

<i>Switched Access</i>
<ul style="list-style-type: none"> <li>-Dial Up Access</li> <li>-Equal Access</li> </ul>

<i>Switched Services</i>
<ul style="list-style-type: none"> <li>• Anytime a telephone number is dialed, a switched service is accessed.</li> <li>• The CO, which performs the switching function, routes calls based on the telephone number dialed. <ul style="list-style-type: none"> <li>- Includes modem, facsimile and voice calls.</li> </ul> </li> <li>• There is no guarantee that the pathway between two locations will be the same for every call.</li> <li>• Each time a connection is made, the call is routed based on open circuits leased to the eventual destination.</li> </ul>

<b>Attributes of Real-time Switching</b>
<ul style="list-style-type: none"> <li>• Addressing <ul style="list-style-type: none"> <li>- provides flexibility for them to transmit to multiple locations vs. a just to other corporate sites.</li> </ul> </li> <li>• DTMF (dual tone multi-frequency) <ul style="list-style-type: none"> <li>- Introduced by AT&amp;T in 1963 to speed call set up in the CO. Pre-1963, calls were dialed using pulse signals, rotary dialing. A ten digit call takes 11.3 seconds vs. 1 second.</li> </ul> </li> </ul>

<b>Attributes of Real-time Switching</b>
<ul style="list-style-type: none"> <li>• Pay-as-you-go Postalized Rates <ul style="list-style-type: none"> <li>- Peak and off-peak vs. a flat rate (postalized pricing).</li> <li>- Once a carrier's high-speed network is in place, it costs the carrier no more to send a call 2000 miles than 400 miles.</li> </ul> </li> <li>• On-Demand &amp; Immediate <ul style="list-style-type: none"> <li>- If capacity is available, service is instantaneous.</li> </ul> </li> </ul>

<b>Switched Access</b>
<ul style="list-style-type: none"> <li>• Switched access is the method by which a customer connects to the IXC for long distance service.</li> <li>• Switched access means the long distance call is switched by the LEC from the customer's local line to a feature group circuit, which takes the call to the long distance provider.</li> <li>• Switched access is owned, priced, tariffed, and maintained by the LEC.</li> <li>• Switched access is a major portion of an IXC's operating cost.</li> <li>• Two types of switched access are: <ul style="list-style-type: none"> <li>- 1) Dial Up</li> <li>- 2) Equal Access</li> </ul> </li> </ul>

<b>Switched Access</b> <i>Dial-Up</i>
<ul style="list-style-type: none"> <li>• The customer dials the IXC's access telephone number. The call goes to the LEC where it is switched to the long distance company over feature group access circuits provided by the LEC.</li> <li>• Once the customer is connected to the IXC, the customer must dial an Authorization code, which identifies the customer, plus dial the long distance number.</li> </ul>

## Switched Access

### *Dial Up - FgA*

- An older method used to access a long distance company is through feature group A circuits.
- FgA circuits are accessed by dialing a regular 7 digit local telephone number.
  - Dialing Procedure:
    - 1) NXX-XXXX 2) Authorization # 3) 1+ANI
- Advantages of FgA: Alternative to AT&T, Cheaper than AT&T Captures IntraLATA calls Home Billing
- Disadvantages of FgA: Inconvenient Code Abuse

## Switched Access

### *Dial Up - FgB*

- Feature Group B Circuits were introduced in the mid-80's
- FgB circuits are accessed by dialing a 7-digit number beginning with the NXX 950.
  - Dialing Procedure:
    - 1) 950-XXXX 2) Authorization # 3) 1+ANI
- Advantages of FgB: Access Number Never Changes, Alternative to AT&T, Cheaper than AT&T, Captures IntraLATA calls, Home Billing
- Disadvantages of FgB: Inconvenient, Code Abuse

## Autodialer

- Popular Brands  
MiTel
- What is an Autodialer? Dials the 7 digit access number & authorization number
- Why use an Autodialer? Makes dial-up virtually invisible to customer. Saves time and helps prevent fraud.

## What is Equal Access?

- Equal Access is another type of Switched Access.
- A customer can choose an IXC other than AT&T to make 1+ IntraLATA calls. The Central Office switching equipment requires upgrading in order to perform additional number screening/routing functions. Pre-equal access Central Offices are called non-conforming. A Pre-subscription process is handled by the LEC. The customer received a ballot and was asked to choose a PIC (Primary Interexchange Code for each telephone line. Each carrier is identified by the LEC via a CIC (Carrier Identification Code).
- The telephone number to verify the long distance carrier is 1-700-555-1414, 700-555-1414, 700-555-1411, or 00.

## Equal Access

- Feature Group D access circuits are required for equal access. The customer no longer has to dial an access number or authorization code.
- LEC passes callers ANI to IXC so they can identify the end user.
  - Dialing procedure:
    - 1) 1+ANI
- 1+ InterLATA call handled by IXC.
- 1+ IntraLATA call handled by LEC.
- Advantages: Alternative to AT&T, Easy & Quick, Best Quality Circuit, Saves Money \$\$\$\$
- Disadvantages: No IntraLATA

## Equal Access

### *An Alternative Dialing Procedure*

- Dialing 101+XXXX tells the LEC to route the call to the carrier belonging to the CIC that is dialed. Also known as "Dial Around".
- Three types of 101-XXXX calls
  - 1) Capture IntraLATA (local toll)
    - Must have an account with IXC (almost always cheaper than LEC)
  - 2) Secondary Carrier
    - Must have an account with IXC (may charge you a fee)
  - 3) Casual Calling
    - No Account with IXC
      - 1. Promotion - like 1010321
      - 2. Emergency - goes through 3rd party billing and is usually the most expensive next to operator assisted

## Feature Group C *What Happened?*

- Pre-Equal circuits.
- Available only to AT&T.
- 1+InterLATA calls are switched by the LEC to AT&T via FgC.

## *Leased Access*

- DAL
- T-1/DS Hierarchy
- Point-to-Point/Private Line

## *Leased Access*

- Leased access means a customer uses a special circuit, rather than the switched telephone line to make long distance calls.
- Used by customers with a large volume of minutes or traffic.
- Leased access is provided by the LEC, and in some locations can be provided by a CLEC (Competitive LEC) or CAP (Competitive Access Provider).

## Foreign Exchange (FX)

- When a person makes a high volume of calls to a particular location, that would normally be a long distance call charged for time and distance.
- By leasing a FX line, when you now pick up the phone. The dial tone comes from the remote CO.
- Now paying a flat fee as opposed to paying for time on the line.

## Remote Call Forwarding

- Ideal for a company located away from the city in which it plans to market a product, and it wants to make it appear that it is in fact a local organization.
  - This represents a local call to the potential customer.
- Business pays a fee much less than long-distance charges connected with dial up switched service.
  - The more calls that are made, the more cost-effective the remote call forwarding leased line becomes.

## Wide-Area Telecommunications Service (WATS)

- A long distance plan that offers bulk rates for calls that are dialed directly. Based on distance and volume.
  - Outward WATS & Inward WATS
- Provides point-to-multi-point service.
  - Generally require a DAL
  - Domestic WATS service is divided into five bands.
- The cost per usage hour decreases as the number of hours used increases.

## Dedicated Access Line (DAL)

- Circuits are hardwired from the customer premise to the IXC.
- Calls do not pass through the LEC's switch; IntraLATA calls can usually be made.
- Dial tone is generated by the IXC.
- The cost for a dedicated access circuit is based on mileage plus channel termination.
- A Dedicated Access Line (DAL) can transmit 1 conversation per circuit.
- The digital transmission state of a DAL is also known as a DS-0 or Digital Signal 0.

## Dedicated Access Line

- Diagram a call using a DAL.

## Pricing Exercise

- Customer Scenario: Customer's current long distance invoice indicates total monthly usage of 20,000 minutes all interstate, day time calls.

Switched Access	Dedicated Access
$.15 \times 20,000 = \$3,000.00$	$.11 \times 20,000 = \$2,200.00$
$.15 \times 2,000 \text{ minutes} = \$300.00$	$.11 \times 2,000 \text{ minutes} = \$220.00$

plus the installation fee**	+\$400.00	\$200.00
plus MRC of 5 DAL's @ \$100/DAL	+\$500.00	\$100.00

**Install for first DAL is \$200, each add'l is \$50		
Total for Dedicated Access:	\$400.00 NRC	\$200.00
	\$2,700.00 MRC	\$320.00

(NRC = Non Recurring Charge)  
(MRC = Monthly Recurring Charge)

## T-1 Service

- Developed by AT&T in the 1960s to save money on the telephone companies' outside cabling.
  - Instead of continuing to lay expensive copper cabling, a scheme was devised to carry 24 voice or data conversations over one telephone circuit.
  - Bandwidth = 1.544 Mbps
  - This was not made available directly to the end user locations until 1983.

## T-1 Service

- In the mid to late 1980s, large organizations such as universities, financial institutions and Fortune 100 companies used T-1 circuits to tie locations to host computers for applications such as order entry, payroll and inventory.
  - This often replaced having to physically carry large computer tapes between locations.

## T-1 Access Review

AKA: DS-1, Hi-Cap, 1.544 MBPS, LD-1, Span

- Digital from the customer premise to the IXC switch.
  - Uses Digital technology to transmit up to 24 separate conversations over one T-1 circuit.
  - Inbound only, outbound only, Internet or Private Line on same T1.
  - The digital transmission state of a T1 is also known as a DS-0. Individual circuits are called channels.
  - LEC does not screen calls.
  - IXC generates dial tone.
- |  |
|--|
| $\frac{8,000 \text{ samples per second}}{\times 8 \text{ bits}}$ |
| $64,000 (64K - \text{voice})$                                    |
| $\times 24 \text{ channels}$                                     |
| $1,536,000$  |
| $\div 8 \text{ bits}$  |
| $1,544,000$  |

## T-1 Access Review

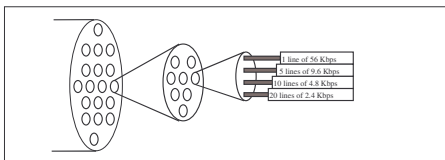
- Equipment required for a T1:
    - 1) If customer has an analog PBX channel bank they need a codec (coder/decoder)
    - 2) If customer has a digital PBX DTI (Digital Trunk Interface) CSU/DSU (Channel Service Unit/Data Service Unit)
- Formation of a T-1**

## European Standards

- The only digital signal speed that is standard throughout the world is the DS-0 speed of 64 kilobits. Speeds of DS-1 and above are different.
  - US, Canada & Japan use 1.544 for T-1 with 24 channels.
  - The rest of the world uses 2.048 with 30 channels.
  - To run a T-1 or higher from the US to an office in Europe, rate adaptation equipment is needed.
- These European speeds are often referred to as E1, E3, etc.

## DS Hierarchy

DS-3    *T-3*    DS-1    *T-1*    DS-0    *DAL*    DDS *Digital Data Service*  
 (28 DS-1's)    672 DS-0    (24 DS-0's)



- ▶ Based on copper as a transport medium.
- ▶ Capacity specifications:
  - DS-0 64 Kbps
  - DS-1 1.5 Mbps
  - DS-3 44.7 Mbps
- ▶ Higher bandwidth than DS-3 generally go to fiber

## Private Line/Point-to-Point/Tie Line

- Point-to-Point dedicated connection from one location to another.
- No switch involvement.
- Customer is charged a monthly fee; however, there is not a rate / min. charge.
- Tie lines normally refer to connecting a PBX in one location to a PBX in another location.

## ISDN

*Integrated Service Digital Network*

- These standards were first published in the mid-1980s, but were finalized in the 1990s.
- A public network call over ISDN was first demonstrated by Nortel in 1987.
  - Uses existing copper wiring.
- ISDN was an interim fix until XDSL, cable modems and other higher speed, megabit services are widely deployed.

## ISDN

*(continued.....)*

- A digital, worldwide public standard for sending voice, video, data or packets over the public switched telephone network.
  - It enables customers to have one or two pairs of wires that they can use for voice, data and video brought onto their premises.
- There are two “flavors” of ISDN
  - BRI - Basic Rate Interface
  - PRI - Primary Rate Interface

<p><b>ISDN</b> <i>characteristics</i></p>
<ul style="list-style-type: none"> <li>• Digital <ul style="list-style-type: none"> <li>– Digital connectivity to achieve consistent, high-quality calling</li> </ul> </li> <li>• Out of channel signaling <ul style="list-style-type: none"> <li>– Calls are set up quickly; each voice/data channel uses all of the bandwidth for user data. The signaling channel is available for packet switching</li> </ul> </li> <li>• A switched service <ul style="list-style-type: none"> <li>– Users pay long distance or local calling fees for the amount of time they use the line.</li> </ul> </li> <li>• A standard interface <ul style="list-style-type: none"> <li>– All users with ISDN can communicate with each other.</li> </ul> </li> </ul>

<p><b>ISDN</b> <i>BRI</i></p>
<ul style="list-style-type: none"> <li>• Basic rate interface consists of two bearer channels for customer voice or data at 64 KBPS along with one 16-KBPS signaling channel. <ul style="list-style-type: none"> <li>– Runs over a single pair of twisted wires between the customer and teleco.</li> </ul> </li> <li>• Common uses: <ul style="list-style-type: none"> <li>– Internet access; Desktop video conferencing; Use of the D, signaling channel, for credit card verification; Downloading software for the Internet; Work-at-home applications; connecting remote LANs</li> </ul> </li> </ul>

<p><b>ISDN</b> <i>PRI</i></p>
<ul style="list-style-type: none"> <li>• Primary Rate Interface consists of twenty-three bearer channels for customer voice or data at 64 KBPS along with one 64-KBPS signaling channel.</li> <li>• Similar to T-1 because they have both 24 channels. However ISDN PRI has out-of-band signaling on the twenty-fourth channel.</li> <li>• Common uses: <ul style="list-style-type: none"> <li>– Video conferencing at speeds generally from 64K to 384K; Backing up LAN to LAN connections; Remotely accessing corporate and ISP sites.</li> </ul> </li> </ul>

<p><b>SONET</b></p>												
<ul style="list-style-type: none"> <li>• Acronym for Synchronous Optical Network.</li> <li>• Typical speeds that are currently specified: <table style="margin-left: 20px; border: none;"> <tr> <td>– OC 1</td> <td>51.84 Mb/s</td> <td>28DS-1's</td> </tr> <tr> <td>– OC3</td> <td>155.52 Mb/s</td> <td>84 DS-1's</td> </tr> <tr> <td>– OC48</td> <td>2.488 Gb/s</td> <td>1344 DS-1's</td> </tr> <tr> <td>– OC192</td> <td>9.953 Gb/s</td> <td>5376 DS-1's</td> </tr> </table> </li> <li>• Expected to eventually displace the DS protocol.</li> <li>• Bellcore developed standard designed for high speed communications over fiber optic networks.</li> <li>• Bi-directional ring topology which ensures traffic can move in opposite direction if fiber is cut.</li> </ul>	– OC 1	51.84 Mb/s	28DS-1's	– OC3	155.52 Mb/s	84 DS-1's	– OC48	2.488 Gb/s	1344 DS-1's	– OC192	9.953 Gb/s	5376 DS-1's
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