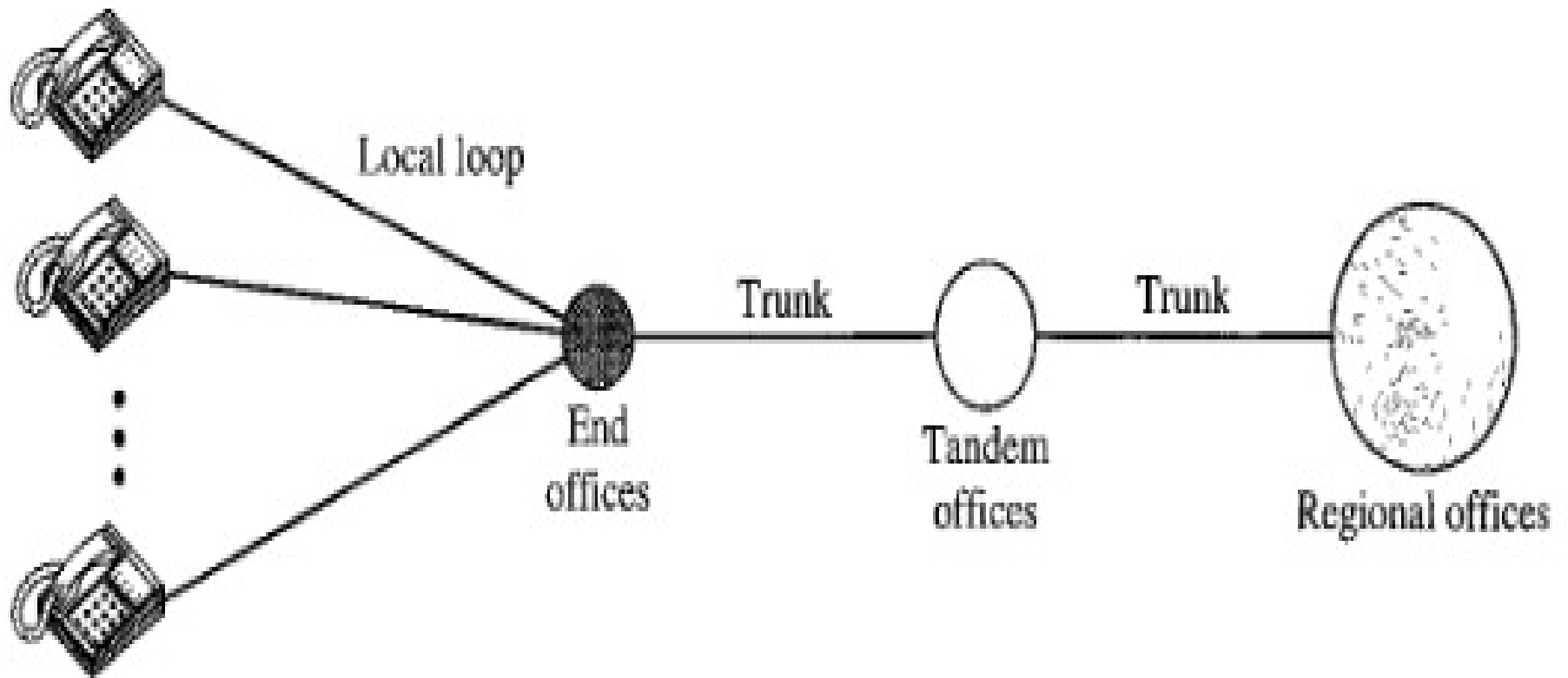


Chapter 9

Telephone Network

- Plain Old Telephone System (**POTS**)
- Was traditionally an analog system
- Now both analog and digital
- Three major components: **end offices, tandem offices, regional offices**

Telephone Network



Signaling

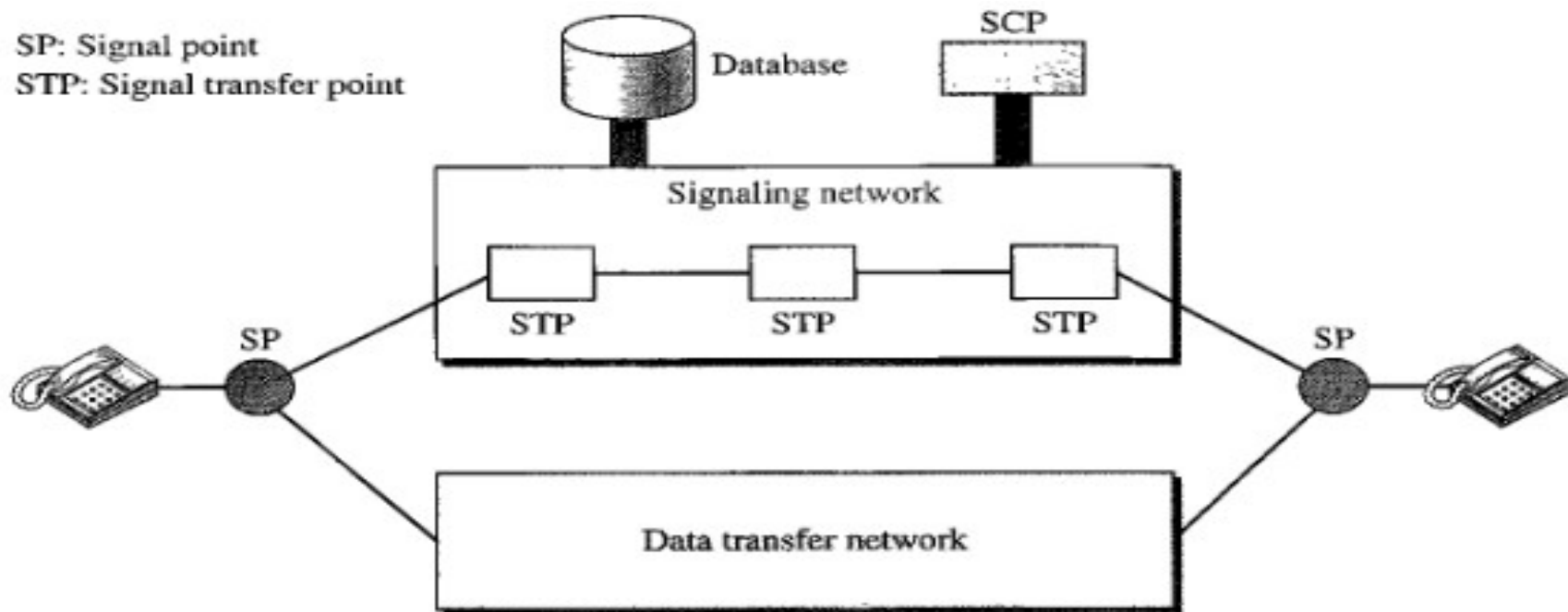
- “Placing a call”
- Telephone network is circuit-switched
- **In-band signaling** – same circuit can be used for signaling and voice communication - manual
- **Out-of-band signaling** – separate channel for signaling and voice - automatic

Signaling

- Tasks of signaling system
 - Provide dial tone, ring tone, busy tone
 - Transfer number between offices
 - Maintain and monitor calls
 - Keep billing information
 - Maintain and monitor equipment status
 - Provide other functions such as caller ID, voice mail, etc.

Signaling

- Separate networks for signaling and data transfer

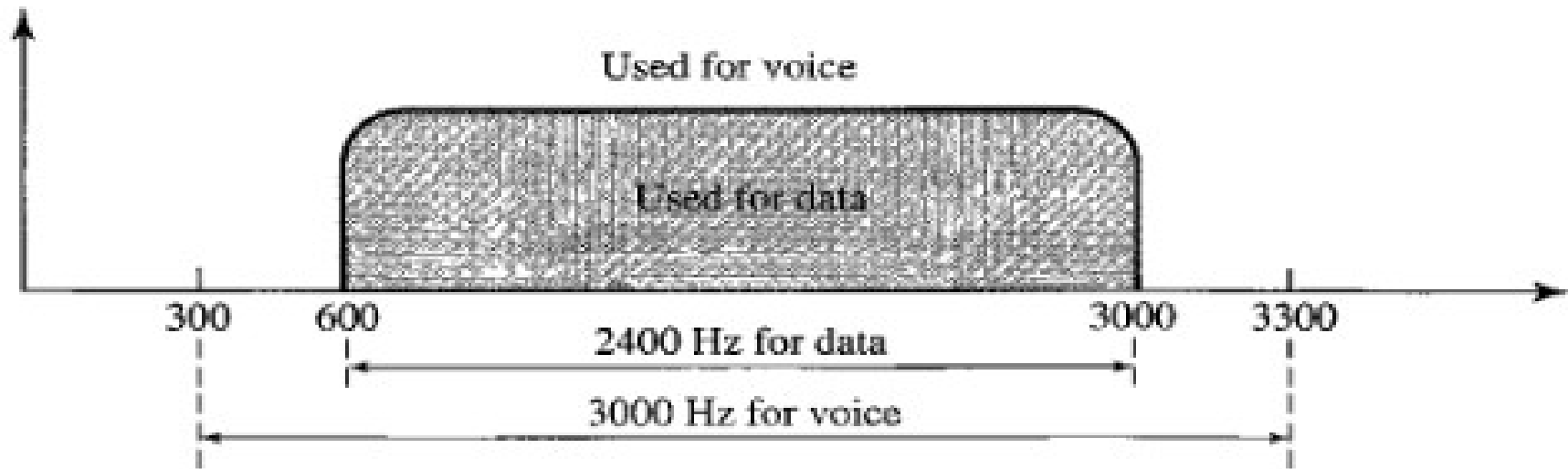


Services provided by POTS

- Analog services
 - Analog switched services – dial-up service
 - Analog leased services – dedicated line, permanently connected
- Digital services
 - Switched/56 service, needs a Digital Service Unit (DSU) device
 - Digital version of analog leased line

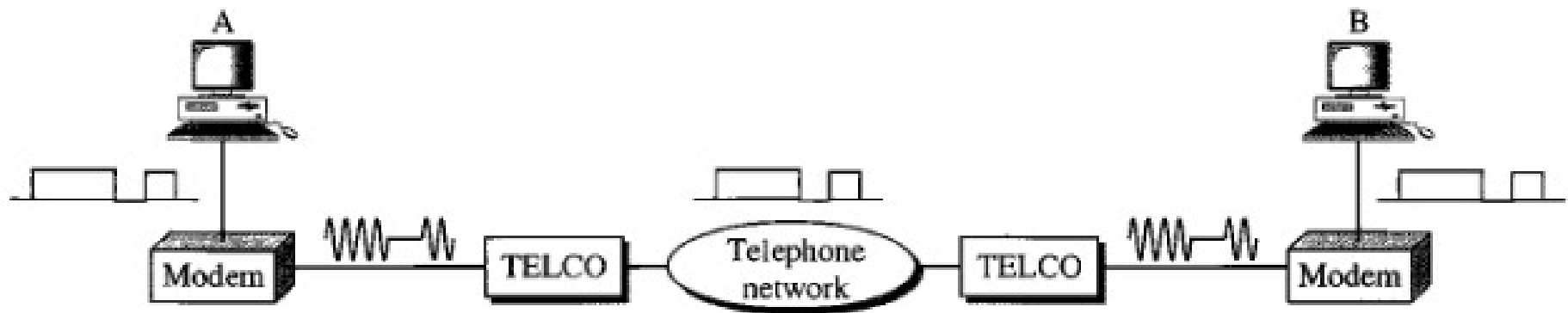
Dial-up Modems

- Telephone lines carry 300-3300 Hz, 3000 Hz bandwidth
- Signal bandwidth must be smaller than cable bandwidth

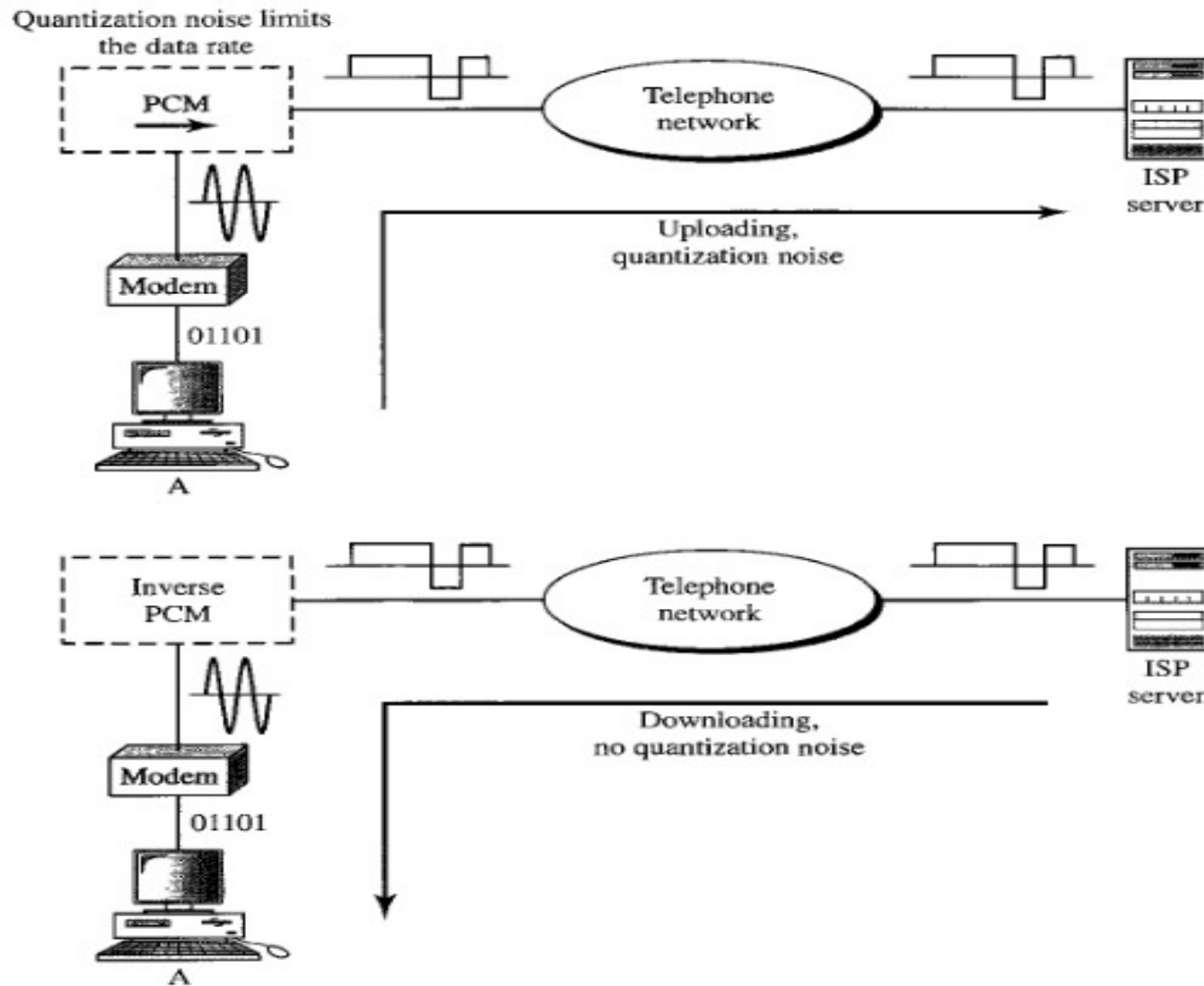


Dial-up Modems

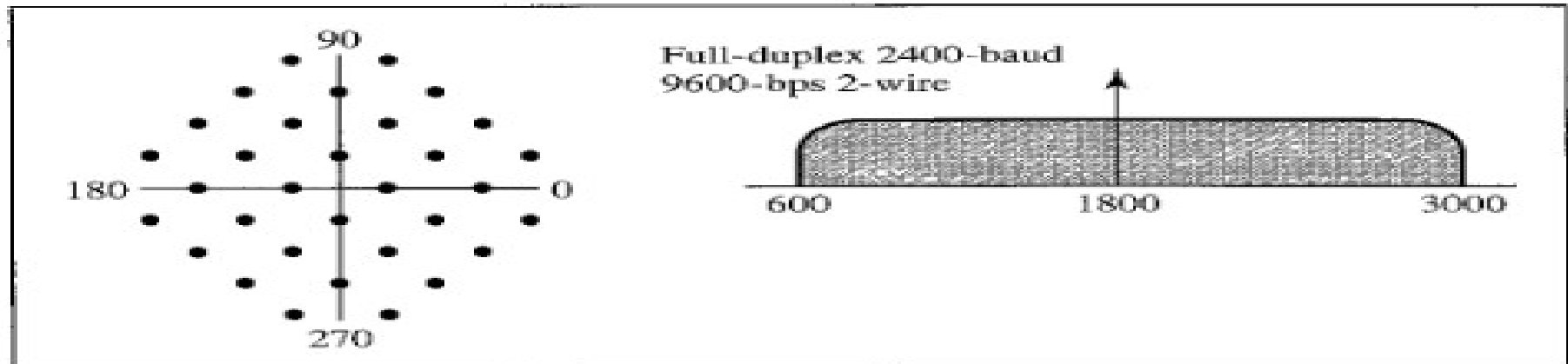
TELCO: Telephone company



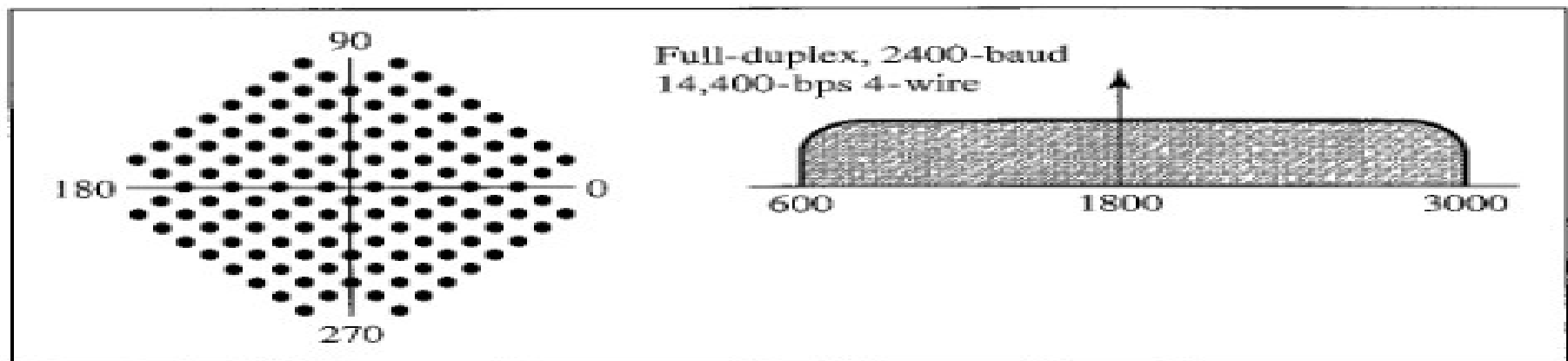
Dial-up Modems



Modem standards

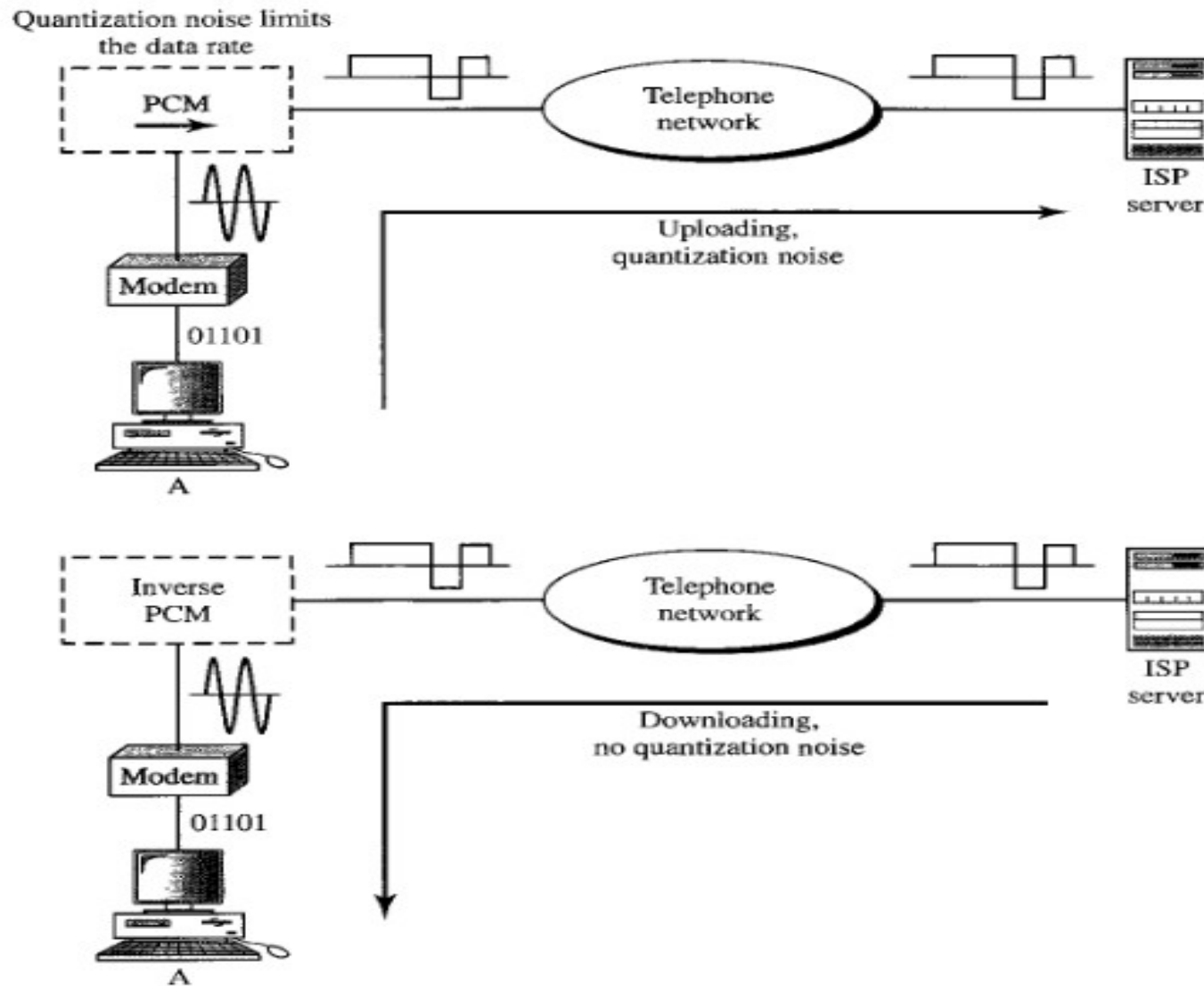


a. Constellation and bandwidth for V.32



b. Constellation and bandwidth for V.32bis

Modem standards



Digital Subscriber Line

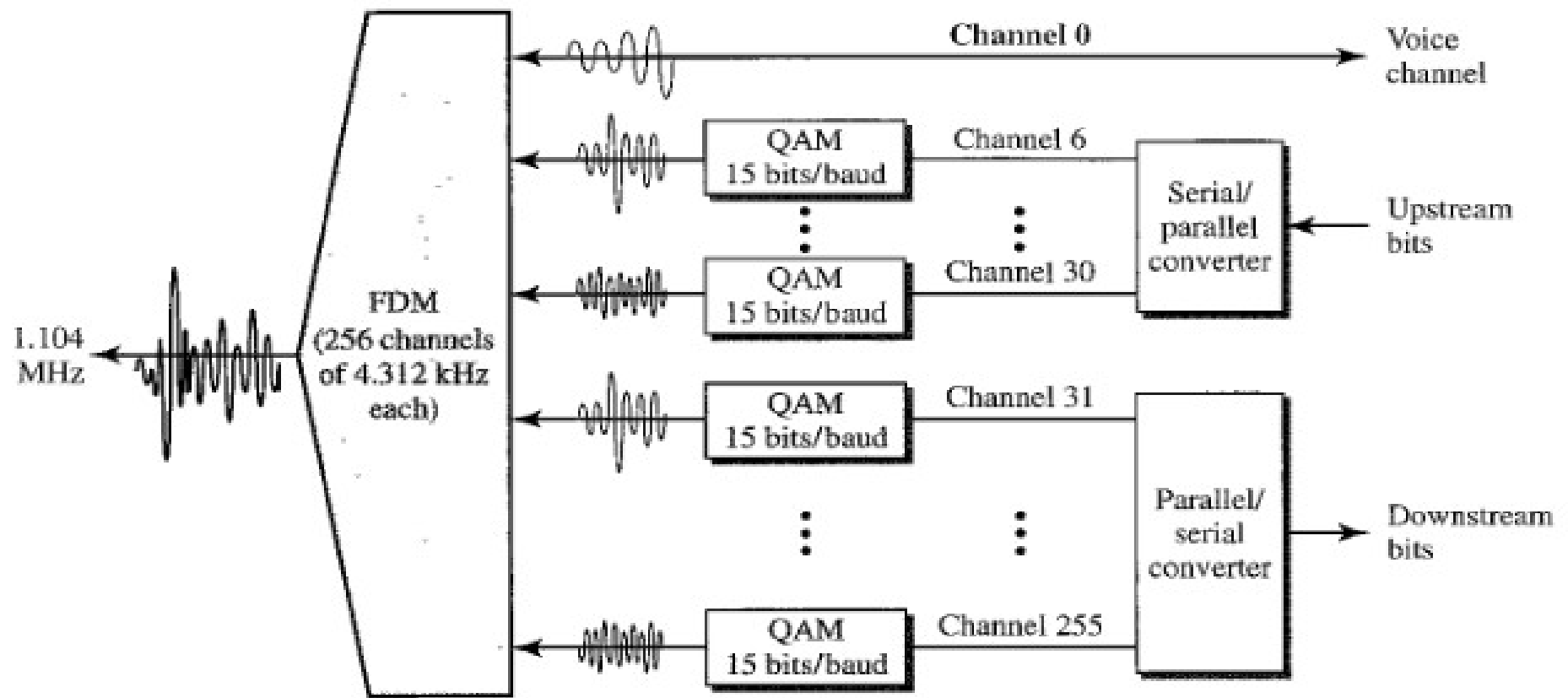
- Supports high-speed digital communication over existing local loops
- ADSL, VDSL, HDSL, SDSL

ADSL

- Asymmetric DSL
- Higher speed (bit rate) in downstream
- Designed for residential users
- Uses existing local loops
- Twisted-pair local loop is actually capable of bandwidth of up to 1.1 MHz
- Adaptive technology – data rate changes depending on the condition and type of local loop cable

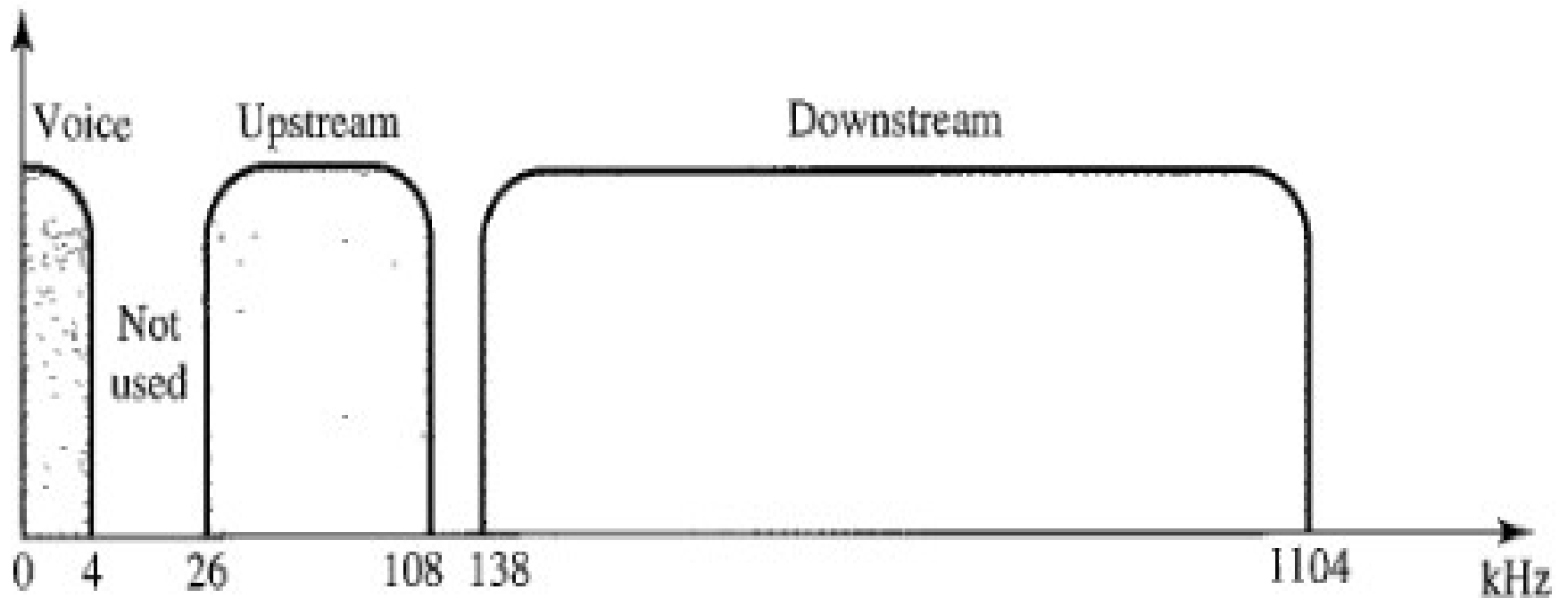
ADSL

- Uses Discrete Multitone Technique – combines QAM and FDM



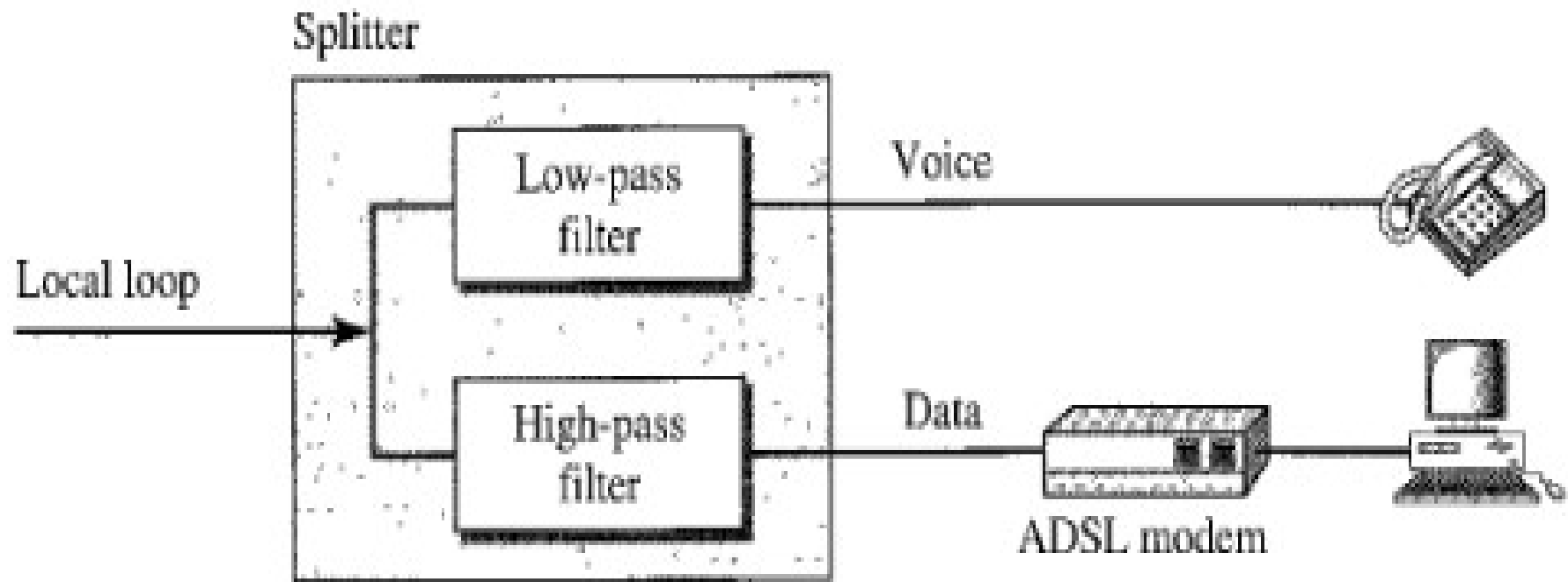
ADSL

- Bandwidth division



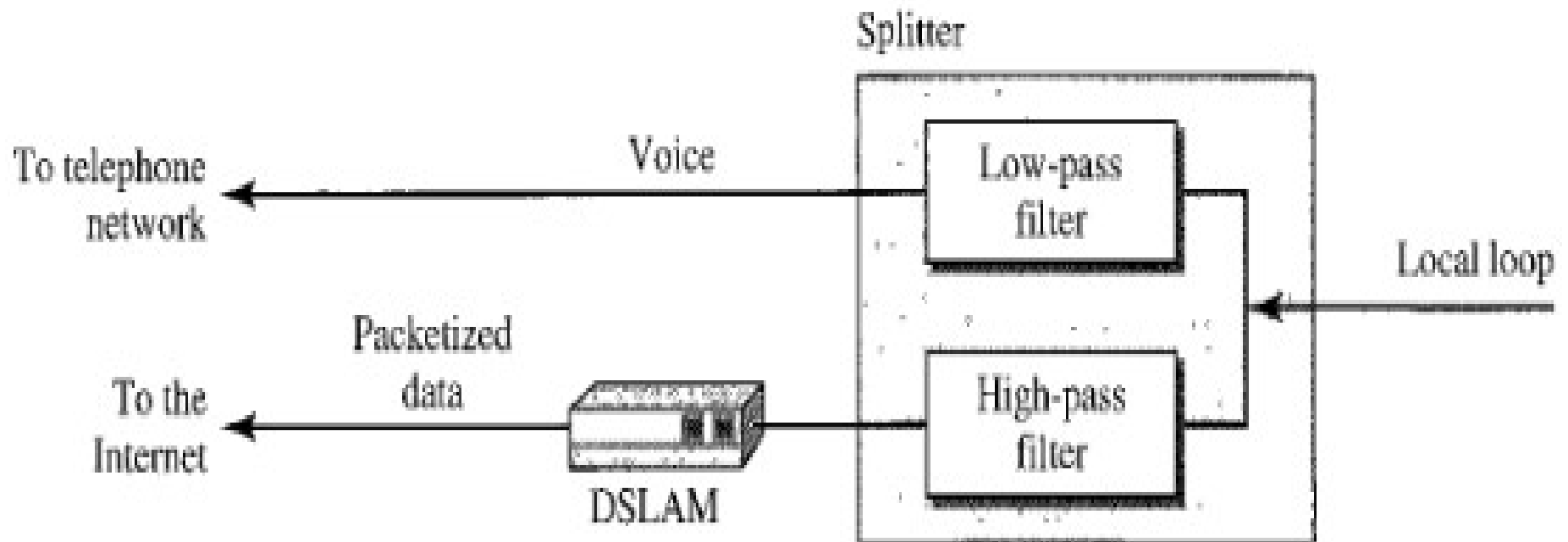
ADSL

- Customer end



ADSL

- Telco end, Digital Subscriber Line Access Multiplexer(DSLAM) packetizes data



HDSL

- High-bit-rate digital subscriber line
- Alternative to T1 line (1.544 Mbps)
- Uses 2B1Q
- Achieves a data rate of up to 2Mbps even without repeaters at distances of 12,000 ft.
- Uses two twisted pairs to achieve full duplex transmission

SDSL

- Symmetric digital subscriber line
- One twisted-pair version of HDSL
- Full-duplex at 768 kbps max in each direction

VDSL

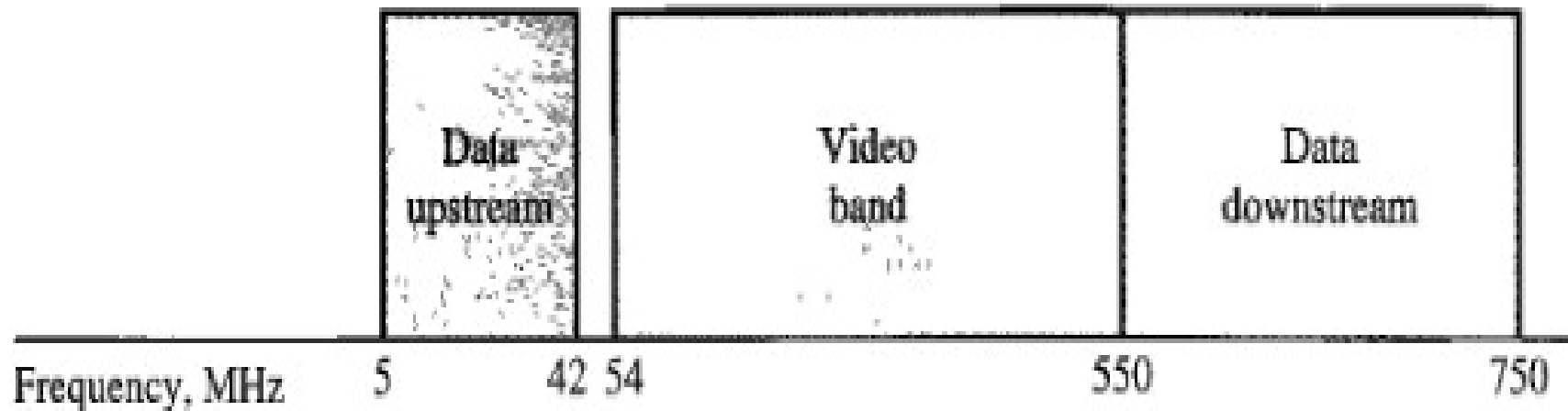
- Very high-bit-rate digital subscriber line
- Uses coaxial and fiber-optic
- Uses DMT
- 25 to 55 Mbps upstream at 3000 to 10000 ft
- Downstream is 3.2 Mbps

DSL Summary

<i>Technology</i>	<i>Downstream Rate</i>	<i>Upstream Rate</i>	<i>Distance (ft)</i>	<i>Twisted Pairs</i>	<i>Line Code</i>
ADSL	1.5–6.1 Mbps	16–640 kbps	12,000	1	DMT
ADSL Lite	1.5 Mbps	500 kbps	18,000	1	DMT
HDSL	1.5–2.0 Mbps	1.5–2.0 Mbps	12,000	2	2B1Q
SDSL	768 kbps	768 kbps	12,000	1	2B1Q
VDSL	25–55 Mbps	3.2 Mbps	3000–10,000	1	DMT

CABLE TV

- Coaxial cable has a bandwidth range from 5 to 750 MHz
 - Each TV channel uses 6MHz
-



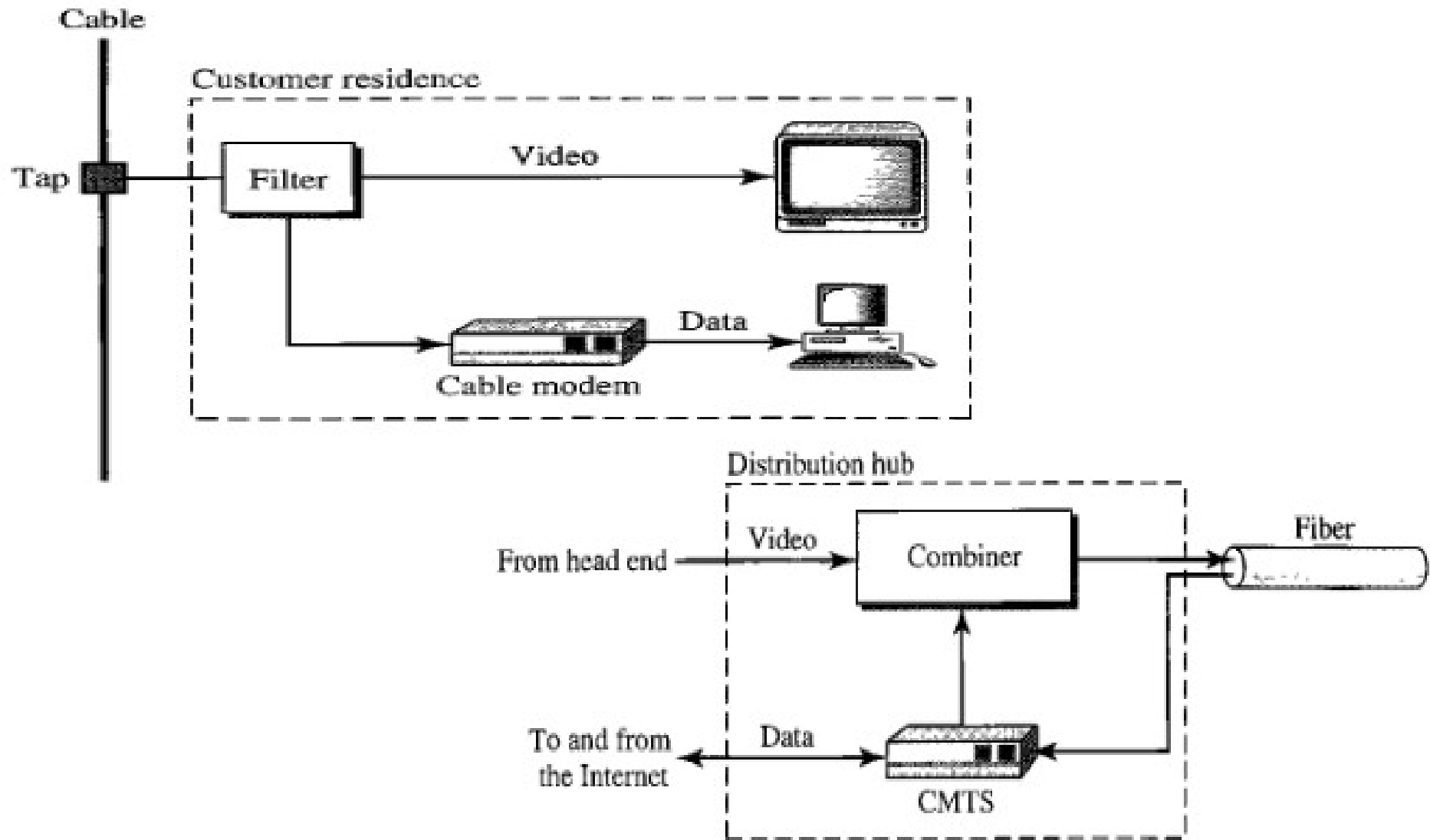
Cable TV

- Downstream video band – 54 to 550 MHz, 6-MHz channels
- Downstream data band
 - Also divided into 6-MHz channels
 - 64-QAM, max 30 Mbps, standard 27 Mbps, actual 10 Mbps
- Upstream data band
 - Also divided into 6-MHz channels
 - QPSK, max of 12 Mbps but actual is usually less

Cable TV

- Upstream sharing
 - Six 6-MHz channels, uses FDM, contention
- Downstream sharing
 - Thirty three 6-MHz channels
 - Multicasting – selected group of customers

Cable TV



Enjoy! :)