Telecommunications

(B.Tech – ECE 7th Semester)

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Syllabus

- **Unit I Evolution of Switching systems:** Introduction: Message switching, circuits switching, functions of a switching system, register-translator-senders, distribution frames, crossbar switch, a general trunking, electronic switching, Reed electronic system, digital switching systems.

- **Unit II Digital switching:** Switching functions, space division switching, Time division switching, two dimensional switching, Digital cross connect systems, digital switching in analog environment.

- **Unit III Telecom Traffic Engineering:** Network traffic load and parameters, grade of service and blocking probability, modeling switching systems, incoming traffic and service time characterization, blocking models and loss estimates, Delay systems.

- **Unit IV Control of Switching Systems:** Introduction, Call processing functions; common control, Reliability availability and security; Stored program control. Signaling: Introduction, Customer line signaling, AF junctions and trunk circuits, FDM carrier systems, PCM and inter register signaling, Common channel signaling principles, CCITT signaling system No. 6 and 7, Digital customer line signaling.

- **Unit V Packet Switching:** Packets formats, statistical multiplexing, routing control, dynamic, virtual path circuit and fixed path routing, flow control, X.25 protocol, frame relay, TCP/IP,ATM cell, ATM service categories, ATM switching, ATM memory switch, space memory switch, memory-space, memory-space-memory switch, Banyan network switch.

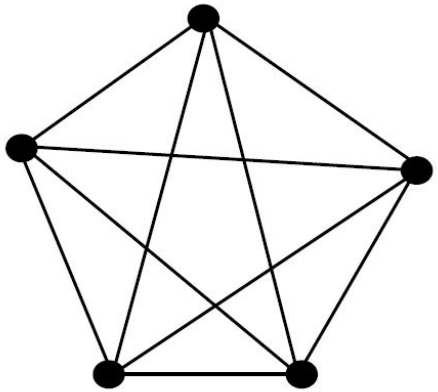
Reference

- **Text Books**
  - Thiagarajan Viswanathan, "Telecommunication switching System and networks", PHI.
  - J.E. Flood, "Telecommunication switching, Traffic and Networks", Pearson education.
  - J.C. Bellamy, "Digital Telephony", John Wiley, 3rd Ed.

- **NPTEL url**
  - https://nptel.ac.in/courses/117/104/117104128/

Evolution of Telecommunication

- The field of telecommunication has evolved from a stage when signs, drum beats and semaphores were used for long distance communication to a stage when electrical, radio and electro-optical signals are being used.
- The first technological development in the field of modern telecommunications was the transmission of telegraphic signals over wires.
- Telegraphy was introduced in 1837 in Great Britain and in 1845 in France.
- In March 1876, Alexander Graham Bell demonstrated his telephone set and possibility of telephony i.e. long distance voice transmission using a point-to-point telephone connection as shown in figure.



Evolution of Telecommunication

- Connectivity in telecommunication networks is achieved by the use of switching systems.
- Some kind of signalling is required with each link between called and calling subscribers. If a called subscriber is engaged, a suitable indication should be given to the calling subscriber by means of signalling.
- In point-to-point network, a calling subscriber chooses the appropriate link to establish connection with the called subscriber.
- In last figure, to connect the 1^{st} entity to all other entities, we require (n – 1) links. With this, 2^{nd} entity is already connected to the 1^{st} entity, so now we need (n – 2) links to connect the 2^{nd} entity to the others. For the 3^{rd} entity, we need (n – 3) links, for the 4^{th} entity (n – 4) links and so on. Therefore, total number of links

$$L = (n - 1) + (n - 2) + \ldots + 1 + 0 = \boldsymbol{n\,(n - 1)/2}$$

- Networks with point-to-point links among all the entities are known as ***fully connected networks***.
- Practically, the number of links required in a fully connected network becomes very large. For example, we require 1225 links for fully interconnecting 50 subscribers. The direct connection of each link can be solved by the use of ***switching system*** or ***switching exchange.***
- The functions performed by a switching system in establishing and releasing connections are known as ***control functions***.

Evolution of Telecommunication

- In such switching system, subscribers are not connected directly to one another instead they are connected to the switching system as shown in figure. When a subscriber wants to communicate with another, a connection is established between the two at the switching system.
- Early switching systems were manual and operator oriented but after these automatic exchanges came into existence which may be classified as ***electro-mechanical*** and ***electronic***.
- Electro-mechanical switching systems include ***step-by-step*** and ***crossbar systems***.
- The ***step-by-step*** system is known as ***Strowger switching system*** after its inventor ***A. B. Strowger***. The control functions in this switching system are performed by circuits associated with the switching elements in the system.
- ***Crossbar systems*** have hard-wired control sub-systems which use relays and latches. These sub-systems have limited capability and it is virtually impossible to modify them to provide additional functionalities.
- In electronic switching system, the control functions are performed by a computer or a processor. Hence, these systems are called ***stored program control (SPC) systems***. New facilities can be added to a SPC system by changing the control program.

Evolution of Telecommunication

- The switching schemes used by electronic switching system may be either ***space division switching*** or ***time division switching***.
- In ***space division switching***, a dedicated path is established between the calling and called subscribers for the entire duration of the call.
- The space division switching technique is also used in Strowger and crossbar system.
- An electronic exchange may use a crossbar switching matrix for space division switching i.e. a crossbar switching system with SPC qualifies as an electronic exchange.
- In ***time division switching***, sampled values of speech signals are transmitted at fixed intervals. This switching may be analog or digital.
- In ***analog time division switching***, the sampled voltage levels are transmitted as they are.
- In ***digital time division switching***, they are binary coded and transmitted. If these coded values are transferred during the same time interval from input to output, the technique is called as space switching. If the values are stored and transferred to the output at a later time interval, the technique is called time switching.
- A ***time division digital switch*** may also be designed by using a combination of space and time division switching techniques.

Basic Terms of Telecommunication

- A major component of switching system or an exchange is the set of input and output circuits are called as ***Inlets & outlets.***
- Primary function of switching system is to establish an electrical path between given inlet-outlet pair.
- The hardware used for establishing above connection is called ***switching matrix*** *or* ***switching network***.
- If the number of inlets N is equal to the outlets M, then it is said to be ***symmetric switching network***.
- When all inlets/outlets are connected to subscriber lines. In this, output lines are folded back to input and called as ***folded network***.
- One for whom the call is destined is known as ***called subscriber***.
- One who initiates the call is known as ***calling subscriber***.
- When a subscriber requests a connection, there are no switching paths free in the network and hence denied connection. In this case, subscriber is said to be *blocked* and switching network is called ***blocking network***.
- The probability that a subscriber may get blocked is known as ***blocking probability***.