CSIS 625 Introduction

Introductory terms

- Telecomunications -
  - The art and science of comminicating over a distance.
  - Includes telephony, telegraph, radio, televison, email, etc.
- Network
  - A set of devices that communicate by media links
  - Devices are often called nodes.
    - May be a person, a telephone, a computer, etc.
  - Examples: Long distance network, LAN on campus
- Media link
  - The physical path by which a message is sent from a sender to a receiver.
  - May be air, wire, fiber optic cable, radio waves, etc.
- Bandwidth
  - A measurement of medium capacity

Protocols

- A set of rules that describe how two nodes on a network communicate
- Defines the syntax of the message
  - ASCII text,
- Defines the meaning of the message
  - 1 if by Land, 2 if by sea.
- Defines the timing of the message

Types Of Communications

- Simplex - One Way
- Half-Duplex - Two Way Alternating
- Full-Duplex - Two-Way Simultaneous

Standards

- The thing I love about standards is that there are so many to choose from.
- Many organizations
  - IEEE, IETF, ITU, ISO, ANSI, EIA, Telecordia (aka Bellcore)
  - ATM Form, Frame Relay Forum, etc.
- Most equipment follows some of the rules from some set of standards.
- Many (most?) times a number of rules are stretched, or things not implemented
- Market pressure and rarely regulations keep things interoperating.

Telecom history

- 1876 Alexander Graham Bell applies for patent on his telephone.
  - Race between Bell and Elisha Gray.
  - Bell won in court
- 1891 Almon Strowger, an undertaker, receives patent for an automatic switcher
- 1921 Graham-Willis act establishes AT&T as a "natural monopoly"
- 1934 Federal Communications Commission (FCC) created
  - With PUCs - regulates AT&T
- 1940s - Hush-A-Phone device

Breaking up is hard to do

- 1969 MCI provides inter-city service
- 1974 US Government files antitrust suit against AT&T
- 1984 - Modified Final Judgement (MFJ)
- Ma Bell broken up into AT&T and 7 RBOCS.
- RBOCS - Regional Bell Operating Companie
  - Nynex, Bell Atlantic, BellSouth, Ameritech, Southwest Bell, US West, Pacific Telesis
- Local and Intra-Lata long distance is kept as monopoly while other services are competitive.

1996 - Telecommunications Act

- Deregulate the local loop.
- Facilities Based
  - Carrier provides its own cables to the customer premise
- Non-Facilities Based
  - Carrier rents or leases equipment and lines from local telcos at a discount rate.
- Allows BOCs to enter long distance market
  - Provided that they show an open competitive environment exists in local loop.
- Creates a lot of mergers
  - Bell Atlantic merges with Nynex
  - Bell Atlantic & GTE ✍ Verizon
  - US West & Qwest ✍ Qwest
  - SBC, Pac Bell, & Ameritech ✍ SBC

Hell's Bells: A Radio history of the Telephone

- http://www.town.hall.org/Archives/radio/IMS/HellsBells/

- 8 Parts - 30 minutes each

Tariffs

- A tariff is a description of a service that offers an appropriate rate of charge for that service, and the rules under which the service is to be provided.
- 50 different regulators rule on tariffs
- FCC governs rates & services for Long Distance providers
- Tariffs are written by phone companies and reviewed and enforced by regulators.

Sound

- Banging of molecules together at a rapid rate
- This banging is called compression and rarefication
- Rate of compression (pitch, or frequency) per unit time (seconds) is measured in Hertz (Hz).
- Human voice has frequency range between 100 and 5000 Hertz.
- Sound also has loudness attribute, or amplitude.
- Human ear is responsive to variations in frequency between 25 and 25000 Hz.

Sound Processing

- Through empirical testing, Phone Companies realized that the majority of useful information is carried in a 3 KHz range
- The actual voice envelope (spectrum) carried by the phone is 200Hz to 3500Hz.
- Thus, the bandwidth of the transmitted voice is 3.3 KHz
- The actual bandwidth of the voice line is 4KHz, but margins are suppressed by bandpass filters to allow multiple channels on the same media

Telephone Network

- Topology of connections is used
- Twisted Pair connects DEMARK point with the wire center (frame).
- Wire Center is connected to the Switch (Central Office)
- Switches are interconnected together to form a network.
- Switches make routing decisions based on the requested destination and available capacity

Pre-84 Network Topology

- Over 19000 End (Class 5) Offices
- Over 940 Toll Centers
- 170 Class 3 Offices (Primary Centers)
- Over 50 Sectional Centers (Class 2)
- 10 Regional (Class 1) Centers
- International Gateways

North American Numbering Plan

- Area Code
  - 160 (152) in 60's, 800 right now
- Central Office (Exchange) Code
  - 640 originally
  - expanded to 800 in 1960's
- 10 digit Subscriber Extension

Local Access and Transport Area

- "Turf" division between Local and Long Distance Companies
- Based on Geographical area and Population Density
- Different Rules applied as to who could route the calls where.

Lines VS Trunks

- Lines
  - Low Capacity
  - Non-intelligent (lack signalling)
  - Normal Voice Load
  - Typically dedicated to 1 consumer
  - Allocated on demand
  - Can be blocked
- Trunks
  - Intelligent (carry signalling information)
  - High Capacity
  - Statically Allocated Capacity

Types of Lines and Trunks

- Direct Inward Dial
- Direct Outward Dial
- FX -- Foreign Exchange -- provides dial tone from the remote (foreign) exchange.
  - Typical use – airline reservation system
- OPX -- Off-premise Extension -- permits a remote phone to function as a local phone.
  - Typical use – "remote" extensions in business offices.
- Tie Lines -- private point-to-point circuit used to connect two voice facilities

Local Echange Carriers

- LEC terminates services at the Network Interface Unit (or Demarkation Point)
- Customer takes over from there on
- Main Service Provided: Dialtone
- Other services can be purchased.
- Either dedicated or party line services is offered
- Residential Dialing Service (Direct Distance Dialing)
- Business Services (DID, DOD)

Pay Phone Service

- Public Phone Service
  - Both phone and and line are owned by LEC
  - No monthly rental charges
  - Accessed by everybody
- Semipublic Service
  - Rent a line and set, place phone in controlled location
  - Minimum rate guaranteed to the LEC -- controlled by tariffs
- Private Service
  - buy or rent a set, rent a line (flat fee) and/or share of profits
  - placed in restricted location

Private Lines

- Tie Lines used to connect different facilities together

WATS

- Wide Area Telecommunications Services
- Primarily a billing service that allows reduced rate for long-distance and local telecommunications
- Initially, WATS was implemented in the form of bands that separated the country into 5 regions
- Currently WATS rates can be negotiated between any geographical localities

800/888 Service

- Reverse-billing WATS
  - Recipient pays for the call, and not the call initiator

Directory Services

- In deregulated market, can be provided by any of the following:
  - LECs
  - IXCs
  - 3-rd party

Access to IEC (Equal Access)

- Either full or partial presence is possible in any market
  - Full presence:
    - IEC rents or buys space
    - installs a POP (Point of Presence, digital switch)
  - Partial presence:
    - IEC buys space or rents space from LEC
    - installs or rents a frame (wire center)
    - runs high-capacity trunks to POP in a different location

PBX Systems

- PBX -- Private Branch Exchange
- Typically a small-capacity (up to 5K lines) digital switch that provides add-on services not available through LEC
- Add-on services include, but are not limited to voice mail, transferring, conference calling, etc.
- Interfaces to the LEC via leased trunks
- Typically utilizes digital phone sets
- Up to the customer to maintain the wiring and the equipment

Centrex Service

- A PBX-like service offered through LECs
- LEC “partitions” a Class 5 switch, dedicating some of its processing and voice capacity to Centrex customers
- Partitioning is typically virtual, or software-only
- Provides the same services as PBXs
- Customer does not have to maintain the wiring or the equipment -- LEC does it for the customer
- Customer has an option of adding own services (voice processing, etc) to Centrex, just like to any PBX

Key Systems

- Same features as PBXs
- Aimed at smaller customers
- Uses dial-up lines instead of trunks to interface with LEC
- Modern PBXs are typically packaged as either Key Systems or PBXs, the only difference being the LEC interface