Telecommunications
Networks
101

Understanding the Basics of Network Telephony

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Telecommunications Networks

- Circuit switched network
- Packet switched network
- Next generation network
Telephone Networks

- Wireline telephone network
- Wireless telephone network
  - Terrestrial telephone network
  - Satellite telephone network
Wireline Networks

- Wireline network is the term used to describe the network that delivers dial tone to residential and office users
  - Local exchange carrier (LEC)
  - Interexchange carrier
As part of the divestiture of the LECs, the Modification of Final Judgment called for the separation of exchange (local) and interexchange (long distance) telecommunications functions. Local Access and Transport Areas (“LATAs”) were adopted to identify the areas in which LECs could offer local service.
An End Office (“EO”) is a Local Exchange Carrier switching system within a LATA or market area where subscriber stations or PBXs are terminated for purposes of interconnection to each other.
What Is a Tandem Office?

A telephone company or centralized equal access provider switching system that provides a concentration and distribution function for originating or terminating traffic between end offices and customer-designated premises. An exchange carrier switching system that provides a traffic concentration and distribution function for inter-LATA traffic originating/terminating within a LATA.
Wireline Telephone Hierarchy

Diagram of the wireline telephone hierarchy with nodes representing Access Tandem, Local Tandem, and End Office, connected by lines indicating the flow of calls.
LATAs in the State of California

LATA 0728 (Fresno, CA)
Wireless Networks

Wireless networks is the term used to describe the network that delivers telephone service using radio frequencies and delivers either mobile or fixed telephone service.

- Cellular network
- Personal communications service network
- Satellite network
Air Interface

- Analog (1G).
  - Widespread introduction around the world based on Advance Mobile Phone System (AMPS) introduced in early 1980.

- Digital.
  - (2G & 2.5G).
    - Introduced in late 1980s to early 1990 based on three different air interface standards.
      - CDMA (IS-95).
      - TDMA (IS-136).
      - GSM.
  - 3G.
    - Introduced in early 2000 based on two air interface standards.
      - CDMA 2000.
      - W-CDMA.
Basic Cellular Concept

Frequency re-use

Base Station
Satellite resembles base stations used in wireless terrestrial networks except they are located in orbit. Each satellite consists of an antenna, a trapezoidal body, two solar arrays and a magnetometer.

There are at least three different orbits:

- **Low earth orbit (LEO)** - A satellite that orbits 400 to 1,600 miles (644 to 2,575 kilometers) above the earth's surface. 48 to 66 LEOs are needed to cover the entire earth.

- **Medium earth orbit (MEO)** - An earth orbit in an altitude roughly midway between the earth and geosynchronous orbit. Satellite orbits between the altitudes of 1,500 and 6,500 kilometers (930 to 4040 miles) may be considered MEOs.

- **Geostationary earth orbit (GEO)** - The orbit directly above the equator, about 35,800 kilometers (22,300 miles) above the earth in space. Also known as Geostationary and Clarke orbit. When positioned in this orbit, a satellite appears to hover over the same spot on the earth because it is moving at a rate that matches the speed of the earth's rotation on its axis.
Satellite Networks (continued)

Satellite Networks operate on different frequency bands:

- **S-band** - The portion of the electromagnetic spectrum allotted for transmission in the 2 to 4 GHz frequency range.

- **L-band** - A band of frequencies in the 0.5 to 2 GHz range that are used primarily for voice communications.

- **C-band** - A band of frequencies in the 4 to 8 GHz frequency transmission range that are used for satellite and terrestrial communications.

- **Ku-Band** - A band of frequencies in the 10.9 to 17 GHz range that are used for fixed satellite service applications.

- **Ka-Band** - A band of frequencies in the 18 to 31 GHz range that are available for global satellite use.
Wireline & Wireless Networks
Similarities & Differences

**Similarities**
- Wireline & Wireless Networks comply with North American Standards
  - Identical Interface with Public/Private Switch Telephone Network
  - Identical Telephone Number Assignment
  - Identical Signaling Platform

**Differences**
- Fixed vs. Mobile
- Reliability
Telephone Network Hierarchy

[Diagram showing a network hierarchy with nodes labeled as End Office, Local Tandem, Access Tandem, Satellite Switch Center, and CLEC Switch Center, connected by lines indicating the network's structure.]
All domestic telecommunications numbering plans for public networks conform to the major aspects of standards established by the International Telecommunication Union (ITU-T) which defines international telephone numbers to be in the format shown below:

Country Code (CC) + National (Significant) Number (N(S)N)

Country codes, which may be 1, 2, or 3 digits in length, are assigned by the ITU. Within the geographic area designated for each country code, the local administration may define its own national numbering plan. The combined length of the country code and national (significant) number cannot exceed 15 digits. Country code “1” is shared by 18 countries in North America. Within this area, national numbers are formatted according to the North American Numbering Plan.
North American Numbering Plan (NANP) is based on a destination code where telephone numbers have a specific address. NANP numbers are 10 digits. The NANP 10 digit format consists of:

Numbering Plan Areas (NPA -3 digits) + End Office Code (3 digits) + Subscriber/Station Number (4 digits)

NANP numbers may be geographic or non-geographic. Geographic NANP numbers define a hierarchy. The area served by the NANP is divided into:

• Geographic areas, called NPAs, each of which is assigned an NPA code.
• Non-geographic areas, such as 800, 900, etc.
• Service NPA codes which identify services rather than geographic areas, such as 411, 911, etc.

End office or Central office (NXX) codes are typically assigned to switching entities/points of interconnection that provide basic switching functions within each NPA. Each end office code can serve as many as 10,000 subscriber lines or subscriber/station numbers.
NPA and End office Code Format and Capacity
NPA codes are in the following format:

NXX where N is any digit 2 to 9. X is any digit 0 to 9

The NPA format provides a total of 792 NPA codes, calculated as follows:

Max. NPA codes Available with NXX format (8*10*10) 800
Less reserved codes of N11 format 8
Total NPA codes 792
Subscriber/Station Number Format and Capacity
Subscriber/Station Numbers are in the following format:

XXX where X is any digit 0 to 9

The subscriber/station line format provides a total of 10,000 numbers within each end office code.
Broadband Networks

- Integrated Services Digital Network (ISDN)
  - BRI rate of up to 128 kbps
  - PRI data rate of up to 1.5 Mbps

- Digital Subscriber Lines (DSL)
  - Data rate up to 6.1 Mbps (depending on the distance from LEC’s EO)
    - ADSL – Data rate of 1.5 to 6.1 Mbps download and 640 Kbps upload over POTs line
    - SDSL – Data rate of 1.5 Mbps for both download and upload over POT lines
    - VDSL – Data rate of up to 52.8 Mbps for download and 2.3 Mbps for upload over fiber