

Telecommunication Switching

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❖ Circuit-Switching

➤ Intro

- **Circuit-Switched Set up a circuit that will be used during a data transmission**
- **We have 2 types dedicated or leased**
- **A private circuit is dedicated analog or digital point-to-point connection joining geographically diverse networks**

➤ Dedicated Line

- **Reserved by a communications carrier for a customer's private use**
- **Are the most expensive type of connectivity**
- **T1 T3 are examples of dedicated lines**
- **Type and speeds**
 - Digital Signal Level 0 (DS-0) Transmitting digital signal over a single channel at 64KBps on T1
 - Digital Signal Level 1 (DS-1) Transmitting digital signal at 1.544MBps on T1 (USA) or 2.108MBps on E1 (Europe)
 - Digital Signal Level 3 (DS-3) Transmitting digital signal 44.736MBps on T3
 - Digital Signal Level 3 (DS-3) Transmitting digital signal 44.736MBps on T3
 - T1 transmits DS-1 formatted data at 1.544MBps through a telephone switching network
 - T3 transmits DS-3 formatted data at 44.736MBps through a telephone switching network
 - E1 Wide area digital transmission used in Europe that carries data at a rate of 2.048MBps
 - E2 Wide area digital transmission used in Europe that carries data at a rate of 34.368MBps
 - Both E1, E2 can be leased for private use

➤ Serial Line IP (SLIP)

- **Developed in 1984 to support TCP/IP over low speed serial interfaces**
- **Support only IP not login or password**

➤ PPP

- **Point-To-Point Protocol**
- **PPP - is an encapsulation protocol for Dial-up connections**
- **It replace SLIP**
- **PPP - is ideal for connecting different types of devices over serial lines**
- **Support logging, password and error correction**
- **Has built-in security such as CHAP PAP**
- **PPP is data Link Layer protocol (layer 2)**

➤ ISDN

- **Integrated Services Digital Network is a combination of digital telephony and data-transport services**
- **It consists of digitization of the telephone network by permitting voice and other**

digital services to be transmitted over existing wires

- **ISDN and Analog allow for the use of "callback" as an extra security measure.**
- **Integrated Services Digital Network (ISDN) is a set of CCITT/ITU standards**
- **Two types are BRI, basic rate, and PRI, primary rate**
- **Basic Rate Interface**
 - Two B-channels 64 Kbps combien = 144Kbps
 - One D- channel at 16 Kbps
 - Basic Rate user can have up to 128 Kbps service
- **The Primary Rate**
 - USA
 - ♦ 23 B-channels
 - ♦ One D-channel at 64 Kbps
 - ♦ Total bandwidth is equivalent to a T1 1.544 Mbps
 - Europe
 - ♦ 30 B-channels
 - ♦ 1 D-channel
- **Broadband ISDN (BISDN)**
 - 2 Mbps up to much higher
 - Can handle many different types of services at the same time
 - Used within telecommunication carrier backbones
- **It is been reaplaced by xDSL**

➤ **XDSL**

- **Intro**
 - Digital Subscriber Line
 - Use existng twisted pair telephone line
 - Consists of Point-To-Point public network accessed through copper phone wire
 - Becoming the standard for inexpensive remote connectivity
 - DSL - transmits high-speed bandwidth over existing phone lines
- **Types**
 - **ADSL**
 - ♦ Asymmetric Digital Subscriber Line
 - ♦ Deliver more bandwidth downstream 1.5 to 9 MBps
 - ♦ Upstream 16 to 640KBps
 - ♦ Work at distance up to 18,000 feet over a single twisted pair
 - ♦ 14,400 feet is the maximum practical lenght
 - **SDSL**
 - ♦ Single-Line Digital Subscriber Line
 - ♦ Synchronous Data Link Control
 - ♦ Is a transmission protocol developed by IBM in the 1970s
 - ♦ Based on dedicated, leased lines with permanent physical connections
 - ♦ SDLC is equivalent to layer 2 of the OSI
 - ♦ SDLC uses the primary station-secondary station model of communication
 - ♦ Use a polling media-access method
 - ♦ It has evolved into HDLC
 - ♦ Delivers 1.544 MBps both downstream upstream
 - ♦ Work at distance up to 10,000 feet over a single twisted pair
 - **HDSL**
 - ♦ High-Rate Digital Subscriber Line
 - ♦ Derived from SDLC
 - ♦ Is a group of protocol or rules for transmitting data between network points

- ♦ In HDLC, data is organized into a unit (called a frame) and sent across a network
- ♦ HDLC protocol also manages the flow or pacing at which data is sent
- ♦ HDLC (layer 2) encapsulates the layer 3 frame, adding data link control information
- ♦ It was created to support both point-to-point and multi-point configurations.
- ♦ HDLC is equivalent to layer 2 of the OSI
- ♦ Delivers 1.544 MBps both downstream upstream
- ♦ Work at distance up to 12,000 feet over TWO twisted pairs
- VDSL
 - ♦ Very-High Data-rate Digital Subscriber Line
 - ♦ Deliver more bandwidth downstream 13 to 52MBps (from central office to client) than upstream 1.5 to 2.3MBps
 - ♦ Work at distance 1,000 to 4,500 feet over a single twisted pair
- HSSI
 - ♦ High Speed Serial Interface
 - ♦ Address the need for High Speed communications over WAN
 - ♦ It defines the electrical and physical interfaces to be used by DTE/DCEs.
 - ♦ HSSI is equivalent to layer 1

❖ Packet-Switching

➤ Intro

- **PSN or PSDN Packet Switching Network**
- **Packet-Switching DO NOT Set up circuits**
- **Packets can travel along many different routes**
- **Nodes share bandwidth with each other**
- **Data in packet is broken up into packets and then sent to destination**
- **At the destination packets are reassembled based on their sequence numbers**
- **Packets are assigned a sequence numbers**
- **Packet switched network is Connection less**
- **Packet switched network are characterized by "Brusty" traffic**
- **Virutal Circuit**
 - PVC - Permanent Virtual Circuit
 - PVC - Permanent programmed into the WAN devices
 - SVC - Switched Virtual Circuits
 - SVC - Require steps similar to dial-up
 - SVC - are temporary connections

➤ **Packet Switched VS Circuit Switched <>**

- **Circuit**
 - Constant traffic
 - Fixed delays
 - Connection-oriented
 - Sensitive to loss of connection
 - Voice-oriented
- **Packet**
 - Busty traffic
 - Variable delays
 - Connection-less
 - Sensitive to loss of data
 - Data-oriented

➤ **Types**

- **X.25**
 - The first packet switching networks
 - It defines point-to-point communication between DTE and DCE or DSU/CSU
 - Frame Relay and X.25 use virtual circuits instead of dedicated ones
 - Support switched virtual circuit SVC's and Permanent Virtual Circuit PVC's
 - Work on network layer 3
 - X.25 define how WAN devices are established and maintained
 - Was designed to operate effectively regardless of the type of the systems
 - It has become international standard
- **LAPB Link Access Procedure Balanced**
 - Created for use with X.25, LAPB
 - Defines frame types
 - Capable of:
 - ♦ Retransmitting
 - ♦ Exchanging
 - ♦ Acknowledging frames
 - ♦ Detecting out-of-sequence or missing frames
- **SMDS Switched Multimegabit Data Service**
 - High-speed
 - Used over public networks
 - Used to exchange LARGE amounts of data
 - Brusty traffic
 - Connection-less
- **Frame Relay**
 - Frame Relay and X.25 use virtual circuits instead of dedicated ones
 - High performance WAN protocol
 - Operates at the physical (1) and data link layers (2)
 - Fee is based on bandwidth usage
 - Designed for cost efficient data transmission
 - It uses a simplified framing approach and utilizes no error correction
 - It uses SVCs, PVCs, and DLCIs for addressing.
 - Originally designed for ISDN
 - Used now in WAN communications
 - It is considered as UPGRADE from X.25 and LAPB
 - Has no error correction
 - It is not available everywhere
- **ATM Asynchronous Transfer Mode**
 - Used more in WAN
 - ATM transfers data in fixed cells 53 bytes
 - Use cell relay technology that combines conventional circuit and packet based systems
 - ATM is an example of a fast packet-switching network
 - ATM - transmit data at very high rates
 - ATM- support voice, data and video
 - Use both switching and multiplexing
 - Very High Bandwidth and Low delay
 - It can allocate bandwidth upon demand
 - Good solution for Brusty applications
 - It can run in both WAN and LAN environments
 - Require high-speed medium like fiber

- **VoIP Voice Over IP**

- Multi-service access IP
- Combines many types of data such voice, audio, video into a Single IP packet
- Is very new area of technology
- Has exciting potential