that are linked in order to share resources (such as printers and CDs), exchange files, or allow electronic communications. The computers on a **network** may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams.

Types of Computer Network

- Personal Area Network
- Local Area Network
- Wireless Local Area Network
- Metropolitan Area Network
- Wide Area Network

**Personal Area Network (PAN)**

A **Personal Area Network (PAN)** is smallest network which is very personal to a user.

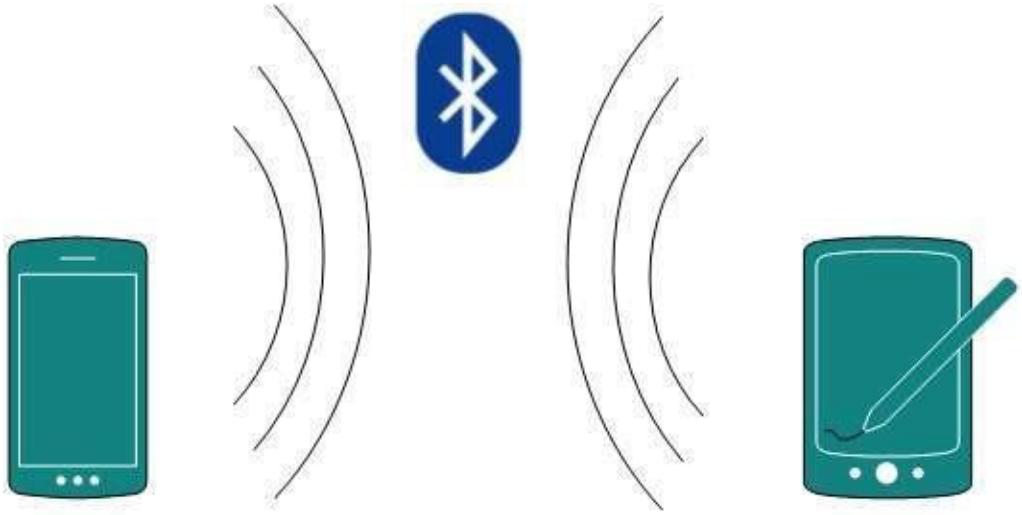


*Figure 3.1.1: Personal Area Network*

Source: TutorialPoints: “Learn DCN: Data Communication and Networking”: 

This may include Bluetooth enabled devices or infrared enabled devices. PAN has connectivity range up to 10 meters.

Examples of Personal Area Network are the devices including:

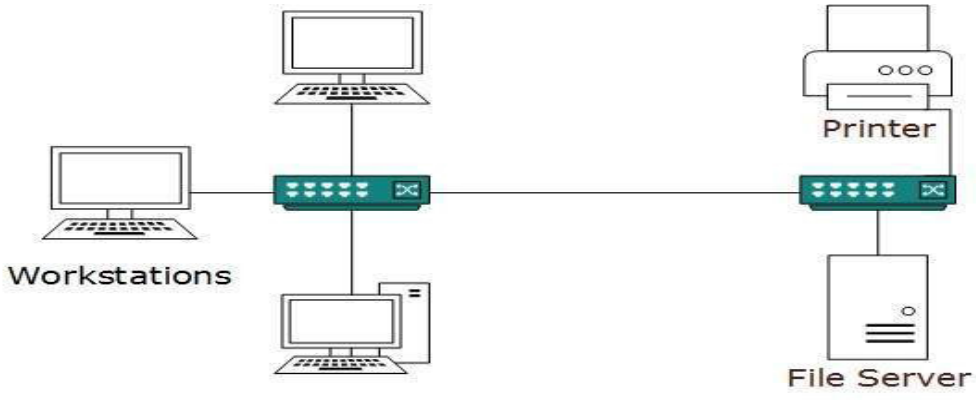
- Cell phone headsets
- Wireless keyboards
- Wireless mice
- Printers
- Bar code scanners
- Game consoles.

## Local Area Network (LAN)

A **Local Area Network (LAN)** is usually owned and connects some hosts in a single office, building, or campus.

LAN can be wired, wireless, or in both forms at once. LAN provides a useful way of sharing the resources between end users. The resources such as printers, file servers, scanners, and internet are easily sharable among computers.

LAN provides a useful way of sharing the resources between end users. The resources such as printers, file servers, scanners, and internet are easily sharable among computers.



Workstations are called such because they typically do have a human user which interacts with the network through them. Workstations were traditionally considered a desktop, consisting of a computer, keyboard, display, and mouse, or a laptop, with integrated keyboard, display, and touchpad. With the advent of the tablet computer, and the touch screen devices such as iPad and iPhone, our definition of workstation is quickly evolving to include those devices, because of their ability to interact with the network and utilize network services.

Servers tend to be more powerful than workstations, although configurations are guided by needs. For example, a group of servers might be located in a secure area, away from humans, and only accessed through the network. In such cases, it would be common for the servers to operate without a dedicated display or keyboard. However, the size and speed of the server's processor(s), hard drive, and main memory might add dramatically to the cost of the system. On the other hand, a workstation might not need as much storage or working memory, but might require an expensive display to accommodate the needs of its user. Every computer on a network should be appropriately configured for its use.

## Wireless Local Area Network (WLAN)

It is a wireless computer network that links two or more devices using wireless communication to form a Local Area Network within a limited area.


*Example 3.1.4: Metropolitan Area Network*

*Example 3.1.3: Wireless Local Area Network*

All components that can connect into a wireless medium in a network are referred to as stations. Wireless stations fall into **two categories**: ***wireless access points,*** and ***clients***.

- **Wireless Access Point** are base stations for the wireless network. They transmit and receive radio frequencies for wireless s enabled devices to communicate with
- **Wireless Clients** can be mobile devices such as laptops, smartphones, non-portable devices such as desktop computers, printers and workstations that are equipped with a wireless network interface.

## Metropolitan Area Network (MAN)

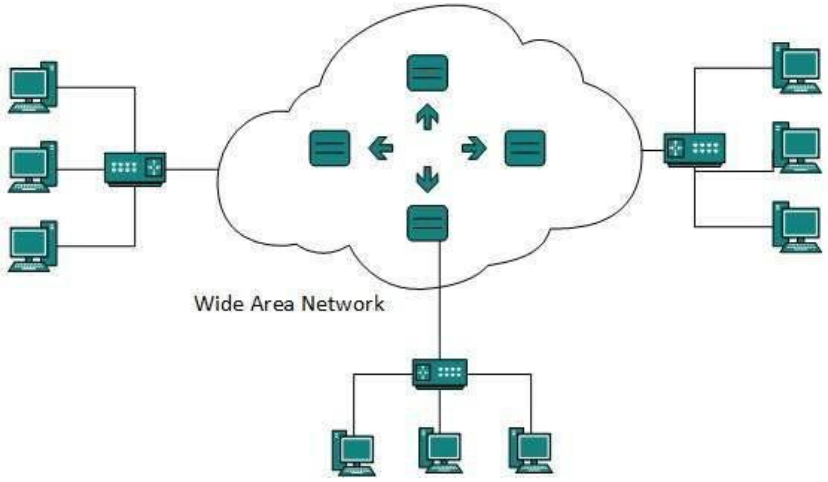
A **Metropolitan Area Network** is similar to a local area network but spans an entire city. MANs are formed by connecting multiple LANs. Thus, MANs are larger than LANS but smaller than Wide Area Network.


*Example 3.1.4: Metropolitan Area Network*

Source: TutorialPoints: "Learn DCN: Data Communication and Networking": Copyright 2019 by Tutorials

### Wide Area Network (WAN)

As the name suggests, the Wide Area Network (WAN) covers a wide area which may span across provinces and even a whole country. A **Wide Area Network** is a network that exists over a large-scale geographical area. It is also an interconnection of the devices capable of communication.




*Example 3.1.5: Metropolitan Area Network*

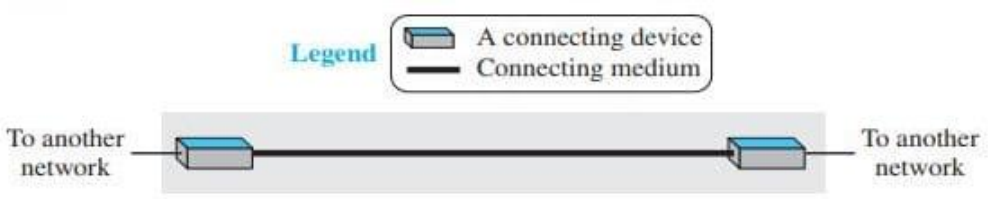
Source: TutorialPoints: "*Learn DCN: Data Communication and Networking*": © Copyright 2019 by Tutorials

Generally, telecommunication networks are Wide Area Network. These networks provide connectivity to MANs and LANs.

Two Distinct Examples of WANs today:

#### Point-to-Point WAN

A point-to-point WAN is a network that connects two communicating devices through a transmission media.

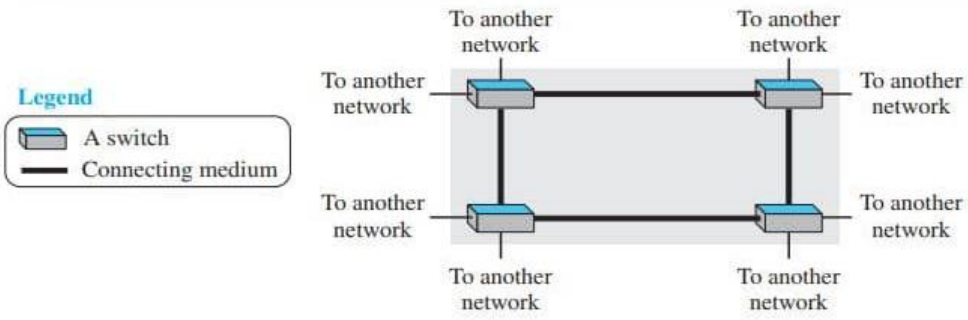



*Example 3.1.6: Point -to – Point WAN*



### Switched WAN

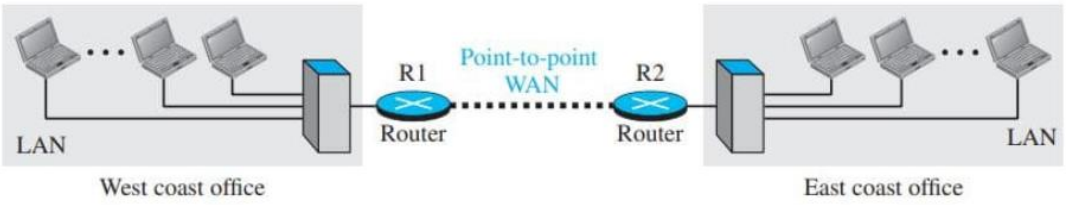
A switched WAN is a network with more than two ends. A switched WAN is used in the backbone of global communication today. It is a combination of several point-to-point WANs that are connected by switches.




*Example 3.1.7: Switched WAN*

### internetwork

When to or more networks are connected, they make an **internetwork,** or **internet** (note that small “i” in the internet).

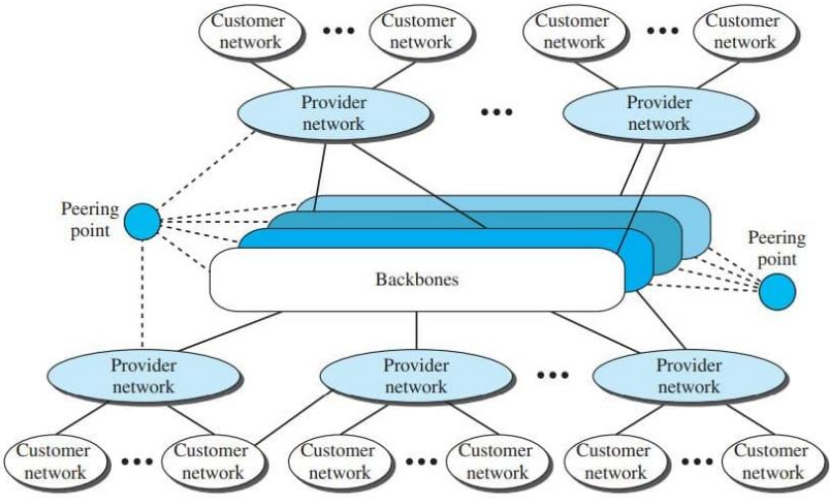



*Example 3.1.8: internetwork*

Source: TutorialPoints: “Learn DCN: Data Communication and Networking”:  Copyright 2019 by Tutorials

## Lesson 2. The Internet

### The Internet




*Example 3.2.1: The Internet*

Source: TutorialPoints: “Learn DCN: Data Communication and Networking”:  Copyright 2019 by Tutorials

A network of networks. The **Internet** (note that big letter "I" is used) is composed of thousands of interconnected networks. It is the largest network in existence on this planet. The internet hugely connects all WANs and it can have connection to LANs and Home networks.

The Internet has several backbones, provider networks, and customer networks. At the top level, the **backbones** are large networks owned by communication companies such as Sprint, Verizon (MCI), AT&T, and NTT. At the second level, there are smaller networks, called **provider networks**, that use the services of the backbones for a fee. The provider networks are connected to backbones and sometimes to other provider networks. The **customer networks** are networks at the edge of the Internet that actually use the services provided by the Internet.

Backbones and provider networks are also called **Internet Service Providers (ISPs).** The backbones are often referred to as **international ISPs;** the provider networks are often referred to as **national** or **regional ISPs.**

## Internet History

**1960** – There where some communication networks such as telegraph and telephone networks that were suitable for constant rate communication at the time, which means that after a connection was made between two users, the encoded message (telegraphy) or voice (telephony) could be exchange.

**1961** – The theory of packet switching was first presented by Leonard Kleinrock at MIT.

**1967** – Advanced Research Project Agency (ARPA) presented its ideas of Advanced Research Project Agency Network (ARPANET) at Association for Computing Machinery (ACM). The idea was that each host computer (not necessarily from the same manufacturer) would be attached to a specialized computer, called an **Interface Message Processor (IMP).**

**1969 –** ARPANET became a reality. Four nodes, at the University of California at Los Angeles (UCLA), the University of California at Santa Barbara (UCSB), Stanford Research Institute (SRI), and the University of Utah, were connected via the IMPs to form a network.

Software called the **Network Control Protocol (NCP)** provided communication between the hosts.

**1972 –** Vin Cerf and Bob Kahn collaborated on what they called the **Internetting Project**.

**1973 –** ARPA Internet now became the focus of communication effort.

**1977 –** an internet consisting of three different networks was successfully demonstrated. Communication between networks was now possible.

**1983 –** authorities abolished the original ARPANET, and TCP/IP became the official protocol for the ARPANET

**MILNET –** In 1983, ARPANET split into two networks: **Military Network (MILNET)** for military users and ARPANET for nonmilitary users.

**CSNET –** In 1981, **Computer Science Network (CSNET)** was a network sponsored by the National Science Foundation (NSF)

**NSFNET –** In 1986, the NSF sponsored the **National Science Foundation Network,** a backbone that connected five supercomputer centers located throughout the United States.

**ANSNET –** In 1992, Three companies IBM, Merit and Verizon form a nonprofit organization called Advanced Network & Services (ANS) to build a new high-speed Internet backbone called **Advanced Network Services Network (ANSNET).**

**World Wide Web –** The Web was invented at CERN by Tim Berbers-Lee. This invention has added the commercial application to the Internet.

## Assessment Task

**Activity No. 1:**

**Acronyms**. Answer the acronym letters below with the space provided.

1. MILNET

   _____

2. ISP

   _____

3. ANSNET

   _____

4. IMP

   _____

5. NFSNET

   _____

6. ACM

   _____

7. ARPA

   _____

8. WAP

   _____

9. NCP

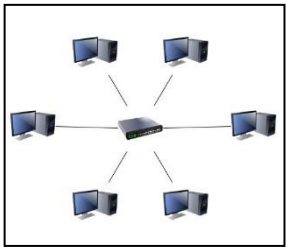
   _____

10. WLAN

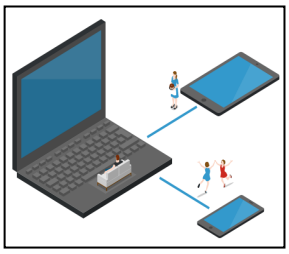
    _____

**Activity No. 2:**

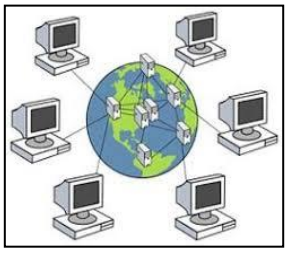
Identify the images below and answer what type of network it is. Write the correct answer on the space provided.



1._____



2._____



3._____

**Activity No. 3:**

Explain each.

1. What is an internet? What is the Internet??

_____

_____

_____

2. What are some of the factors that determine whether a communication system is a LAN or MAN? Explain.

3. Difference between Point to Point WAN and Switched WAN.

4. What is the difference between the MAN and WAN?

5. What are the three levels of the Internet? Explain each.

## Summary

Computer networks are generally distinguished by its geographical scope. It can span within your workspace up to global space connection. And this geographical span can be a Personal Area Network that reaches within a personal space for up to 10 meters. It can also be a Local Area Network with wired connections for office or building uses or it can be a wireless connection like Wireless Local Area Network that uses an Access Point to wireless devices. A Metropolitan Area Network can span for up to 50km of geographical range, it is a connection of different LAN. Or Wide Area Network that can span for the whole country.

The Internet is the interconnections of thousands of computer networks. It connects all WANs, MANs, LANs and even PANs. The Internet has a backbone which is owned by large communication companies worldwide, the Internet also has provider networks, which uses the services from the backbones for a fee. And lastly, the Internet also has customer networks that avail services from the provider networks. AT&T can be one of the example of the Internet backbone, Globe Telecommunications can be an example of the provider network of the Internet here in our country, and the consumers which are the individuals who uses the services from the Globe Telecommunications are the customer networks. (Ramakrishhan, Raghu and Gehrke,Johannes,2018).

# References

(Ramakrishhan, Raghu and Gehrke,Johannes,2018)

Source :SQL for beginners: A guide to study SQL programming and database management systems

Database management systems Gupta, G. K.,2018

# MODULE 4
# DATA FLOW, ACCESS NETWORKS AND PHYSICAL MEDIA

## Introduction

Everything that moves has its own flow of directions, a wheel runs in a circle, a river streams downhill, the sun sets and rise. The same in data communication, the data has a flow from unidirectional to bidirectional.

The Internet today is an internetwork that allows an individual user to become part of it. But how does an individual access a network? In this lesson we will tackle the data flow, how to access to a network and physical mediums.

## Learning Outcomes

At the end of this lesson, the student should be able to:

- ✓ Know how the data travels or flow with the transmission medium
- ✓ Understand the different ways of accessing the network.
- ✓ Identify the different type of transmission medium that is used in a computer network.

## Lesson 1. Data Flow

The flow of data in communication between two devices is called data flow. It can be classified as the following:

- Simplex
- Half-Duplex
- Full Duplex

*Simplex*

The communication between devices is unidirectional, as one-way street. Only one of the two connected devices can transmit, the other device can only receive. The entire channel capacity is consumed to send data in one direction only.

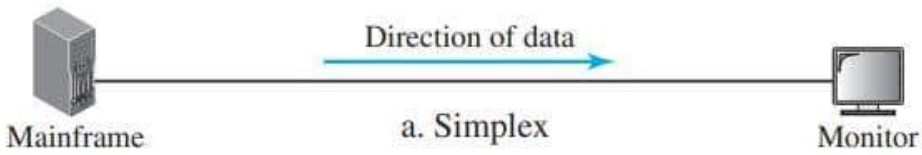



*Figure 4.1.1: Simplex*

*Half Duplex*

Only one of the two devices can transmit at a time. Here, both devices are transmitter and receiver, but they cannot transmit and receive simultaneously. The entire channel capacity of the channel is utilized for one-directional data movement at a time.

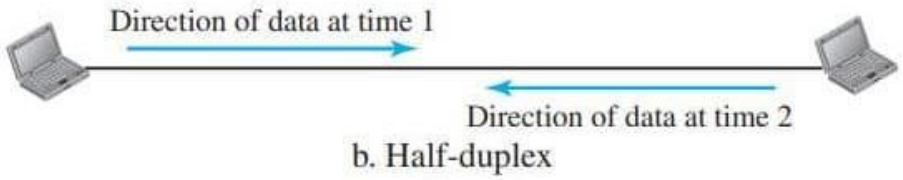



*Figure 4.1.2: Half Duplex*

*Full Duplex*

Both of the two devices can transmit and receive at the same time. Here, both devices are transmitter and receiver, and they can transmit and receive simultaneously. The channel capacity is shared among two directions.

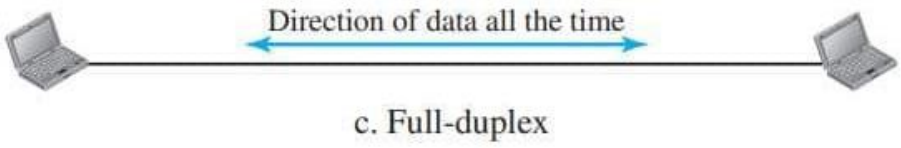



*Figure 4.1.3: Full Duplex*

## Lesson 2. Accessing the Network

The Internet today is an internetwork that allows user to become part of it. The user, however, needs to be physically connected to an Internet Service Provider or the ISP. The physical connection is normally done through a point to point WAN.

Connecting to a network can be done in the following ways:

- Using Telephone Networks
- Using Cable Networks
- Using Wireless Networks

*Using Telephone Networks*

Most telephone networks have an Internet connection. To connect to the internet, is to change the voice line between the residence to a point-to-point WAN.

This can be done in two ways:

*Figure 4.1.4 Telephone Networks*

**Dial Up Service**

- The software installed on the computer dials the ISP and imitates making a telephone connection.

**DSL Service**

- The DSL service allows the line to be used simultaneously for voice and data communication.

*Using Cable Networks*

It provides a higher speed connection, but the speed varies depending on the number of neighbors that use the same cable.

*Figure 4.1.5 Fiber Optic*

**Fiber**

- Fiber optics are long, thin strands of pure glass about a diameter of human hair. They are arranged in bundles called optical cables and used to transmit light signals over long distances.

**Ethernet**

- Networking cables are networking hardware used to connect one network device to other network devices or to connect two or more computers to share printers, scanners etc.

*Figure 4.1.6 Ethernet*

*Using Unguided Medium / Using Wireless Networks*

With the wireless devices emerging and become increasingly popular, almost every device can be connected to a wireless network through a wireless access point. Unguided medium transport electromagnetic waves without using a physical conductor. Signals are normally broadcast through space and thus are available to anyone who has a device capable of receiving them.

*Figure 4.1.7 Wireless Network*

**Wi-FI**

- the name of a wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections

Unguided signals can travel from source to the destination in several ways:

- **Ground Propagation**
- **Sky Propagation**
- **Line-of-Sight Propagation.**

*Ground Propagation*

Radio waves travel through the lowest portion of the atmosphere, hugging the earth.

*Sky Propagation*

Higher frequency radio waves radiate upward into the ionosphere where they are reflected back to earth.

*Line-of-Sight Propagation*

Very high-frequency signals are transmitted in straight lines directly from antenna to antenna. Antennas must be directional, facing each other

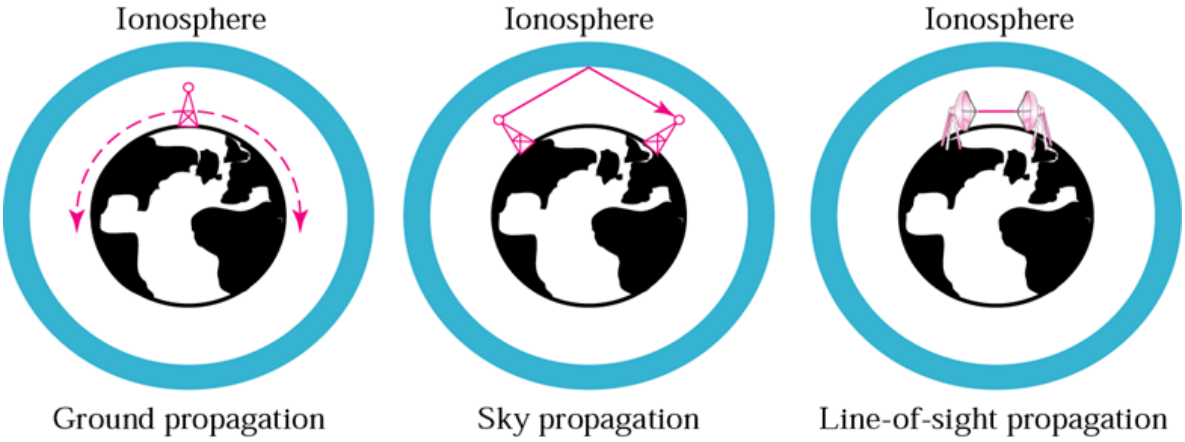



*Figure 4.1.8: Unguided Signals Propagation*

Source: TutorialPoints: "Learn DCN: Data Communication and Networking": Copyright 2019 by Tutorials

Some common applications of wireless data communication include the following:

- Accessing the Internet using a cellular phone
- Establishing a home or business Internet connection over satellite
- Beaming data between two hand-held computing devices
- Using a wireless keyboard and mouse for the PC.

## Lesson 2. Physical Media

Refers to the physical materials that are used to store or transmit information in data communication. These physical media are generally physical objects made of materials such as copper or glass. They can be touched and felt and have physical properties such as weight and color

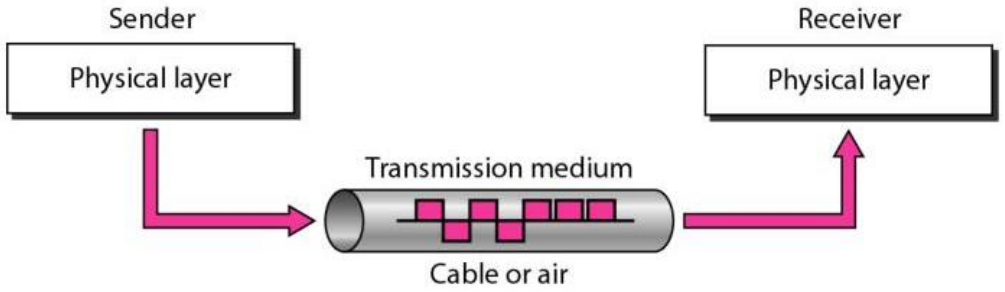


*Figure 4.2.1: Transmission Medium*

Source: TutorialPoints: "Learn DCN: Data Communication and Networking": 

Transmission media can be in a form of:

- Twisted Pair Copper Wire
- Coaxial Cable
- Fiber Optics

*Twisted Pair Copper Wire*

Twisted pair is a type of cabling that is used for telephone communications and most modern Ethernet networks. A pair of wires forms a circuit that can transmit data.

There are two basic types of Twisted Pair:

- **Unshielded Twisted Pair (UTP)**

  The most common twisted pair cable used in communications. UTP cable is a medium that is composed of pairs of wires. UTP cable is used in a variety of networks. Each of the eight individual copper wires in UTP cable is covered by an insulating material. In addition, the wires in each pair are twisted around each other.

  The following summarizes the features of UTP cable:

  - Speed and throughput—10 to 1000 Mbps
  - Average cost per node—Least expensive
  - Media and connector size—Small
  - Maximum cable length—100 m (short)

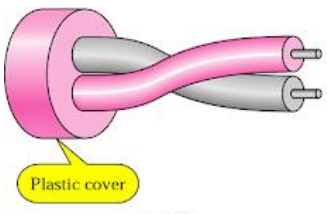



*Figure 4.2.2 UTP*

Commonly used types of UTP cabling are as follows:

- **Category 1**—Used for telephone communications. Not suitable for transmitting data.
- **Category 2**—Capable of transmitting data at speeds up to 4 megabits per second (Mbps).
- **Category 3**—Used in 10BASE-T networks. Can transmit data at speeds up to 10 Mbps.
- **Category 4**—Used in Token Ring networks. Can transmit data at speeds up to 16 Mbps.
- **Category 5**—Can transmit data at speeds up to 100 Mbps.
- **Category 5e** —Used in networks running at speeds up to 1000 Mbps (1 gigabit per second [Gbps]).
- **Category 6**— Typically, Category 6 cable consists of four pairs of 24 American Wire Gauge (AWG) copper wires. Category 6 cable is currently the fastest standard for UTP.

- **Shielded Twisted Pair (STP)**

  The STP has a metal foil or braided-mesh covering that encases each pair of insulated conductors. This cable combines the techniques of shielding, cancellation, and wire twisting. Each pair of wires is wrapped in a metallic foil.

  The following summarizes the features of STP cable:

  - Speed and throughput—10 to 1000 Mbps
  - Average cost per node—Moderately expensive
  - Media and connector size—Medium to large
  - Maximum cable length—100 m (short)

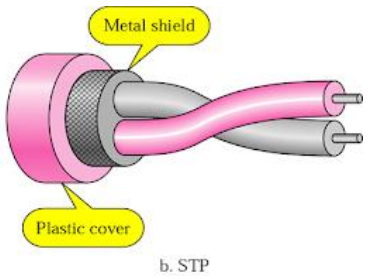



*Figure 4.2.3 STP*

When comparing UTP and STP, keep the following points in mind:

- The speed of both types of cable is usually satisfactory for local-area distances.
- These are the least-expensive media for data communication. UTP is less expensive than STP.
- Because most buildings are already wired with UTP, many transmission standards are adapted to use it, to avoid costly rewiring with an alternative cable type.

Common uses of Twisted Pair Cables:

- Local Area Network
- Office
- Home Network

*Coaxial Cable*

Coaxial Cable or **coax** carries signals of higher frequency ranges than those in twisted-pair cable. *Coaxial cable* consists of a hollow outer cylindrical conductor that surrounds a single inner wire made of two conducting elements. One of these elements, located in the center of the cable, is a copper conductor. Surrounding the copper conductor is a layer of flexible insulation. Over this insulating material is a woven copper braid or metallic foil that acts both as the second wire in the circuit and as a shield for the inner conductor. This second layer, or shield, can help reduce the amount of outside interference. Covering this shield is the cable jacket.

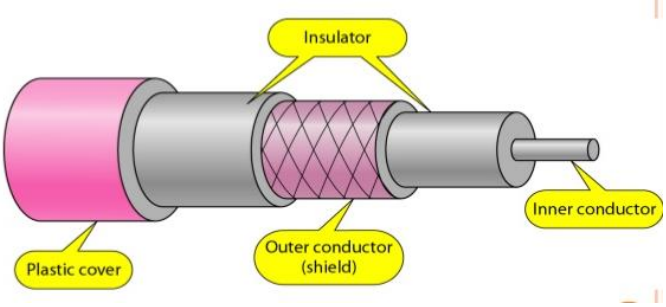



*Figure 4.2.4 Coaxial Cable*

Source: TutorialPoints: "Learn DCN: Data Communication and Networking": Copyright 2019 by Tutorials

The following summarizes the features of coaxial cables:

- Speed and throughput—10 to 100 Mbps
- Average cost per node—Inexpensive
- Media and connector size—Medium
- Maximum cable length—500 m (medium)

Common uses of Coaxial Cable:

- Cable Operators
- Telephone Companies
- Internet Providers

*Fiber Optics*

Fiber-optic cable is made of glass or plastic and transmit signals in the form of light. Optical fiber cable has become very popular for interconnecting infrastructure network devices. It permits the transmission of data over longer distances and at higher bandwidths (data rates) than any other networking media.

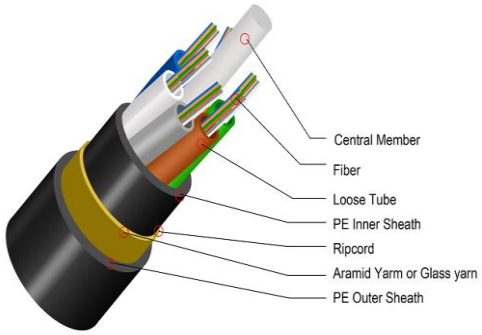



*Figure 4.2.5 Fiber Optics Cable*

Source: TutorialPoints: "Learn DCN: Data Communication and Networking": 

The following summarizes the features of fiber optics cables:

- Speed and throughput—10 Mbps to 100 Gbps
- Average cost per node—Expensive
- Media and connector size—Medium
- Maximum cable length—1000 m (medium)

Common uses of Fiber Optics:

- Internet
- Cable Television
- Telephone

## Assessment Task

**Activity No. 1:**

Fill in the blank space in the table below.

| | STP | UTP | Coaxial | Fiber Optic |
|---|---|---|---|---|
| **Max. Speed** | Mbps | 1000 Mbps | Mbps | Mbps |
| **Cost** | | | | Expensive |
| **Length** | m | m | 500 m | m |
| **Durability** | Strong | | | |

**Activity No. 2:**

Explain each.

6. Assume that you will build an office network, which type of transmission would you use? And why?

_____

_____

_____

7. What are the differences between the Unshielded Twisted Pair and Shielded Twisted Pair cable?

_____

_____

_____

_____

_____

8. Assume that you will build a home network composed of smartphone, laptop, desktop and tablets. What type of transmission medium would you use and why?

9. Give an example of simplex, half duplex and full duplex mode of data flow from a real-life scenario.

10. What are the advantages of having a Wireless connections?

## Summary

In order to communicate with other devices a network must have a transmission medium. This medium can be in a form of cables or wireless medium. A physical medium has different types; Twisted Pair; Coaxial Cable, and Fiber Optics. These cables are used for a network but they have a difference. A twisted pair has two types, unshielded twisted pair and shielded twisted pair, both has a 4 pairs of copper wires, normally used for a Local Area Network. Coaxial Cable is a commonly used in telecommunication companies and Fiber Optics can also be used in Internet Communication companies, cable television and etc.

The data that being transmitted can travel through the transmission medium to its destination. And the data can flow into three modes; simplex, half duplex, full duplex. In simplex, only one device can transmit a data and the one can only receive. In half duplex, both can transmit and receive but one at a time. And in full duplex, both can transmit and receive a data simultaneously.

# References

(Ramakrishhan, Raghu and Gehrke,Johannes,2018)

Source :SQL for beginners: A guide to study SQL programming and database management systems

Database management systems Gupta, G. K.,2018

- END OF THE PRELIM TERM MODULE -

CHECK YOUR EXAM SCHEDULE FOR THIS COURSE.

DO NOT FORGET TO TAKE THE EXAM AS SCHEDULED.

THANK YOU AND GOD BLESS