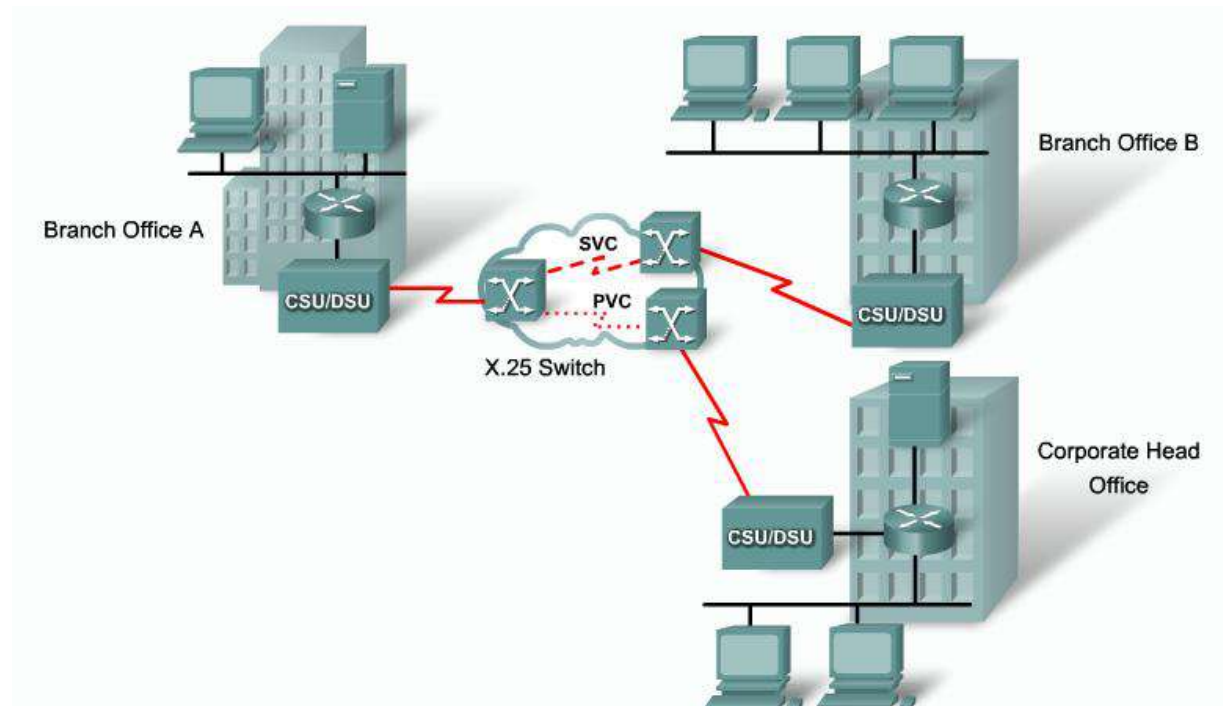


WANS, FRAME RELAY, DSL, CABLE

Packet Switched - X.25 Protocol

2

- Provides low bit rate, packet switched service.
- Variable capacity over switched or permanent circuits



Wan, Frame Relay, DSL, Cable

ITU X.25 Protocol

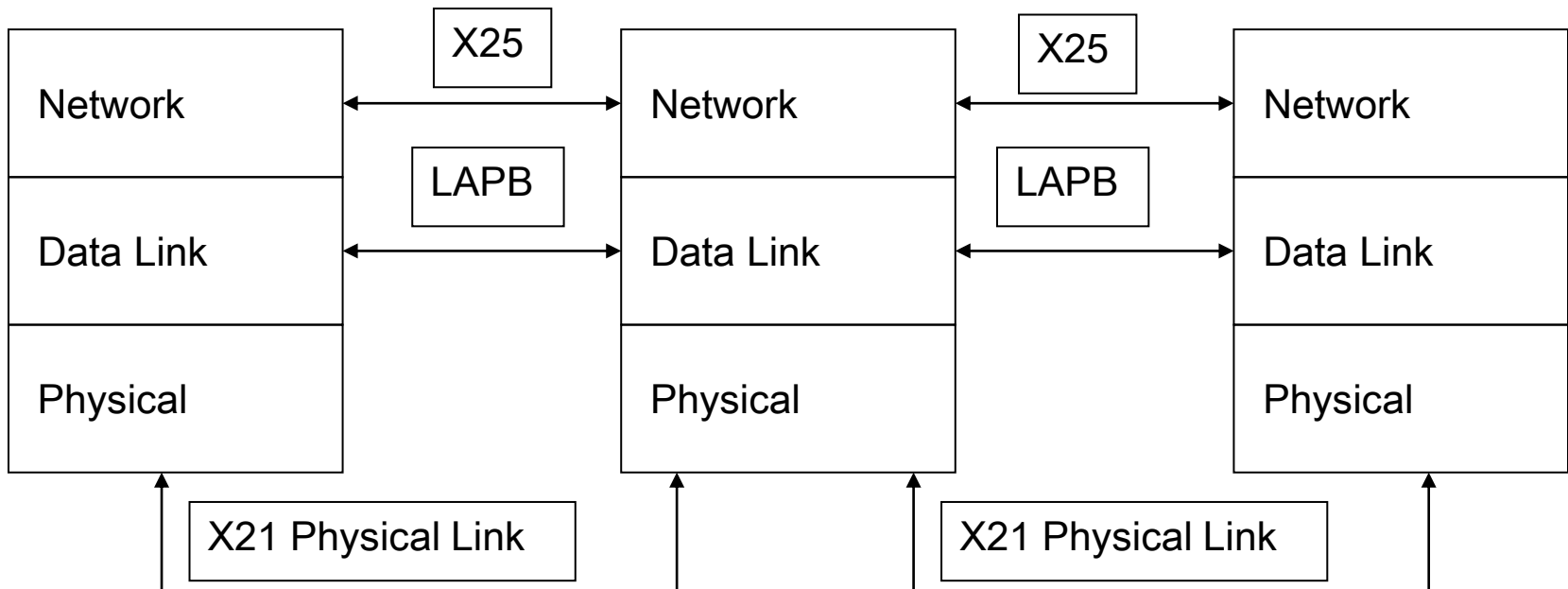
3

- X.25 is defined within OSI 7-layer model for packet-switching networks.
 - ▣ Layer 1 (physical – X.21)
 - ▣ Layer 2 (data link - LAPB)
 - ▣ Layer 3 (network – X.25)

ITU X.25 Protocol

4

- Max packet size = 4096 Bytes
- LAPB - Link Access Procedure, Balanced

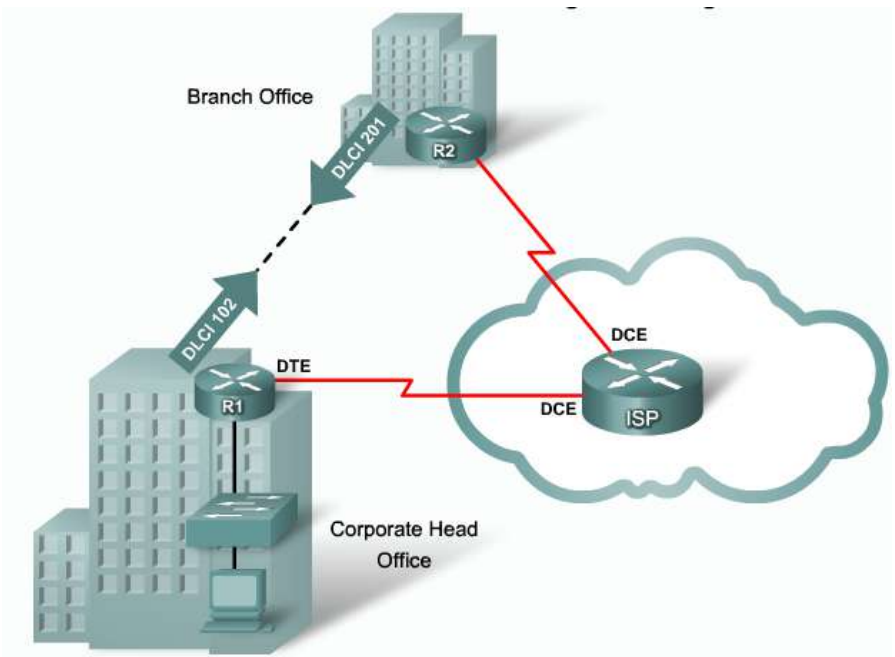


Wan, Frame Relay, DSL, Cable

Packet Switched - Frame Relay

5

- Frame Relay VCs are uniquely identified by a DLCI (Data Link Connection Identifier)
 - ▣ DLCI ensures bidirectional communication from one DTE device to another.
- Most Frame Relay connections are PVCs rather than SVCs.



Frame Relay

6

- Operates at OSI Layers 1 and 2.
- Initially designed to work with ISDN.
- A streamlined version of X.25.
- Uses 2 types of connection:
 - ▣ Switched Virtual Circuits (SVCs).
 - ▣ Permanent Virtual Circuits (PVCs).

Frame Relay

7

- A packet-multiplexed interface for packet switching environment (Developed by Cisco).
- In the US, frame relay uses T1 (up to 1.5Mbps) and T3 (up to 45Mbps) connections.
- In Europe, frame relay supports E1 (up to 2.044Mbps) and E3 (up to 34.36Mbps.)
- The DTE (router) and the DCE (switch) can multiplex various connections over a common medium using virtual circuits.
- Designed for reliable digital / fibre environments, so it has little need of the error checking overheads.

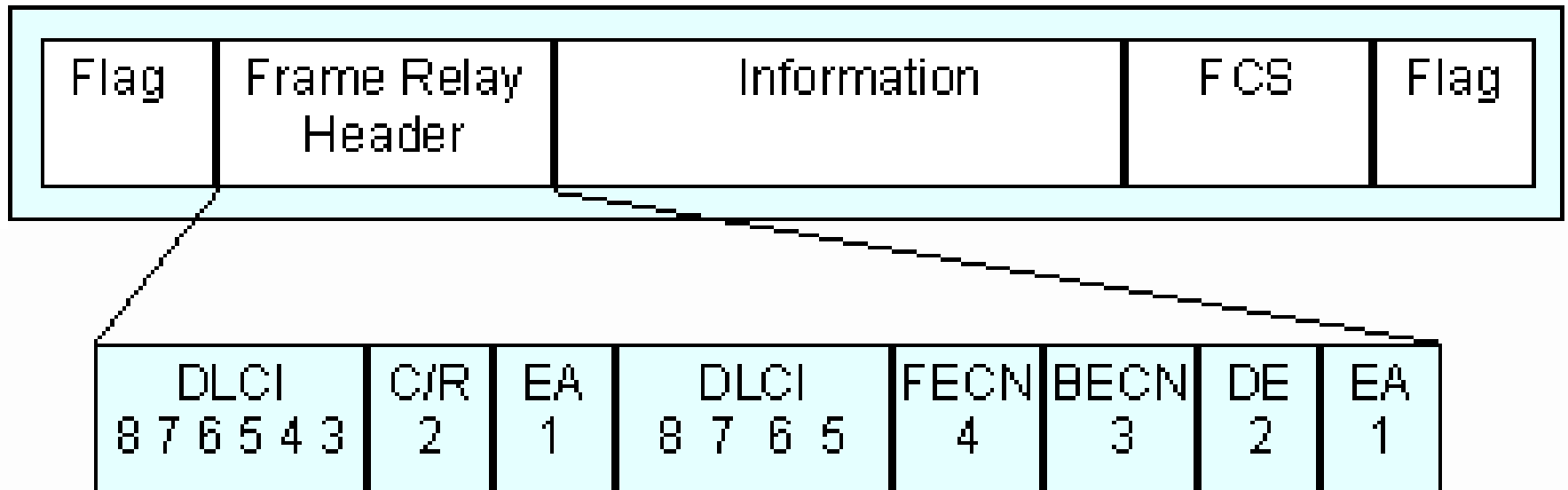
Frame Relay

8

- ❑ Cost efficient service for intermittent traffic between sites
- ❑ Data put into variable sized units called FRAMES
- ❑ Error correction performed by end points
- ❑ Designed to replace the analogue X.25 system
- ❑ Most common use is to connect LAN's to major backbones
- ❑ Frames operate at Layer 2
- ❑ CIR – committed information rate, any packets after this are marked Discard Eligible (DE) and can be dropped if link congested

Frame Relay structure

9

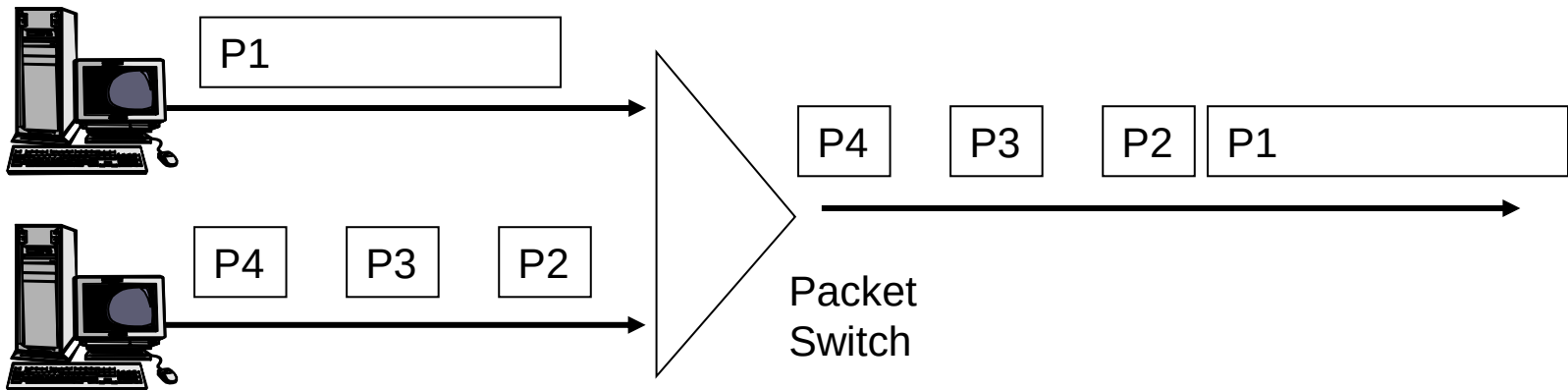


www.protocols.com

Packet Switching Issues

10

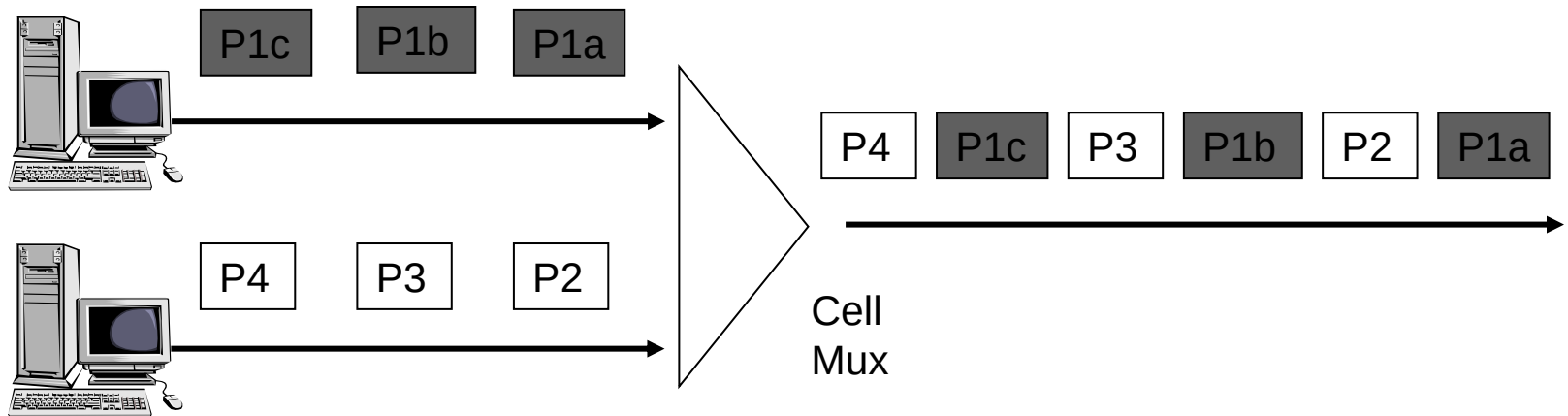
- The variety of packet and frame sizes make traffic handling unpredictable in a packet switched network
- The size of packet P1 is serviced first, delaying packets P2-P4



Cell Switched – Asynchronous Transfer Mode (ATM)

11

- A cell is defined as a small, fixed-sized block of information – 53 bytes
- All data frames are broken up into cells which allows them to be transmitted with predictability and uniformity

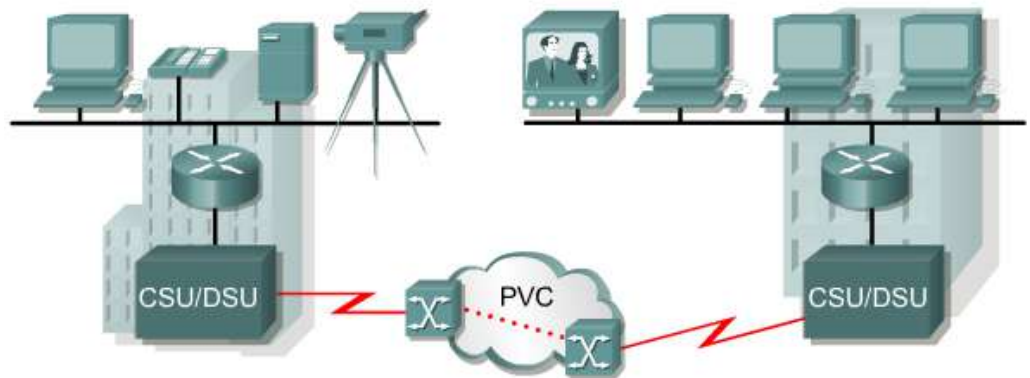


Wan, Frame Relay, DSL, Cable

Cell Switched - ATM

12

- A shared network technology that offers very low latency and jitter at much higher bandwidths than frame relay.
- Capable of transferring voice, video, and data through private and public networks.
- Built on a cell-based architecture rather than on a frame-based architecture

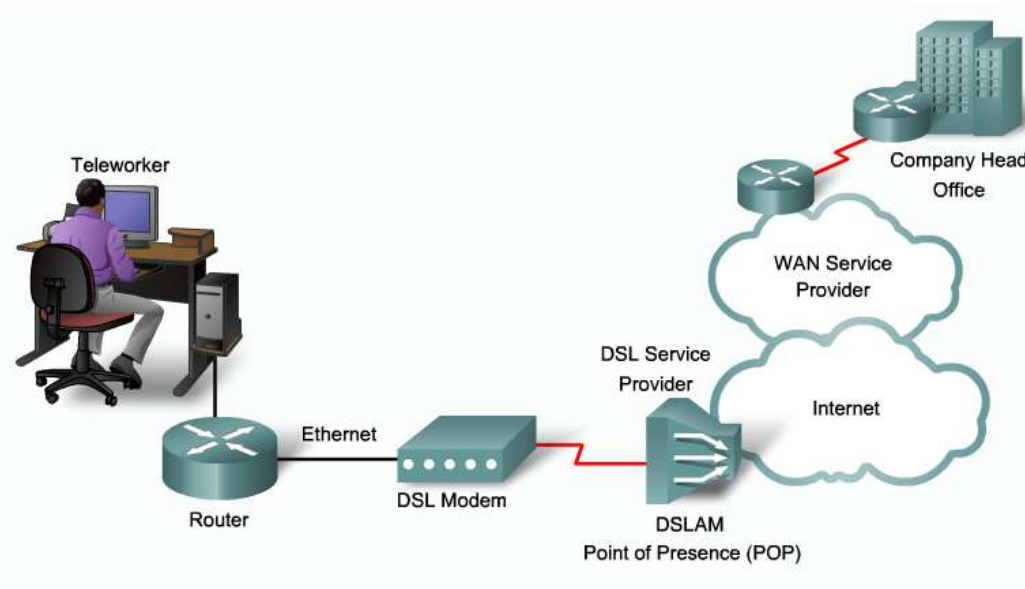


Wan, Frame Relay, DSL, Cable

Internet Connection – Digital Subscriber Link (DSL)

13

- An always-on connection technology
- Use existing twisted-pair telephone lines to transport high-bandwidth data, and provides IP services to subscribers



Wan, Frame Relay, DSL, Cable

DSL Technology

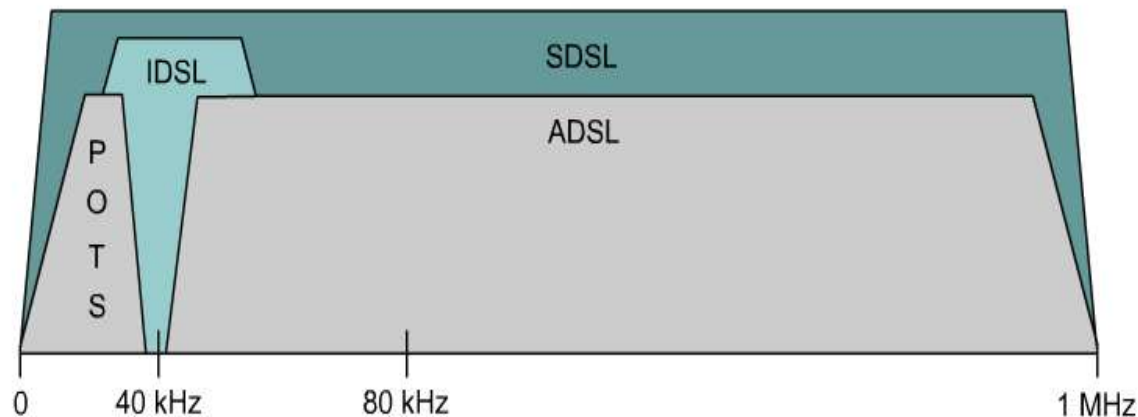
14

Service	Download	Upload
ADSL	64 kbps - 8.192 Mbps	16 kbps - 640 kbps
SDSL	1.544 Mbps - 2.048 Mbps	1.544 Mbps - 2.048 Mbps
HDSL	1.544 Mbps - 2.048 Mbps	1.544 Mbps - 2.048 Mbps
IDSL	144 kbps	144 kbps
CDSL	1 Mbps	16 kbps - 160 kbps

What is DSL?

15

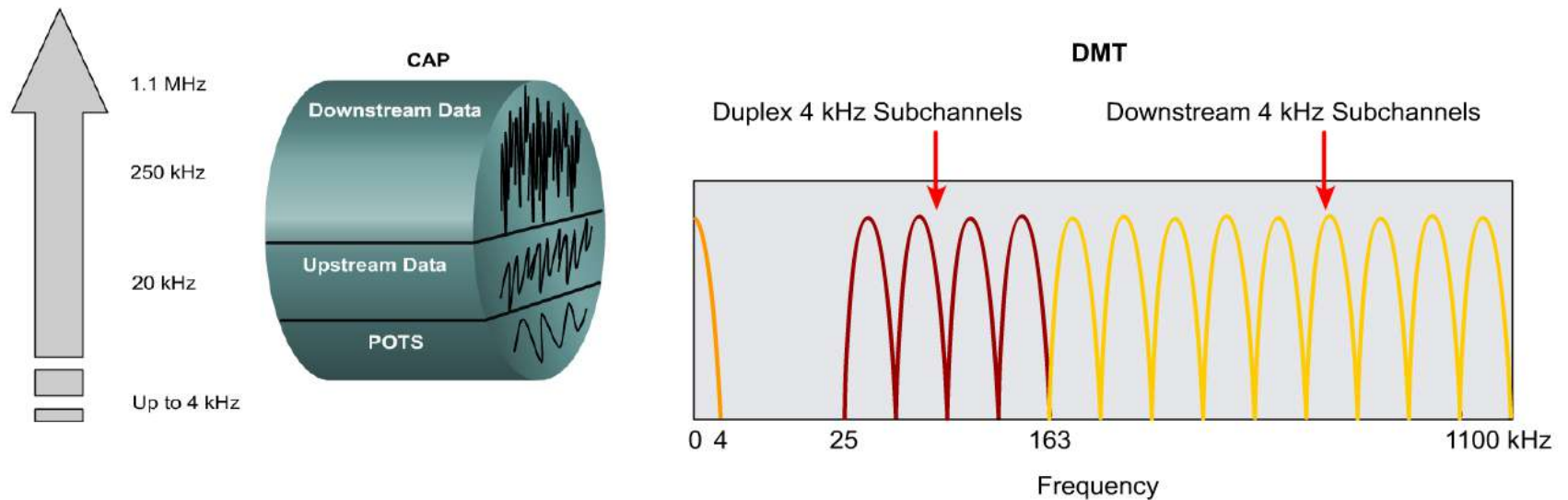
- DSL uses the high frequency range of up to about 1 MHz.
- For example, ADSL uses about 42 kHz to 1 MHz.
- ADSL does not overlap the Plain Old Telephone Service (POTS) voice frequency range (300 – 4000 Hz)
- POTS and ADSL service can coexist over the same wire.



ADSL channels and encoding

16

- DMT (Discrete Multitone Modulation)
- DMT divides signals into separate channels.



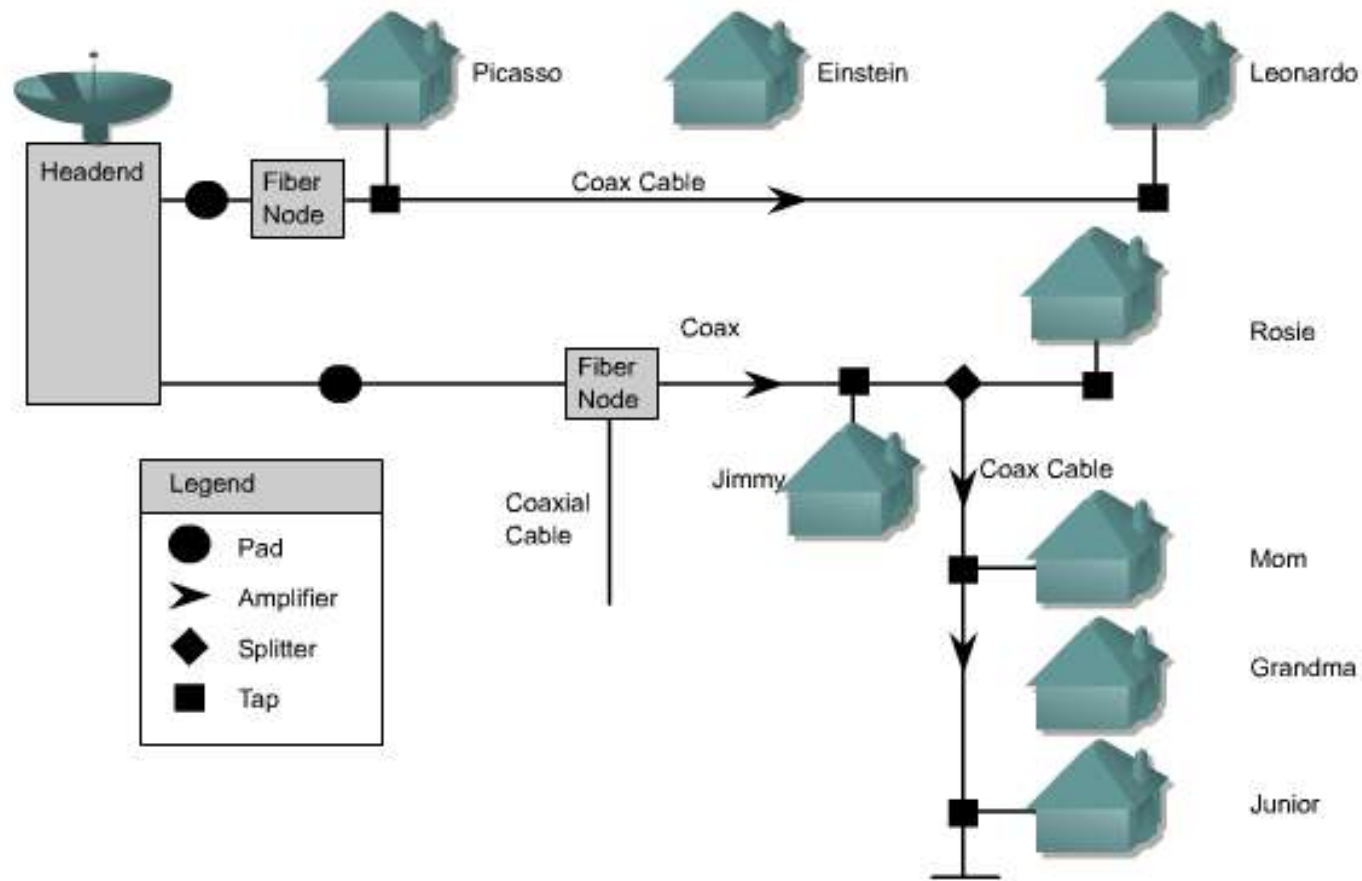
ADSL channels and encoding

17

- ❑ DMT divides the data into 250 separate channels, each 4 kHz wide.
- ❑ Each channel is monitored.
- ❑ If the quality is too impaired, the signal is shifted to another channel.
- ❑ This system constantly shifts signals between different channels, searching for the best channels for transmission and reception.

Internet Connection – Cable Modem

18



Wan, Frame Relay, DSL, Cable

Internet Connection – Cable Modem

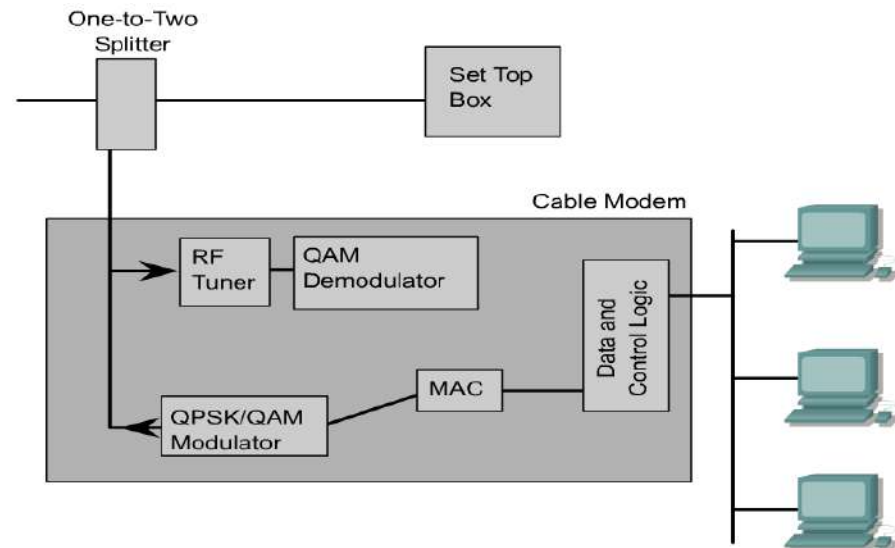
19

- Coaxial cable is widely used in urban areas to distribute television signals.
- Network access is available from some cable television networks
 - ▣ allows for greater bandwidth than the conventional telephone local loop.

Cable Modem

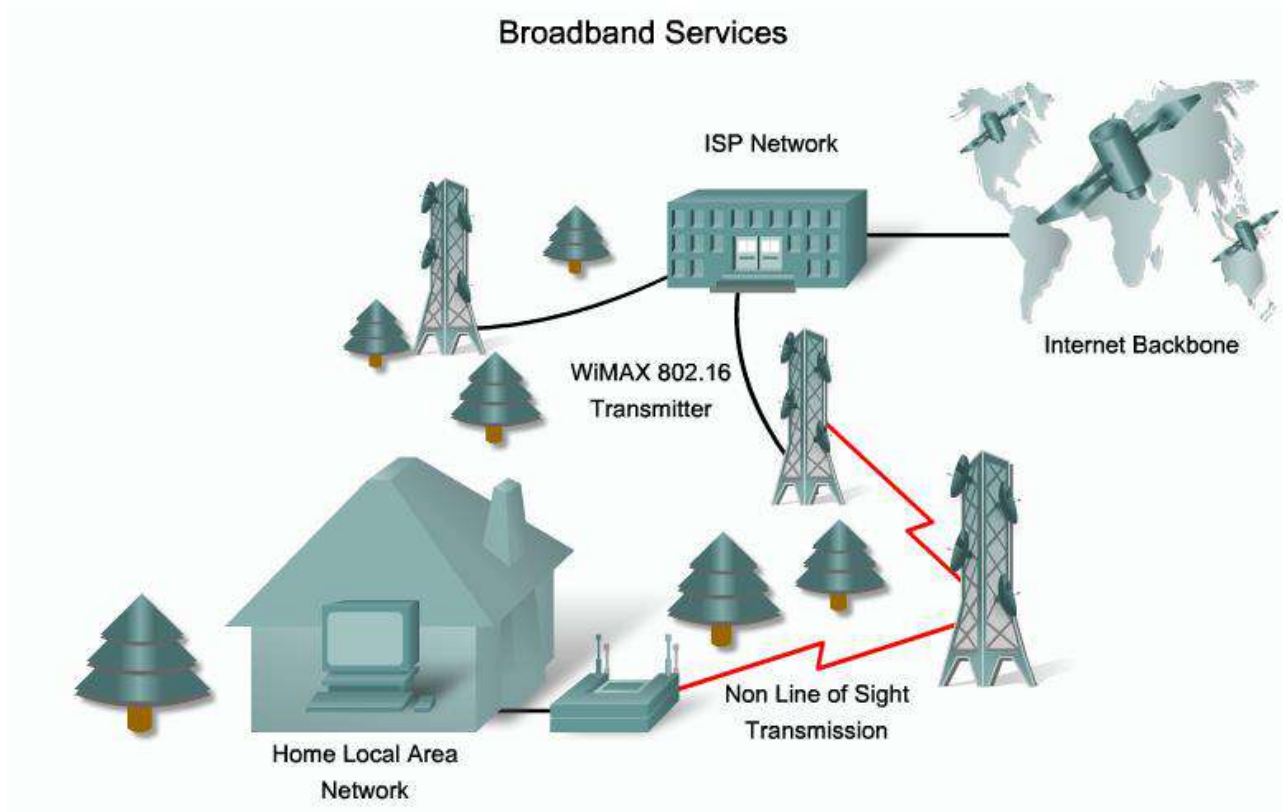
20

- An always-on connection and a simple installation.
- A cable modem is capable of delivering up to 30 to 40 Mbps of data on one 6 MHz cable channel.
- Simultaneous cable television service and data to a personal computer.



Internet Connection – Broadband Wireless

21

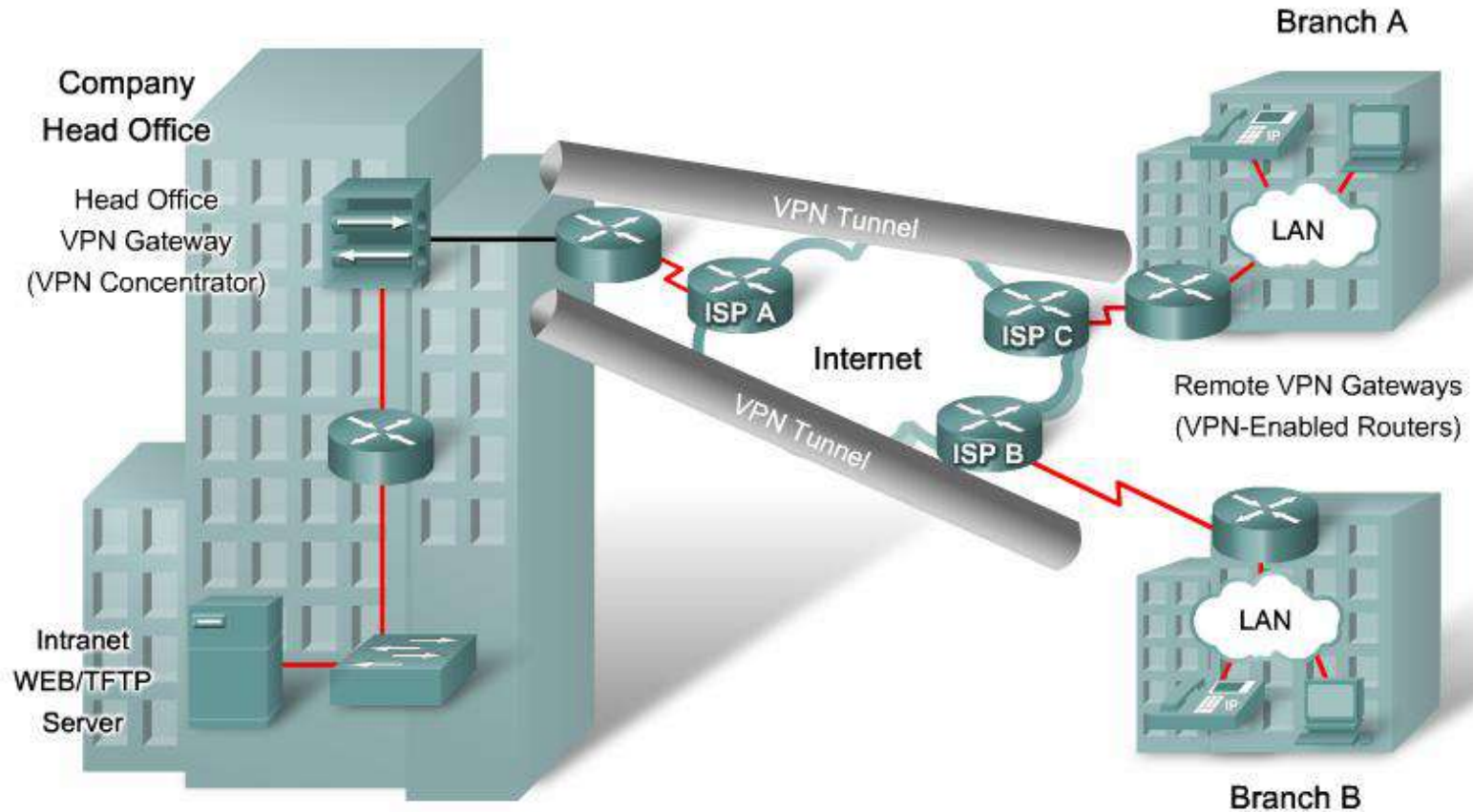


- Municipal WiFi
- WiMax (IEEE 802.16)
- Satellite

Wan, Frame Relay, DSL, Cable

Virtual Private Networks (VPN)

22



Wan, Frame Relay, DSL, Cable

Virtual Private Networks (VPN)

23

- To address security concerns when network resources are accessed remotely over the Internet, broadband services provide capabilities for using Virtual Private Network (VPN) connections to a VPN server.
- A VPN is an encrypted connection between private networks over a public network such as the Internet.
 - ▣ Instead of using a dedicated Layer 2 connection such as a leased line, a VPN uses virtual connections called VPN tunnels, which are routed through the Internet to connect LAN resources.