

# Unit IV

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# Telephone System: Structure of telephone system

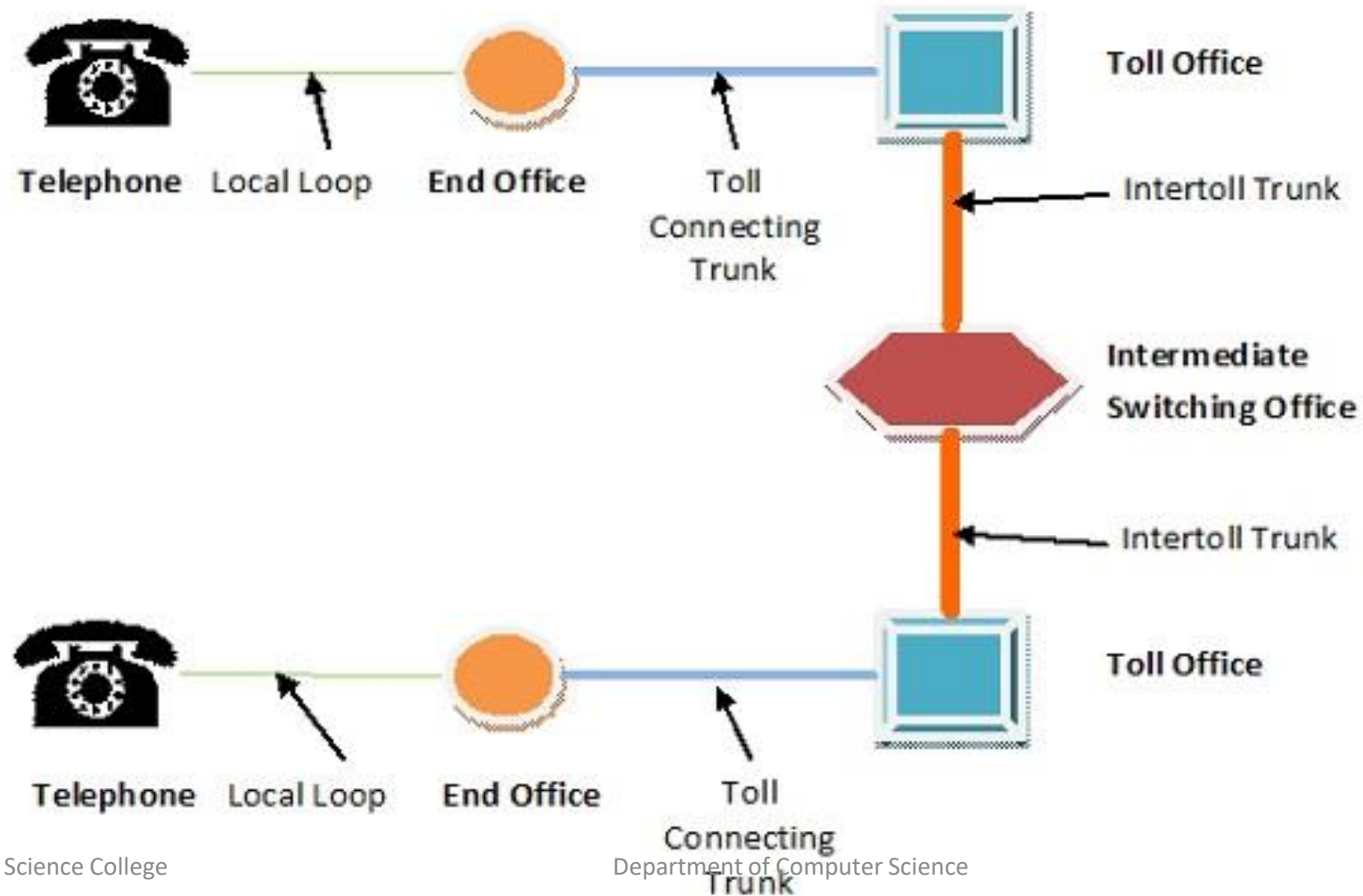
- ▶ The telephone system is organized as a highly redundant, multilevel hierarchy. Each telephone has two copper wires. The two wire connections between each subscriber's telephone and the end office are known as the Local Loop.
- ▶ If the **caller** and **callee** both are attached to a given **end office**, the switching mechanism is within the office and set a direct electrical connection between the two local loops.



- ▶ If the called telephone is attached to **another end office**, a different procedure has to be used.
- ▶ Each end office has a number of outgoing lines to one or more nearby switching centers, called **Toll offices** (or if they are within the same local area called **Tandem offices**). And these lines are called **Toll connecting trunks**.

- ▶ If both the caller's and callee's end offices attached with same toll office, the connection may be established within the toll office.
- ▶ But if they are not in same toll office, the path will have to be established somewhere higher up in the hierarchy, via high bandwidth called inter-toll trunks or interoffice trunks

## Typical Circuit Route For A Medium- Distance Call.



- ▶ A variety of transmission media are used for telecommunication. Local loops consists of twisted pairs. [Co-axial cables](#), [microwaves](#) and [fiber optics](#) are widely used between switching offices.
- ▶ Analog signals are passed throughout the telephone system with the actual voice signal being transmitted as an electrical voltage from source to destination.

# Transmission & Switching

- ▶ The transmission link carry both information (e.g. voice, data) and signaling parts. The common example of transmission links are as follows.
  - Two wire transmission line
  - Coaxial cable
  - Microwave terrestrial link
  - Fiber optic cable
  - Satellite based communication link
  - Infrared communication



# Transmission & Switching

- ▶ The medium of transmission can be guided or unguided. The guided include copper, fiber etc. while unguided include microwave, satellite etc. The transmission system is characterised by three parameters viz. bandwidth of information to be carried, propagation delay and path attenuation from source to the destination.

# Transmission & Switching

- ▶ Following modules are typically incorporated in transmitter and receiver parts of the communication system.
  - Analog to digital conversion at transmitter and D to A at receiver.
  - Encoding (at transmitter) and decoding (at receiver).
  - Modulation (at transmitter) and demodulation (at receiver)
  - Multiplexing (at transmitter) and demultiplexing (at receiver)
  - Multiple access techniques such as FDMA, TDMA and CDMA in order to have efficient usage of common resources of the communication system.

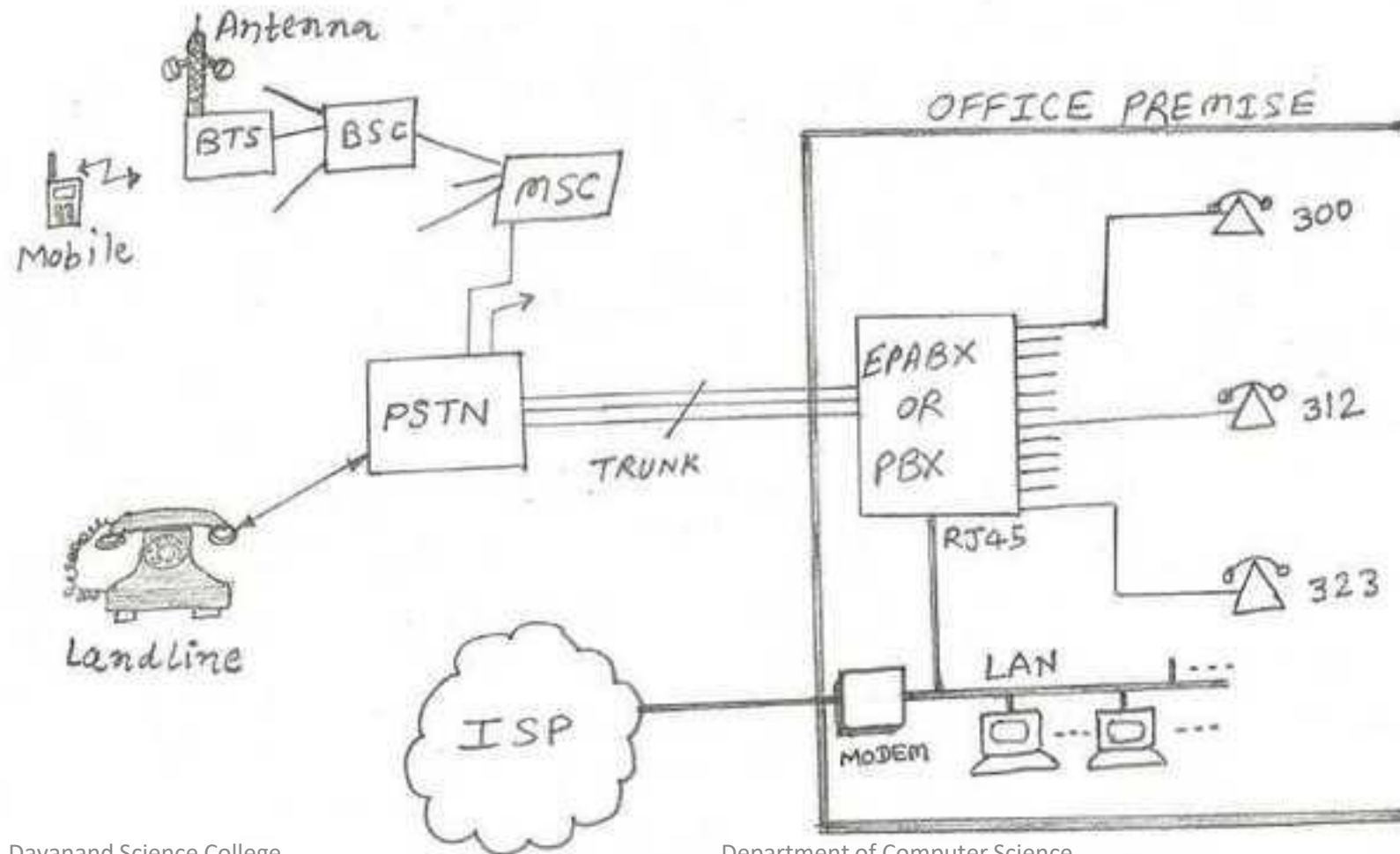
# Switching system

- ▶ The system which provides switching of baseband information such as voice and data at intermediate points during transmission is known as switching system. Typically switching system is characterised by number of input and output lines.
- ▶ Examples of switching systems include following modules or system.
  - Telephone Exchanges
  - Voice Switches
  - Packet or data switches
  - Routers or Gateways

# Example of Switching : EPABX

- ▶ EPABX stands for Electronic Private Automatic Branch Exchange.
- ▶ As shown in the figure EPABX/PBX facilitates use of one external telephone line by many internal users in the office premises. In the office each employee is provided one telephone set and all the telephones are connected with PBX. All the employees within the office premises can communicate using 3-digit or 4-digit number programmed in EPABX/PBX without any charge.

# Diagram: Working Model of EPABX or PBX



- ▶ EPABX/PBX is connected to PSTN (Public switched Telephone network) via trunk lines; hence all can use one external voice line in time shared basis.
- ▶ PSTN is connected with MSC (Mobile switching centre) of cellular networks such as GSM/CDMA/UMTS.
- ▶ By this mobile cell phone user can connect to any telephone set in the office premises using extension number.

# Trunks & Multiplexing

## Trunks

- ▶ Trunks are a large-bandwidth communication channels connecting switching centers, forming the core of the telephone network.
- ▶ A trunk comprises of broadcast frequencies that are suitable for long distance communication of many voice and data signals simultaneously.

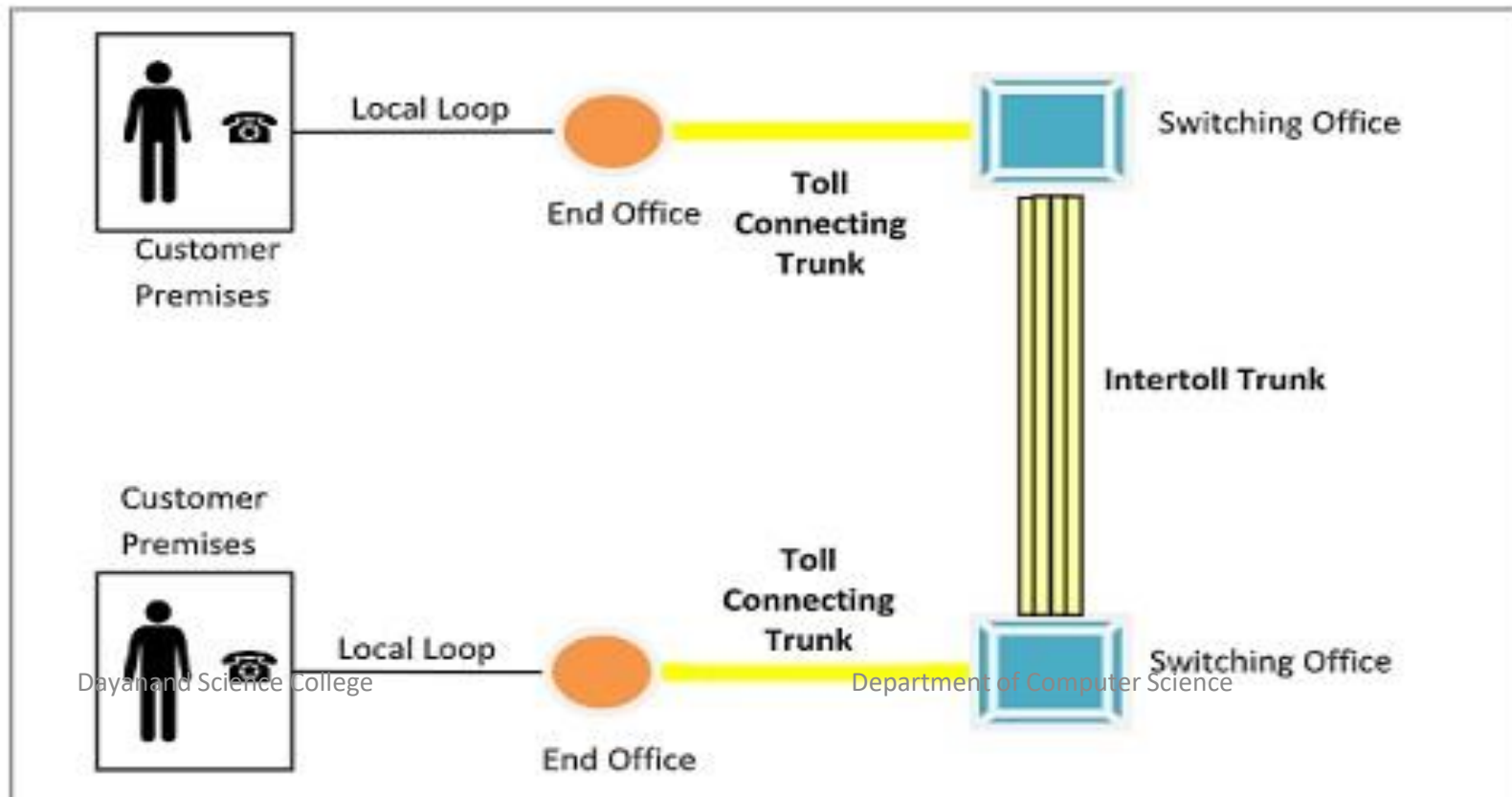
# Features

- ▶ The characteristic features of a trunk are –
- ▶ They carry digital information
- ▶ They are designed for both voice and data transmission.
- ▶ They can carry millions of calls simultaneously over long distances.
- ▶ They have very high bandwidth.
- ▶ Another method of achieving high bandwidth is to use a single high capacity link that can carry many signals multiplexed together.



# Trunks used in Telephone Networks

- ▶ **Toll connecting Trunk** – Lines that connect end offices with toll offices. Fiber optic cables are used here.
- ▶ **Intertoll Trunk** – Very high bandwidth channels that connect either two toll offices via intermediate switching offices. Fiber optic cables and microwaves are used here.

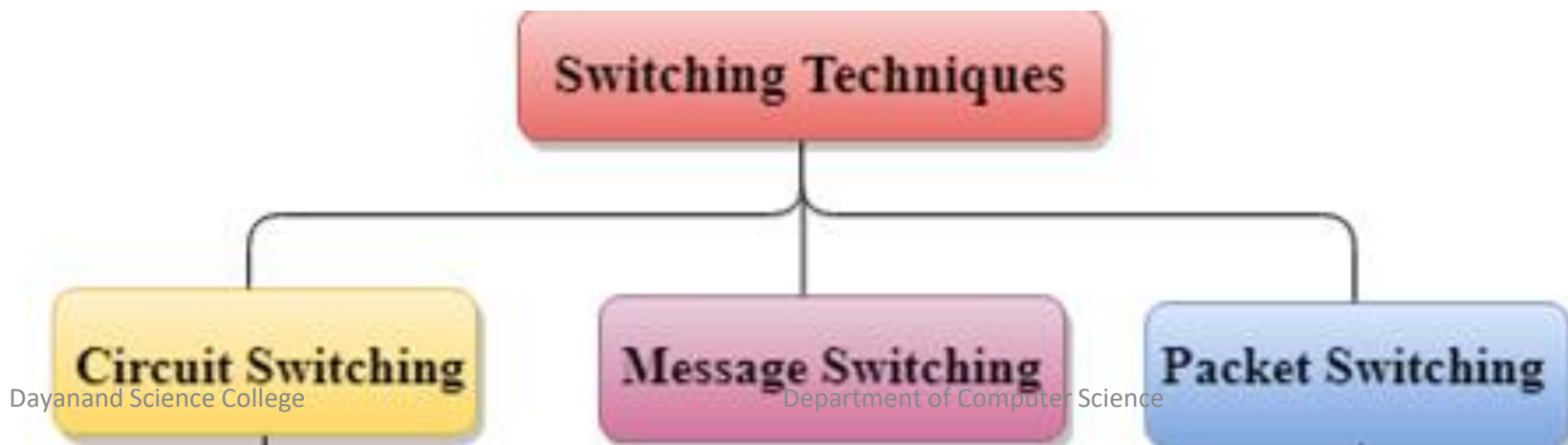


# Multiplexing in Trunks

- ▶ Multiplexing is best solution for simultaneous transmission of several signals.
- ▶ Multiplexing is a method of combining more than one signal over a shared medium.
- ▶ The commonly used multiplexing techniques in trunks are:  
**Time division multiplexing (TDM)** - In TDM, the users are allowed the total available bandwidth on time sharing basis.
- ▶ **Frequency division multiplexing (FDM)** - In FDM, signals of different frequencies are combined for concurrent transmission.

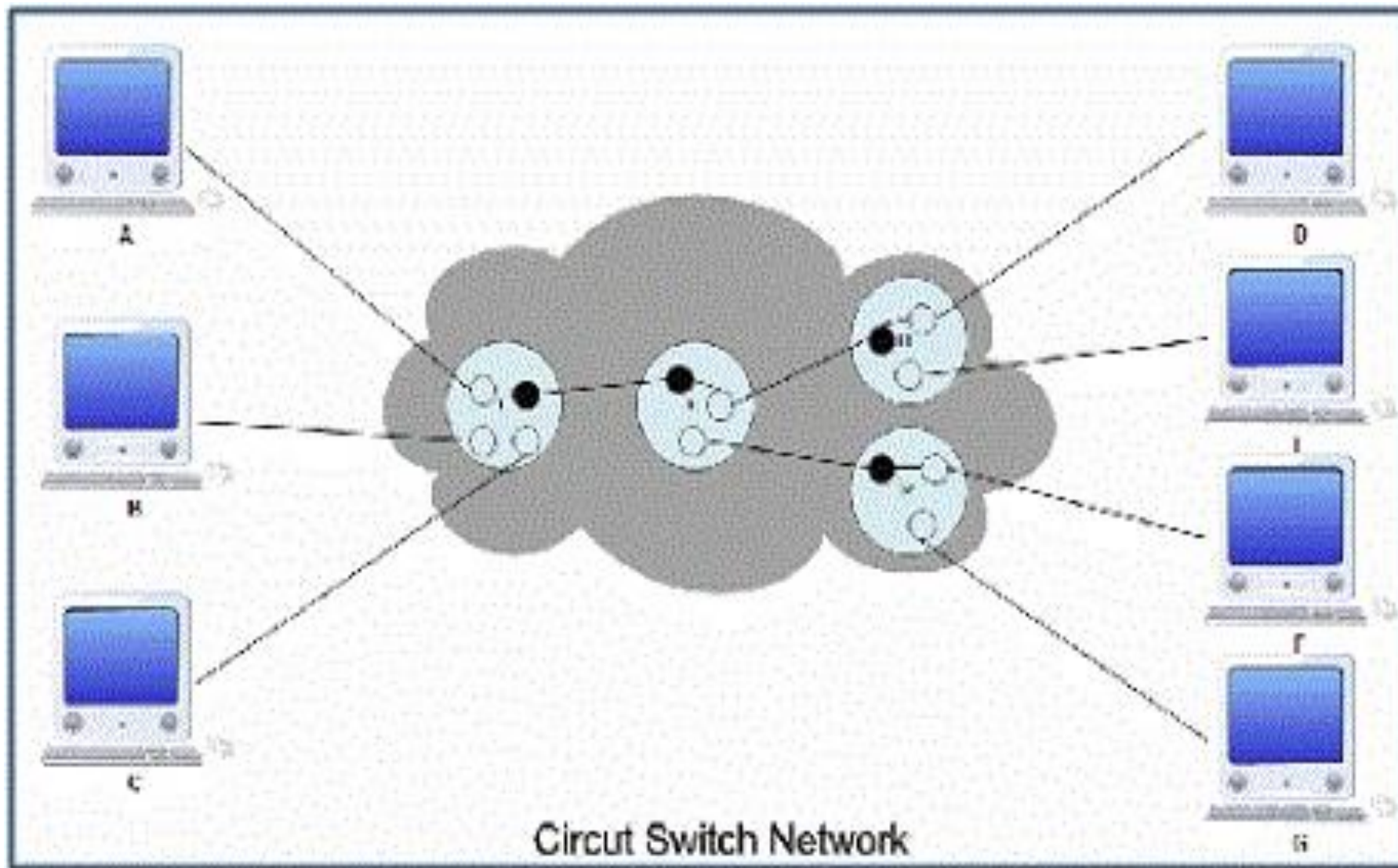
# Type of Switching

- ▶ In large networks, there can be multiple paths from sender to receiver. The switching technique will decide the best route for data transmission.
- ▶ Switching technique is used to connect the systems for making one-to-one communication.
- ▶ **Classification Of Switching Techniques**



# Circuit Switching

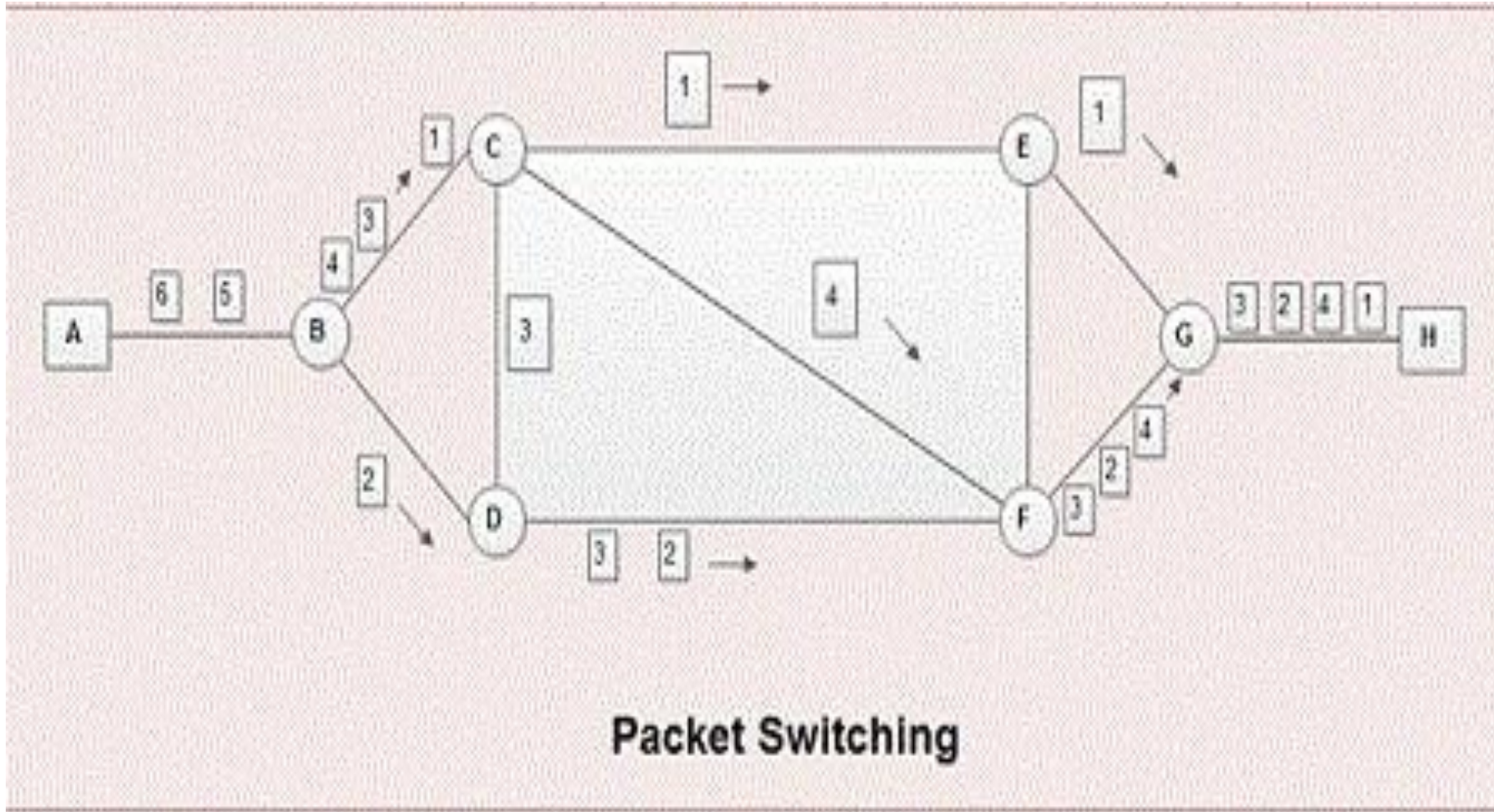
- ▶ When two nodes communicate with each other over a dedicated communication path, it is called circuit switching. There 'is a need of pre-specified route from which data will travels and no other data is permitted. In circuit switching, to transfer the data, circuit must be established so that the data transfer can take place.
- ▶ Circuits can be permanent or temporary. Applications which use circuit switching may have to go through three phases:
  - ▶ Establish a circuit
  - ▶ Transfer the data
  - ▶ Disconnect the circuit



# Packet Switching

- ▶ In Packet Switching, data can be divided into small pieces are called packets that can be flow independently in network based on the destination address that contained header within each packet. Multiple paths are exist between sender and recipient in a packet switching network..
- ▶ The main advantage of packet switching network is the efficiency. The other advantage is that, it is faults tolerant. In packet switching, the quality of data transmission is kept high (error free).

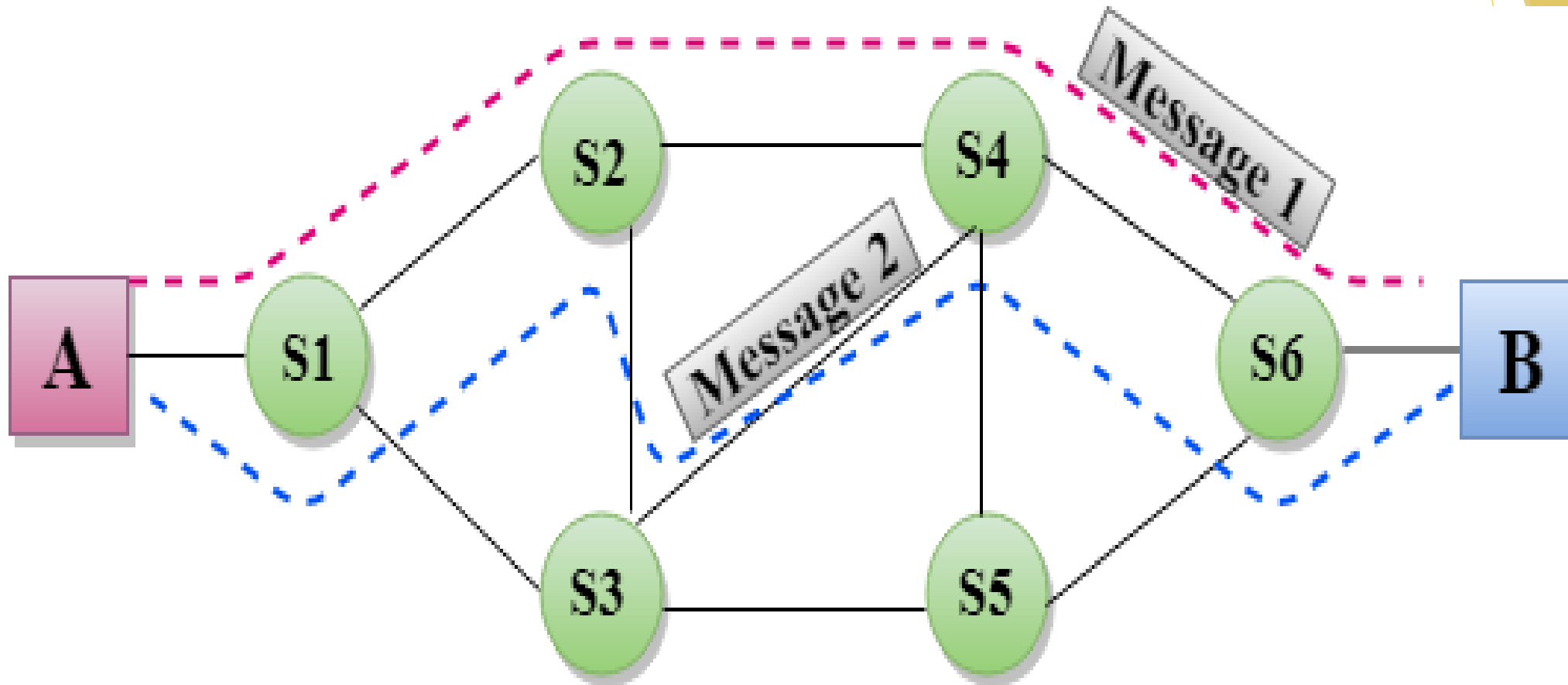




# Message Switching

- ▶ Message Switching is a switching technique in which a message is transferred as a complete unit and routed through intermediate nodes at which it is stored and forwarded.
- ▶ In Message Switching technique, there is no establishment of a dedicated path between the sender and receiver.
- ▶ The destination address is appended to the message. Message Switching provides a dynamic routing as the message is routed through the intermediate nodes based on the information available in the message.
- ▶ Message switches are programmed in such a way so that they can provide the most efficient routes.
- ▶ Each and every node stores the entire message and then forward it to the next node. This type of network is known as **store and forward network**.
- ▶ Message switching treats each message as an independent entity.

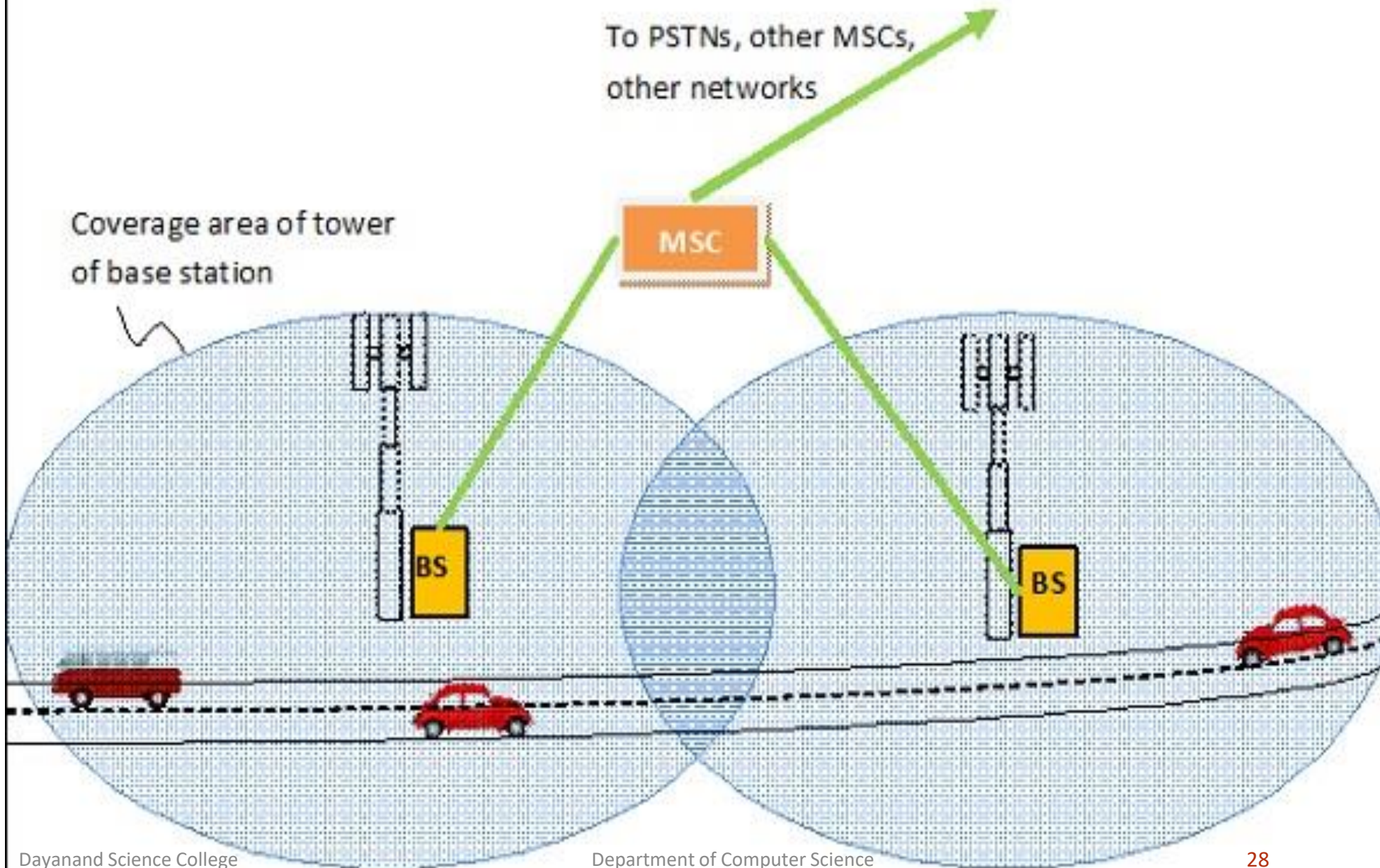




# Introduction to mobile telephone system

- ▶ Mobile telephone service connects mobile radio telephones with other networks like public switched telephone networks (PSTN), other mobile telephones and communication systems like Internet.
- ▶ Mobile phones and other mobile devices, called mobile stations are connected to base stations.
- ▶ Communication between the mobile stations and the base stations are done by wireless radio signals, which may be both data signals and voice signals.

- ▶ Each base station has a coverage area around it, such that mobile stations within this area can connect provided they have access permissions.
- ▶ Base stations contain transmitters and receivers to convert radio signals to electrical signals and vice versa. Base stations transmit the message in form of electrical signals to the mobile switching center (MSC). MSCs are connected to other MSCs and public networks like PSTNs.
- ▶ The system is diagrammatically shown as follows –



# Generations of Mobile Phone Systems

- ▶ **1G (First Generation)** – They were standards for analog voice mobile phone communications.
- ▶ **2G(Second Generation)** – They were standards for digital voice mobile phone communications.
- ▶ **3G(Third Generation)** – These standards were for communications in form of both digital voice as well as digital data.
- ▶ **4G(Fourth Generation)** – 4G standards provide mobile broadband internet access in addition to digital voice and data.
- ▶ **5G(Fifth Generation)** – It is the next step of mobile communication standards beyond 4G which currently under development.