Public Telephone Network

Together, the wires, frame, and switches form the basis of the telephone network.

LEC Info

- **The telephone company operates from a central point called the central office (CO).**

From the central office, a star topology is often used to connect to the customers.

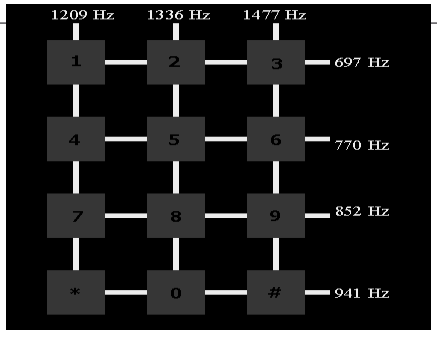
- **Central offices are usually linked in a ring topology.**
- **Bundles of cable, called feeders, are fed to splice points. Feeder cables typically consist of 50 to 3000 pair of wires. Branch feeder lines are then fed to the customer.**

- **The RBOC's and other independent carriers are called local exchange carriers (LEC's).**
- **LEC's connect with interexchange carriers (IXC's) at a point of presence (POP).**
- **Central offices are connected to end offices, which are connected to each other by end office trunks.**
- **There are over 19,000 end office trunks in the United States.**

- Strategic asset by the US government.
  - FCC tracks the reliability of carriers' network.
  - US Post Office ran AT&T during World War I.
- Original 144 area codes lasted from 1947-1995.
- From 1995-mid-1996, 35 new area codes were assigned.

Attributes of Real Time Services

- A TN is dialed. This is the "address" to which the call is directed.
- Numbers on the a telephone are used to send Dual Tone Multi-Frequency (DTMF) tones over the network. (697 Hz - 1,477 Hz)
  - DTMF was introduced by AT&T in 1963 to speed call set up in the central office (CO).
  - Two different frequency tones are generated each time a button on the telephone is pressed.
    - 2 = 697 Hz and 1,336 Hz



- The first attempt to automate the "off-hook" process was done with rotary dials, which create pulses at a rate of ten pulses per second.
- The touch tone pad, which we are used to today, uses a cross point matrix to generate a pair of tones Each two tone combination represents a different digit.
- The ringer is a -48 volt current that alerts the receiver that someone at the other end of the connection wishes to converse.

North American Numbering Plan (NANP)

North American Dialing Plan (NADP)

- Domestic
  - To make a domestic long-distance call, the caller must usually dial a "1". The three components of the domestic number are:
  - 1) ***NPA (Number Plan Area)*** 2) ***NXX*** 3) ***XXXX***

area code ***prefix exchange*** ***subscriber # station #***

1995 = 152-792

N=2-9
X=0-9

ANI is ***Automatic Number Identification***

Process of Call Processing

- Origination
  - off hook & request for service
- Routing
- Transport
  - In-band & Out-of-band Signaling
- Completion
- Disconnect

Central Office & Switch Development

The Local Telephone Network

- The local telephone company is called the LEC and can be either a RBOC or an Independent telephone company. The local telephone company handles IntraLATA calls, which may be local or local toll.

- **Parts of the local network**

- The CO (Central Office) contains switching equipment that connects residential and business subscribers to each other locally and long distance.

- The EO (End Office) switch delivers dial tone to the subscriber and is used to switch calls in a callers area.

- The TO (Tandem Office) switch is used to switch calls to other LEC switches and it is usually the point of interface for the IXC.

- The 2-wire telephone line that comes to your office or home is called a local loop.

- A 4 wire circuit which connects switches is called a trunk. The local telephone company calls these circuits IOT (Interoffice Trunk).

Example of a Local Call

- Joe Lata is calling his friend across town by dialing a seven digit number (NXX-XXXX). Diagram this call and label all the parts of the LEC network. Who would handle this call?

Examples of an IntraLATA Call

- Joe Lata is calling his friend in the next town by dialing 1+ the 10 digit number. The call is within his LATA. Diagram this call and label all the parts of the LEC network. Who would handle this call?

Circuit Switching

- A circuit is a physical path for the transmission of voice, image or data. The ITU (International Telecommunications Union) definition of circuit switching is:
  - The switching of circuits for the exclusive use of the connection for the duration of a call.
- The path or channel (the circuit) is available *exclusively* for the duration of the call. The path is not shared.

Packet Switching

- Combines the advantages of message & circuit switching while minimizing their disadvantages.
- The message lengths are divided into smaller packets that are the same length. (Either 128, 256, 512, or 1024 bits long)
  - Datagram services
  - Switched Virtual Circuit (SVC)
  - Permanent Virtual Circuit (PVC)

Local Voice Components

- Standard Local
  - -flat rate
  - -per call
  - -per minute
- Local Basic Lines
- Local Multi-line
- Local Trunks
  - Analog or Digital
- Local ISDN - BRI & PRI

Standard Features/Capabilities…

- 911 E911 where available
- Directory Listing
- Directory Assistance 1010-9000
- Operator Service
- Customer Service
- Telephone Number Assignment
- Service Access Codes (SACs) - 700, Toll Free
- Telecommunications Relay Service
- Equal Access

Local Number Portability

- LNP (Local Number Portability) will be used for number retention wherever it is available.
- If LNP is not available, INP (Interim Local Number Portability) may be used.

Access Types for CLECs

How dial tone is provided….

- Facilities Based/ Lit Buildings/On-Net/On-Ring
  - Lit Buildings customers are located in a building which is connected to IXC's local fiber ring.
  - The IXC negotiates with building management for space to use for its Point of Presence.
  - The IXC runs cable from this POP to the customer within the building to provide them with service.
  - The customer has the option to also use the ILEC for service to establish a "Bullet proof" network.

Access Types for CLECs

(continued)

- Off-Net/LUP/Co-Locate/Unbundled Loop
  - The ILEC (Incumbent Local Exchange Carrier) or CAP (Competitive Access Provider) connects the customer to the central office.
  - The customer's line is routed to IXC's equipment which is co-located in the central office.

What is co-locate?

- Utilization of the LEC to connect customers to the CLEC network by physical location of their equipment inside the LEC building.
- Similar to the concept of a POP for local.
- Allows the CLEC, where provided, a larger base of prospective customers.

What is an Unbundled Loop?

- Reuse of LEC Copper Cable at the customer site.
- Provided in areas where negotiated by the CLEC.
- CLEC must install an IDLC (Integrated Digital Loop Carrier) in co-located central offices.
- Customers can have CLEC local service with a different long distance carrier. Although it is encouraged for customers to have both local and long distance with the CLEC.

Long Distance Network

- Any Long Distance provider is called an IXC (InterExchange Carrier)
- Who are they?*AOL, AT&T, Dial Tone Savers, Excel Communication, Frontier, LCI, LOGIX, MCI WorldCom, Sprint, US Long Distance, Westel Inc, Williams Communications, 1-800-RECONEX, etc…..*

Parts of the Long Distance Network

- The physical location where the long distance carrier interfaces with the LEC is called a POP (Point of Presence)

*Switch 1. Route Calls
2. Create CDR (Call Detail Record)

*Switchless POP (DAC/DCS)
Allows customers to access to IXC network

Digital Access Cross Connect or Digital Cross Connect System

1/0, 3/1, 3/3

- When a call enters a POP where there is no switch, the call is backhauled or transported from that POP to another POP with a switch.
- Circuits which connect switch sites are called InterMachine Trunks (IMT).

Example of an InterLATA Call

- Diagram a call that you would make to a friend or relative living in a distant town outside of your calling zone. Include all the parts of the call process discussed in this module.

IDD (International Dialing Plan)

- International
  - The IDD or International Direct Dial prefix assigned to North America and used to access the international network is "011".
  - The three components of the international number are:

1) ***CC - Country Code*** 2) ***CC - City Code*** 3) ***Local number***

US - 1, Australia - 61, Russia - 7, France - 33, England - 44

International Call Process

Toll Free Service

- AT&T developed 800 numbers in the late 1960's to provide a convenient way for businesses to pay the toll charges for their customers who contacted them.
- In 1984, there were over 3 million 800 numbers in service by AT&T, and other IXCs wanted to provide 800 service.

Toll Free
Features & Components

- **Basic Toll Free Service**
  - Toll Free Calling
  - Nationwide Origination
  - Toll Free-NXX-XXXX Number Format
  - Single Number Service
  - Switched or Dedicated Access
- **Basic Coverage Includes:**
  - United States
  - U.S. Virgin Islands
  - Puerto Rico

Toll Free Routing

- Pre-Equal Access

ATT	1-800-000-0000
	1-800-599-9999
MCI	1-800-600-0000
	1-800-799-9999
Sprint	1-800-800-0000
	1-800-999-9999

- After Equal Access (1993)


SMS & RespOrg

- SMS or Service Management System
  - Toll Free Portability
  - Located in St. Louis, MO
  - Maintained by BellCore (now Telecordia 3-9-99).
  - Contains information on: toll free numbers availability & routing.
  - Access to SMS via a RESPORG

RESPORG

- RESPONSIBLE ORGANIZATIONS
  - Responsibilities Include: provision, maintain, change, route & release
  - Authorized by the customer
  - Functions of a RespOrg: provision, maintain, change, route & release

Payphone Surcharges
(somebody's gotta' pay)

- PSPs or Payphone Service Providers have been losing money for years because people make so many toll free calls from payphones.
  - As part of the Telecommunications Act of 1996, facilities-based long distance carriers will be charged a .26 per call surcharge for toll free calls originating from a payphone.
  - These charges will be used to pay the PSPs. Affects all toll free, access code (101XXXXX and 950), calling card calls (including # re-origination) and prepaid cards.

Payphone Surcharges
(continued)

- IXC's charge the "owners" of the toll free numbers dialed .26 to .35 per call to recoup these charges.
- The payphone surcharge are marked on the invoice.
- Many IXC's are currently developing a feature which will block calls coming from payphones to a customer's toll free number.

900 Service

- Generally not free to the caller.
- A unique feature is that 7,000 calls can be handled simultaneously on a single ANI or DAL.
  - This capability allows television stations to use 900 numbers to poll their viewers on attitudes about specific topics. A station will provide two or more 900 numbers; viewers dial the number that represents their opinion or desired option.
  - The calls are tallied automatically after the caller hangs up. The cost of the telephone call usually is displayed on the television screen

Signaling System 7

- AT&T pioneered the project by which the signaling information necessary to process a call could be separated from the voice data and transmitted independently over an entirely different network that carried ONLY signaling information.
- SS7 Network Elements
  - Signaling Point (SP), Signal Transfer Point (STP), Service Control Point (SCP), Signaling Link (SL)

Signaling Point (SP)

- An SP can both send and receive SS7 messages.
- At originating switch the SP converts conventional signaling into SS7 format and sends the information out to elements of the signaling network. Reversed at terminating switch.
- Generic term for an SS7 interface node.
  - In DSC switch terminology, an SP is called a “Service Switching Point” (SSP).
  - DMS terminology refers to the SP as a Link Peripheral Processor (LLP).

Signal Transfer Point (STP)

- The backbone of the SS7 network consists of STPs deployed in redundant pairs.
- STPs are packet switches that route signaling messages to other STPs or SPs. The STPs, themselves, are not destinations for the messages. STPs are located at IXC terminals and serves specific geographic regions.

Service Control Point (SCP)

- An ancillary part of the SS7 network. These nodes are not involved with “signaling information”, but are databases in which customer profile information is located.
- These databases can be accessed by the LEC, for 911 information or to provide “caller ID”.
- The SCP is accessed by the SP via standard signaling links (SL).

Signaling Links (SL)

- Connect various elements of the SS7 network.
- The are dedicated 56 or 64 kb/s circuits that carry the “signaling information” necessary to establish, maintain and disconnect calls.
- Signaling links are identified as one of five types, based upon connectivity.

SL Connectivity

- "A" Links
  - Connects SPs to the redundant STPs in the region
- "B" Links
  - Connects redundant STPs to other redundant STPs outside the region
- "C" Links
  - Connects redundant STPs within the region

- "D" Links
  - Connects IXC STPs to LEC STPs
- "E" Links
  - Connects STPs to other STPs that do not reside within the region
- "F" Links
  - Connects SPs to other SPs within the region