Let’s start with PSTN Introduction..By the way PSTN stands for Public switch telephone network

Objectives

- At the end of this session, you will be able to:
  - Explain telecom evolution and typical milestones in telecom evaluation
  - Understand typical composition of PSTN network and its topology
  - Understand PSTN access network composition
  - Understand basic terminologies used in PSTN network such as local loop, signaling, trunk, central office, etc.
  - Understand typical scheme of PSTN addressing
  - Understand signaling classification

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Agenda

- Telecom Evolution
- PSTN: Nuts and Bolts
- PSTN: Typical Network Composition
- Addressing and Routing
- LATA, LEX and IXC
- Introduction to signaling

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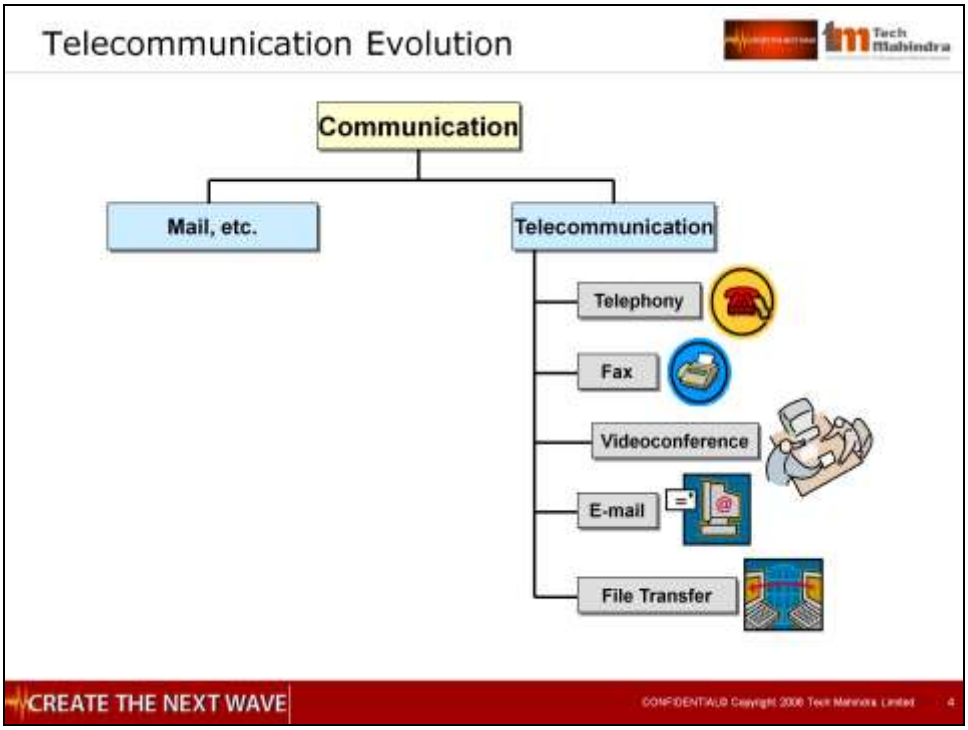


Telecommunication evolution

Meaning of Tele happens to be far , so it is far or distance communication…

Again in the today's context there is no really no meaning for word 'FAR' goes. Nevertheless, I will not be surprised if communication crosses galaxies and planets in the days to come…we may find an address of website like … www.google.nr.milkiway

Shown in front are some modes of communication like Telephony, fax, video conference , email etc….

Of left side we have a typical Postal mail service …

Let's move on further…

Here are typical milestones achieved in the area of communication..yearwise

1837: A major break throrugh …**Samuel Morse** invented **telegraph…**prior to that communication was in very very initial stage…In this mode of communication information or data was transferred as a morse code

Year 1858.. This is the year where first ever transoceanic telegraph cable was laid

Again a major break though in year 1876: **Alexander Graham Bell** invented **telephone**

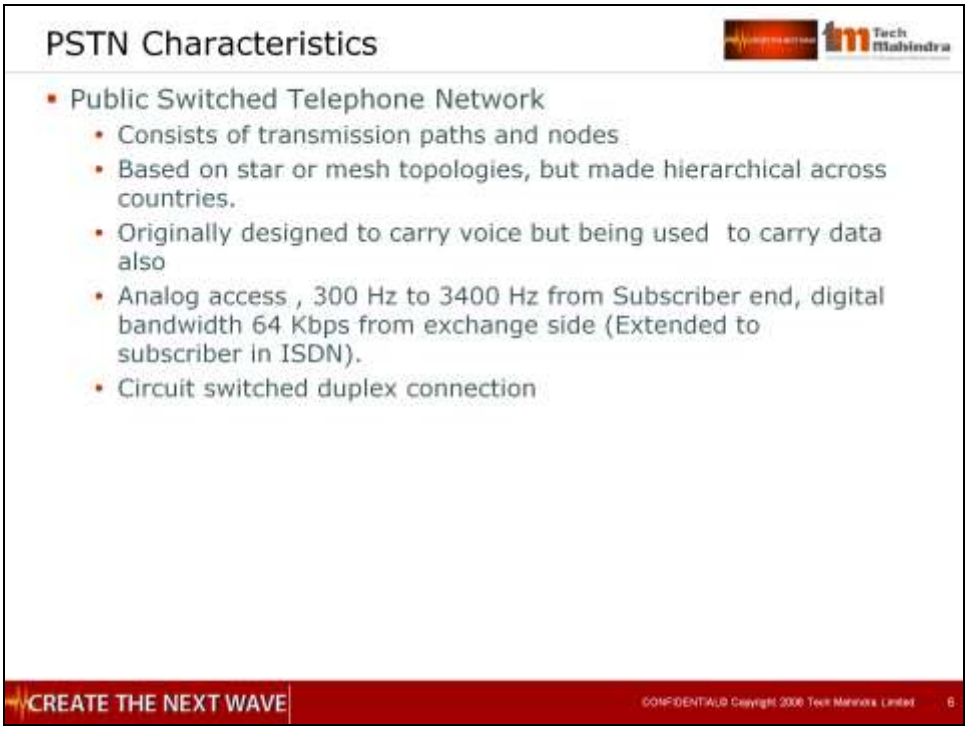
Year 1877… Bell Telephone company was formed

1885… Incorporation of AT&T

Again a very major breakthrough in 1892…**Invention** of **Strowger exchange** Because prior to that what we had was a manual exchange but credit goes to this gentleman called Strowzer who have replaced human intervention and invented first ever automatic exchange that is why the name Strowzer exchange

Year 1912: Limitations of Strowzer exchange lead to an **Invention** of initial **crossbar exchange**

And finally year 1971 where First electronic exchange was developed….



Let's have a look at more details and the characteristics of PSTN

PSTN – Public Switch Telephone Network

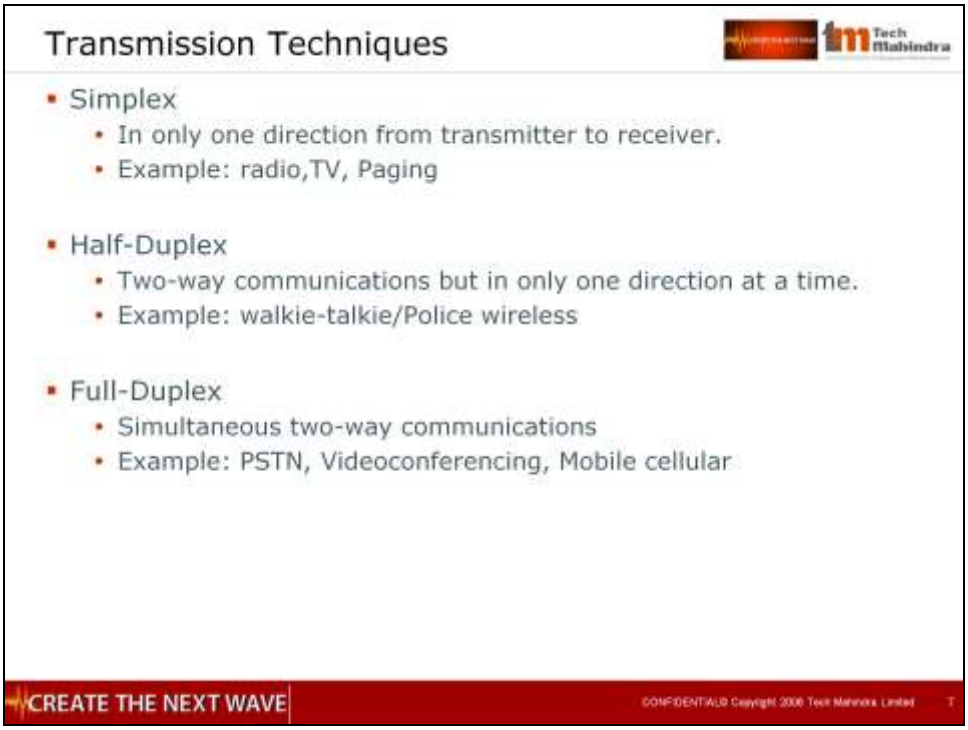
PSTN consists of transmission paths and nodes

It is based on star or mesh topologies. By the way, topology is nothing but physical layout of the network. Telephones are connected to local exchange in a star topology and exchanges are connected with each other in a hierarchical mesh to have a better redundancy.

Let's move onto next point. It was originally designed to carry voice but as you know ….now a days even data also is carried through telephony network. Of course the data rate is low.

It was meant for an Analog access , in the frequency range of 300 Hz to 3400 Hz. It happens to be a human voice range. By the way, it is worth to mention here that – human being can speak in the frequency range of 300 Hz to 3400 Hz but human can listen till 20Khz. Beyond 20Khz, human ear is going to act as a filer and it will never let above frequencies go inside. Digital bandwidth of voice communication comes out to be 64 Kbps. And we will soon see as to how this figure of 64Kbps is derived.

PSTN is Circuit switched duplex connection. The meaning of circuit switching is , end to end connection or so called circuit is fist established prior to communication and the meaning of duplex connection is two way data transfer can happen. Rather PSTN is full duplex in a sense voice communication can happen both way simultaneously also.



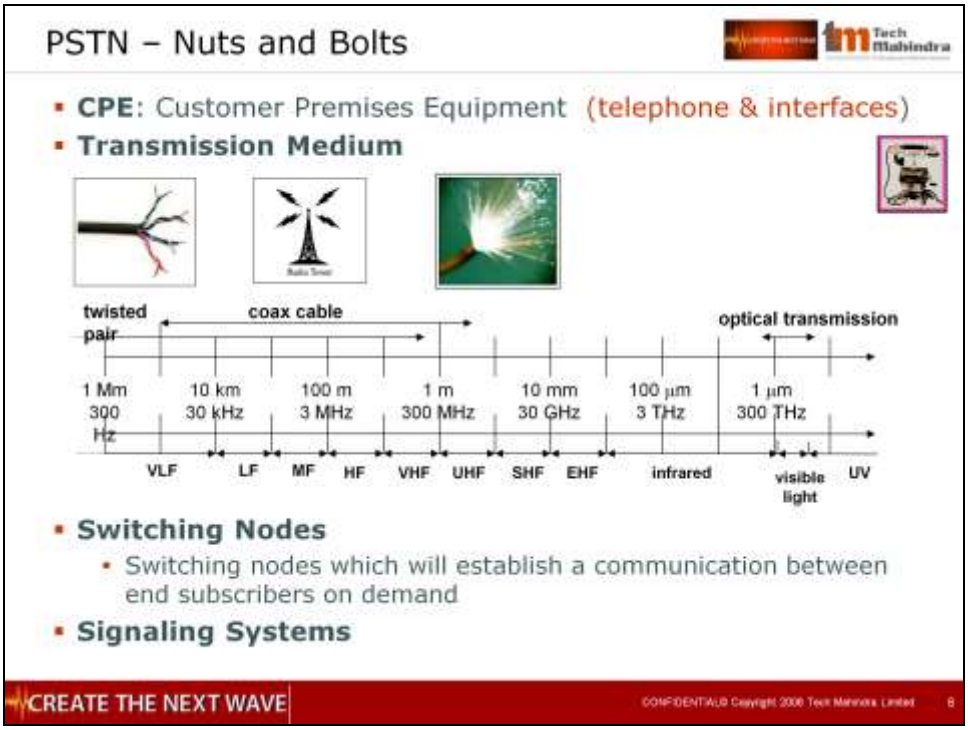
Let's try n understand different transmission techniques…

Simplex Communication: here direction of communication is only one way i.e. from transmitter to receiver. And the examples of simplex communication are : Radio , TV, Keyboard and display. For example, we can only take input from a keyboard, we can not output to a keyboard. Similarly we can only output to a console or a display device and the radio and TV transmission are the systems where we have radio transmitter or a TV transmitter which will transmit the signal and what we have , at our homes or business houses , are radio or TV receivers. And that is precisely we call radio and TV as a receiver.

Let's go to next technique.

Half duplex communication …In this category, communication can happen in both the directions but not simultaneously…Example is walkie-talkie

On the contrary , Full-Duplex communication happens in both directions simultaneously. This is a difference between a half duplex and full duplex communication. Examples of full duplex communication are videoconferencing , telephony , computer network. In telephony both party can talk simultaneously…it is a different story that we as a human being never do so because communication path being used is same and the kios may occur so we follow a half duplex communication



Here are nuts and bolts of PSTN. A composition of PSTN…

Customer Premises Equipment , Transmission medium and the switching nodes…

Let's begin with CPE…As the name indicates it is the equipment that is installed by the service provider on a request by a customer at the customer premises.

Next thing is the transmission medium…

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PSTN network is composed of CPE Customer Premise Equipment so called telephone, switching nodes or exchanges and transmission media to interconnection exchanges.

Communication media can be classified as wireline and wireless. Under wireline category , we have copper wire which comes in two forms – co-axial cable used for cabel TV and CN and twisted pair used for CN , Telephony. On the other hand we have fiber cable which can be throught of FAT wire. Fat in terms of bandwidth and amount information carrying capacity. By the way , nature of signal gets transmitted through fiber is light.

Under wireless category we have AIR. Electromagnetic waves of different frequency ranging from low to very high traverse through air. Even though AIR through with EM waves are transmitted is free and non propriatary , the freq. bands are licensed.

.

VLF = Very Low Frequency **LF** = Low Frequency (Submarine) **MF** = Medium Frequency (AM)

HF = High Frequency (AM) **VHF** = Very High Frequency (TV, Mobile)

UHF = Ultra High Frequency (TV, Mobile) **SHF** = Super High Frequency (Satellite)

EHF = Extra High Frequency(Satellite) **OPTICAL** = Optical Fiber links (IR)

UV = Ultraviolet Light

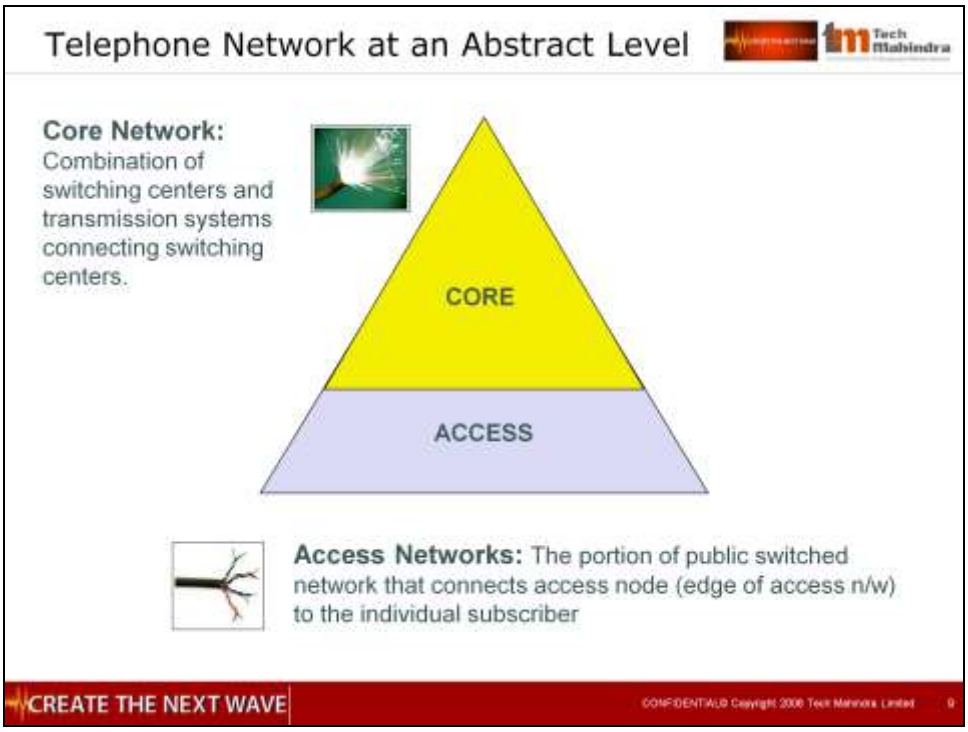
Nodes : Switches has gone a revolution starting from Manual switching, mechanical switching , electromechanical switching to today's automatic switching

Types :

Local switch

Transit switch

International switch



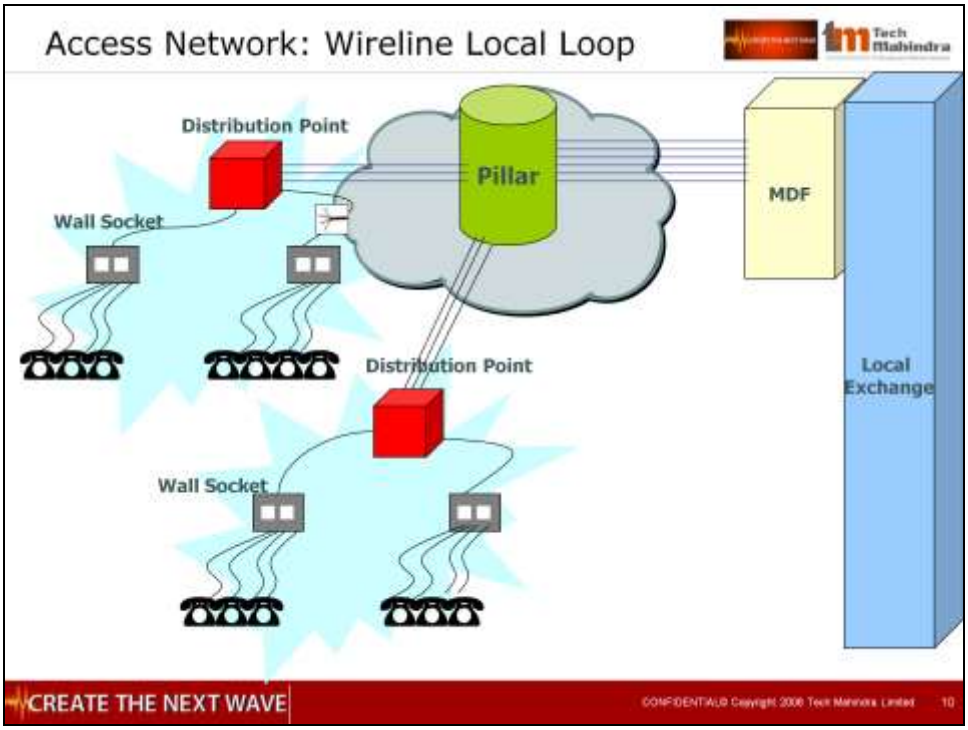
PSTN is a combination of core network and access networks.

Core Network:

Combination of switching centers and transmission systems connecting switching centers. Switches are arranged in hierarchical meshy way. Transmission medium used in Fiber optic or air to send micro waves.

Access Network is the portion of public switched network that connects access node (edge of access n/w) to the individual subscriber

Access network in world is predominantly twisted copper wire connected to Analog telephone.



This is how a typical access network composition will look like. What you see over here is a wireline access network. Here every where in the access network there is wire. By the way in case of PSTN, access network uses twisted pair wire.

Let's begin a journey from Customer premises equipment or so called telephone. Telephone of connected to wall socket. Wall socket is connection to distribution point which is typically a red box or a blue box. It is basically a passive concentration point. From Distribution point connections are brought onto a pillar and from Pillar multiple such connections are brought and terminated at MDF situated in the local exchange. By the MDF stands for Main Distribution Frame. Behind MDF, there is LIC card which will take care of A-2-D and D-2-A conversion i.e. analog to digital and digital to analog conversion in case of digital exchange.

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Let's have a look some terminology with reference to access network.

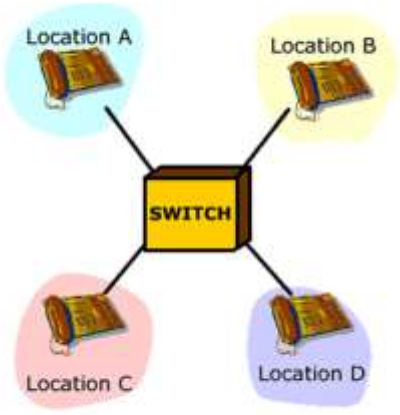
Local Loop :

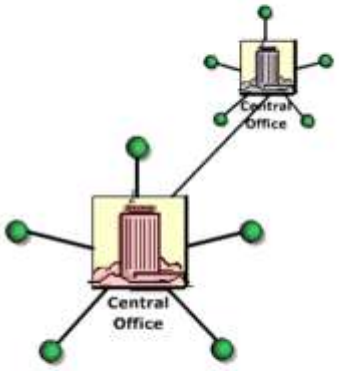
The *local loop* is the telephone line that runs from the telephone company's local exchange to your home or business. It is also called as Subscriber local loop or In the US Telecom scenario it called as "Last Mile". It starts with Telephone at the subscribers end which is connected to wall socket, which in

turn are connected to distribution point were all line are from the wall sockets in localized area are collected . DPs are connected to Pillar which a concentration point for DPs and finally all lines from Piller are terminated at MDF i.e. Main Distribution Frame at local exchange. Transmission of voice from telephone to exchange is analog in nature. It is interesting to note that power for telephone is provided by an exchange.

…this is especially a solution …. Where wire can not reach for whet ever reason and exchange has facility

Topology - Star





Star/Extended Star Topology

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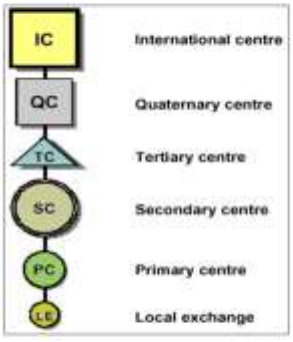
Telephone Network Topology

Mesh-shaped network with direct connections between every node



The network hierarchy according to the ITU-T

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Slide added for clarity. It is repeated else where also.

Introduction - Telephone Systems

- Local Loop
  - The pair of wires that runs from the Telephone Exchange into our home or business office
- Phone Line
  - Communication path between CO(central office) and our home
  - Twisted pair 22 AWG or 0.5 mm copper wires
- Line Circuit
  - The voltage applied to the line to drive the telephone is -48 Volts DC
- Central Office
  - is the hub of a city's telephone network, providing power for the telephones, routing the calls ,and recording the necessary billing information. Also known as Telephone Exchange
- Trunk communication path between CO's
- Switch a device that routes communications to different parties

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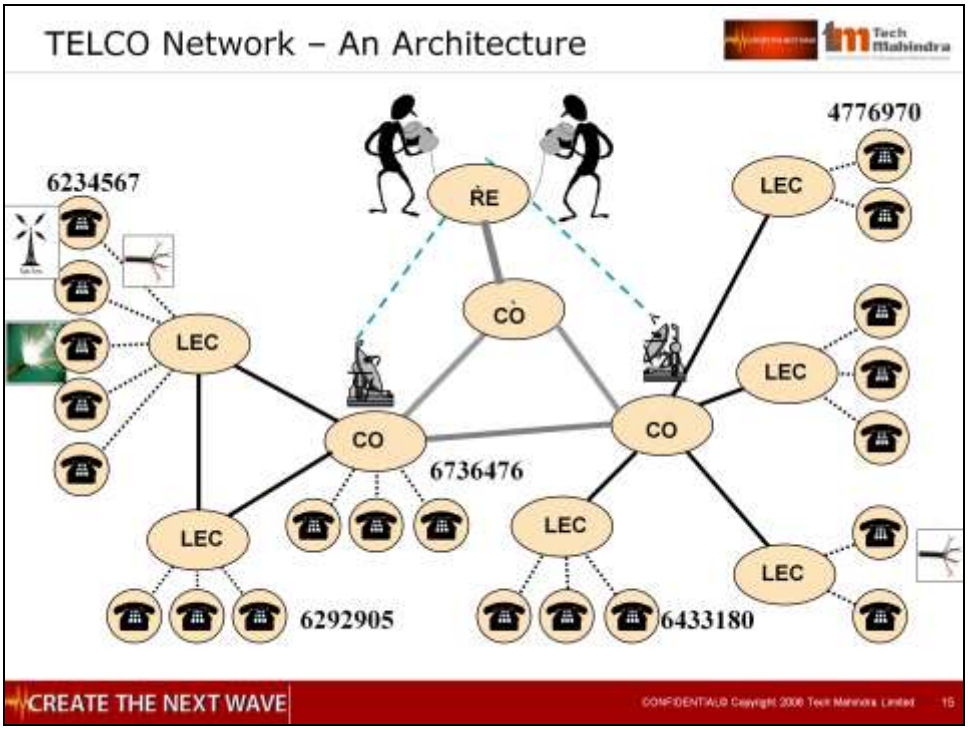

Local Loop

the pair of wires that runs from the Telephone Exchange into our home or business office connecting to CPE.

Local Exchange

is the hub for location's telephone network

Central Office

is the hub of a city's telephone network, providing power for the telephones, routing the calls ,and recording the necessary billing information. Also known as Telephone Exchange. If you place a long distance call, the central office passes your telephone call off to a long distance provider.

Trunk

A *trunk* is a special telephone line that runs between central offices and other telephone company switching centers.

A trunk is usually digital, high speed, and carries multiple telephone circuits.

Switch

a device that routes communications to different parties.

LATA (Local Access Transport Area *) Again in US context the area being server by local exchange is called LATA.*

The USA is divided into a few hundred *local access transport areas (LATAs).*

LEC (Local Exchange Carrier)

Telco operator who offers services in LATA are called Local exchange carrier. If your call stays within a LATA, it is a local distance call and is handled by a local telephone company called LEC.

IXC (Inter Exchange Carrier)

If your call goes from one LATA to another and happens to be a long distance call and is handled by a long distance telephone company called Inter exchange carrier. MCI , Sprint , AT&T are dominant players in IXC area.

A telephone number is an unique identification of subscriber in the world. To uniquely identify one subscriber , telephone number consists of Country code , city/area code, an exchange code and a subscriber number.

Addressing and Routing

- Each subscriber has address (telephone number)
  - Hierarchical addresses

- Telephone address used for setting up route from caller to callee

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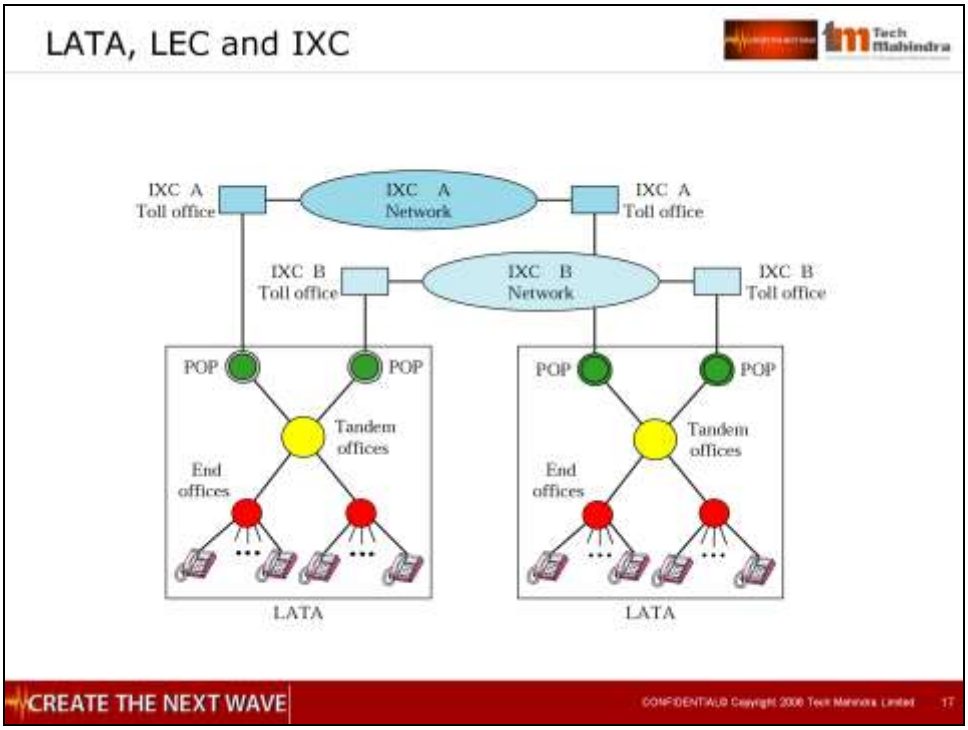

LATA …Local Access Transport Area

LEC : Local Exchange Carrier

IXC : Interexchange Carrier

POP: Point of Presence

Introduction - Voice Signaling

Signal Name	Function
Off-hook	Informs CO that user want to call
Dial tone	Informs user to Dial numbers
Address	User Dials Number
Ring tone	Informs user that destination phone is ringing
Busy Signal	Informs the user that destination phone is in use
On-hook	Informs CO that user has disconnected
Supervision	Supervises the condition of subscriber state

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Summary

- In this session, we have learned:
  - Telecom evolution along with typical milestones achieved in the journey of telecom so far
  - Typical composition of PSTN network and its topology
  - PSTN access network components: Wireline access network and wireless access network
  - PSTN terminologies: local loop, signaling , trunk, Central office, LATA, LEC, IXC
  - Telephone addressing and routing scheme
  - PSTN signaling classification

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Thank You

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