

Forouzan

Chapter 9

Using Telephone and Cable Networks for Data Transmission

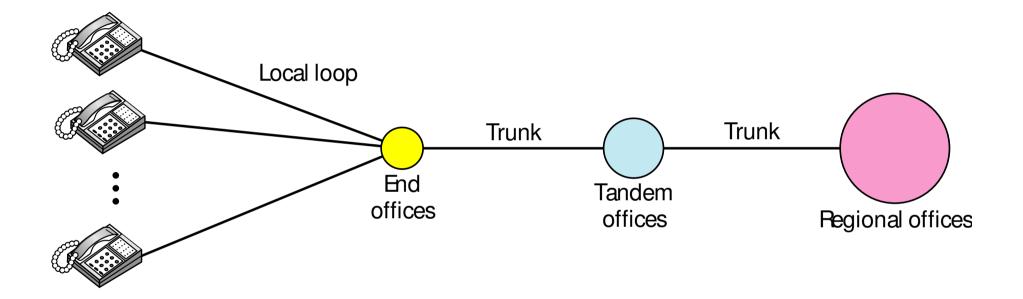
9-1 TELEPHONE NETWORK

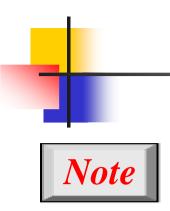
Telephone networks use circuit switching. The telephone network had its beginnings in the late 1800s. The entire network, which is referred to as the plain old telephone system (POTS), was originally an analog system using analog signals to transmit voice.

Topics discussed in this section:

Major Components
LATAs
Signaling
Services Provided by Telephone Networks

Figure 9.1 A telephone system





Intra-LATA services are provided by local exchange carriers.
Since 1996, there are two types of LECs: incumbent local exchange carriers and competitive local exchange carriers.

Figure 9.2 Switching offices in a LATA

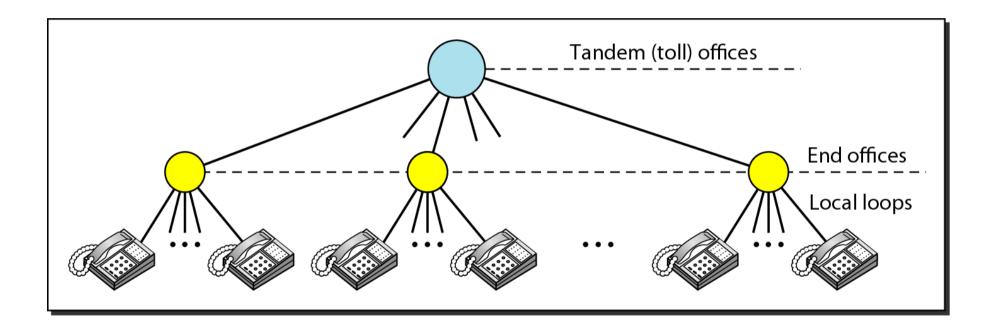
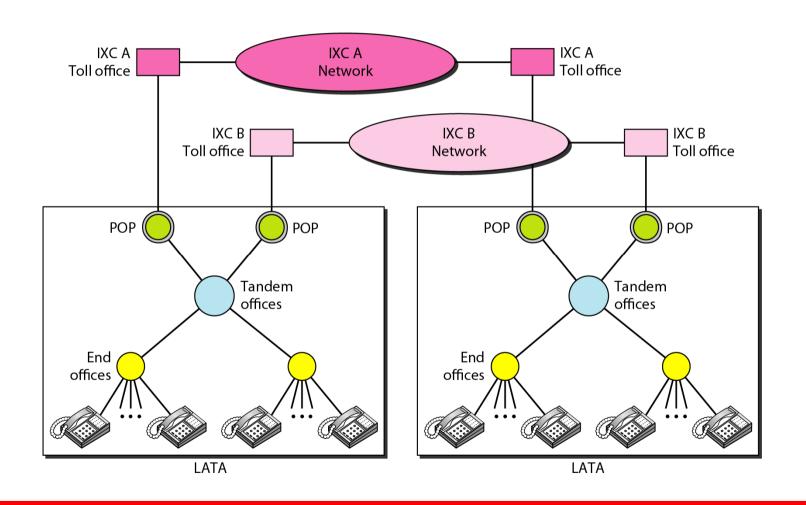


Figure 9.3 Point of presences (POPs)





The tasks of data transfer and signaling are separated in modern telephone networks: data transfer is done by one network, signaling by another.

Figure 9.4 Data transfer and signaling networks

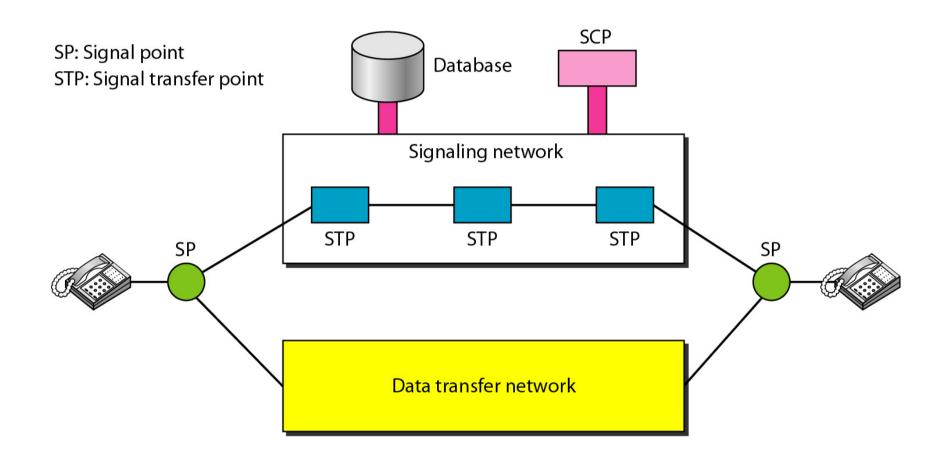
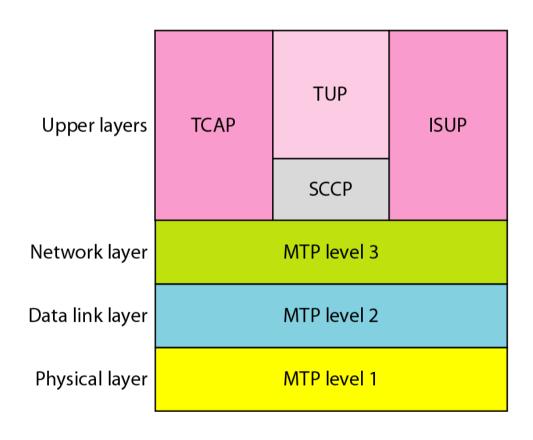


Figure 9.5 Layers in SS7



MTP: Message transfer part

SCCP: Signaling connection control point

TCAP: Transaction capabilities application port

TUP: Telephone user port

ISUP: ISDN user port

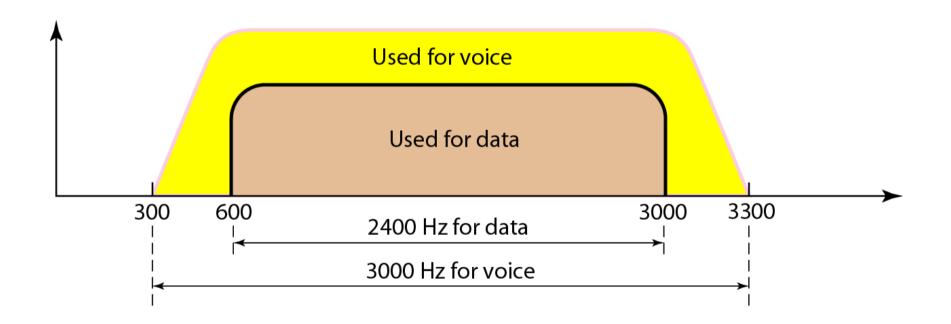
9-2 DIAL-UP MODEMS

Traditional telephone lines can carry frequencies between 300 and 3300 Hz, giving them a bandwidth of 3000 Hz. All this range is used for transmitting voice, where a great deal of interference and distortion can be accepted without loss of intelligibility.

Topics discussed in this section:

Modem Standards

Figure 9.6 Telephone line bandwidth





Modem stands for modulator/demodulator.

Figure 9.7 Modulation/demodulation

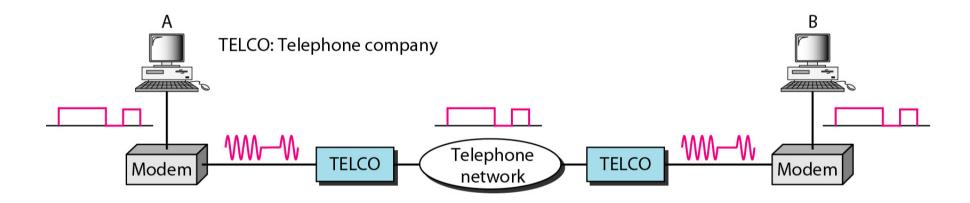
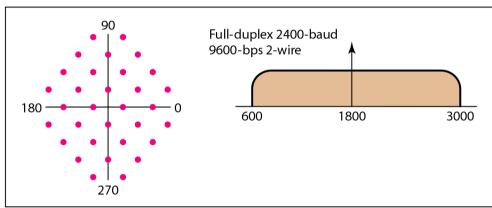
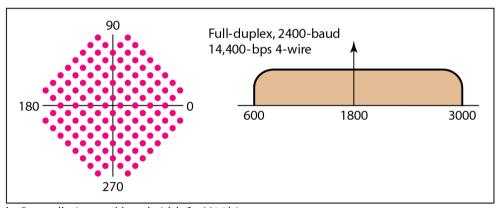


Figure 9.8 The V.32 and V.32bis constellation and bandwidth

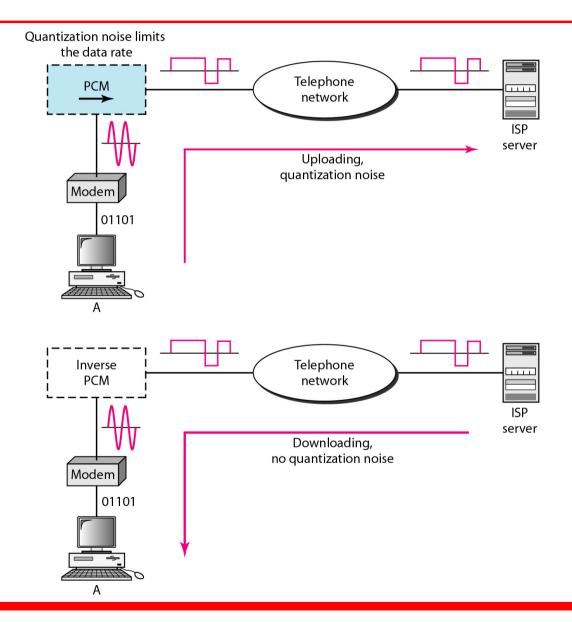


a. Constellation and bandwidth for V.32



b. Constellation and bandwidth for V.32bis

Figure 9.9 Uploading and downloading in 56K modems



9-3 DIGITAL SUBSCRIBER LINE

After traditional modems reached their peak data rate, telephone companies developed another technology, DSL, to provide higher-speed access to the Internet. Digital subscriber line (DSL) technology is one of the most promising for supporting high-speed digital communication over the existing local loops.

Topics discussed in this section:

ADSL ADSL Lite HDSL SDSL VDSL



ADSL is an asymmetric communication technology designed for residential users; it is not suitable for businesses.



The existing local loops can handle bandwidths up to 1.1 MHz.



ADSL is an adaptive technology.
The system uses a data rate based on the condition of the local loop line.

Figure 9.10 Discrete multitone technique

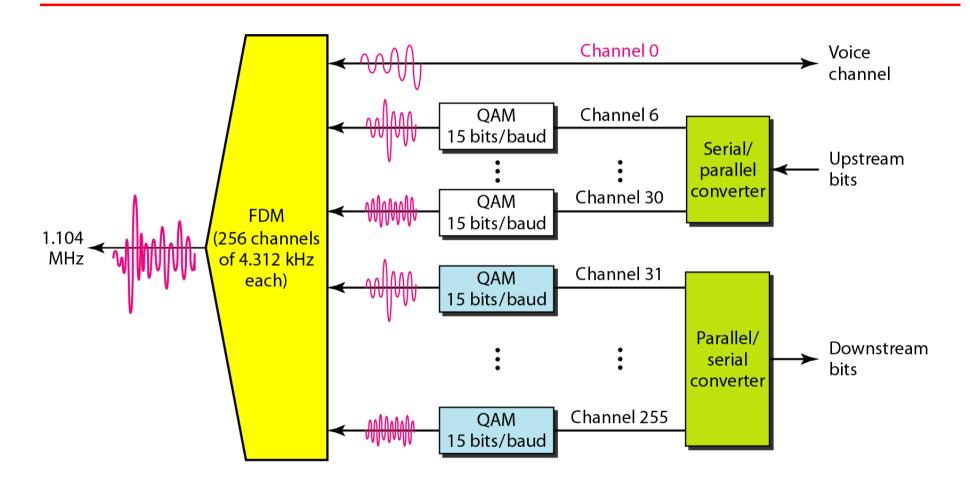


Figure 9.11 Bandwidth division in ADSL

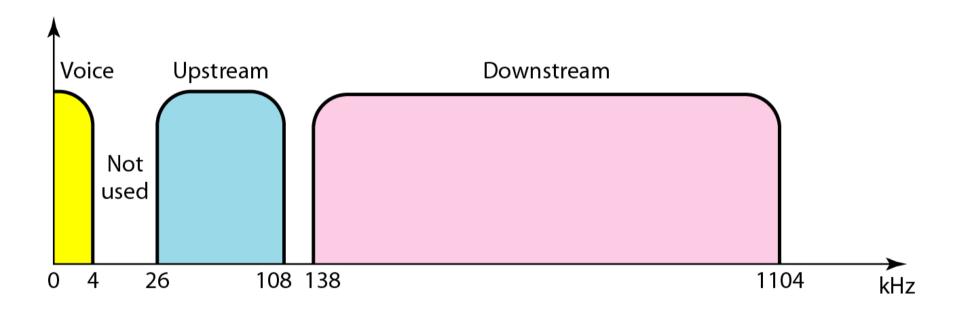


Figure 9.12 ADSL modem

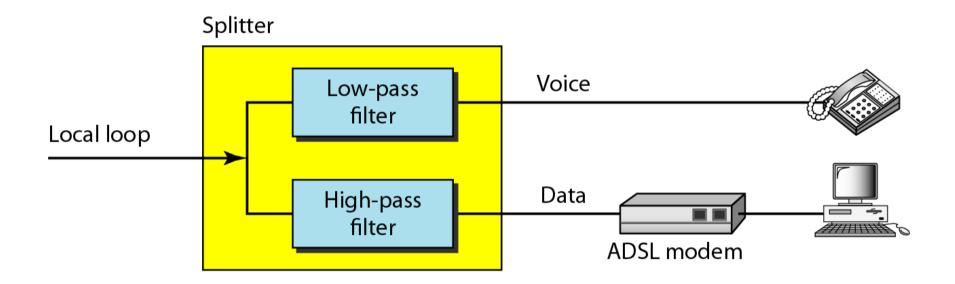


Figure 9.13 DSLAM

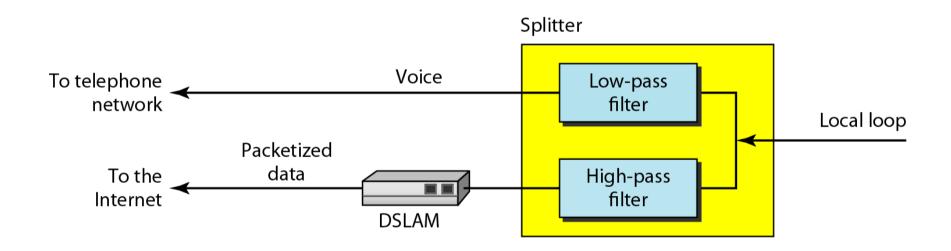


 Table 9.2
 Summary of DSL technologies

Technology	Downstream Rate	Upstream Rate	Distance (ft)	Twisted Pairs	Line Code
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

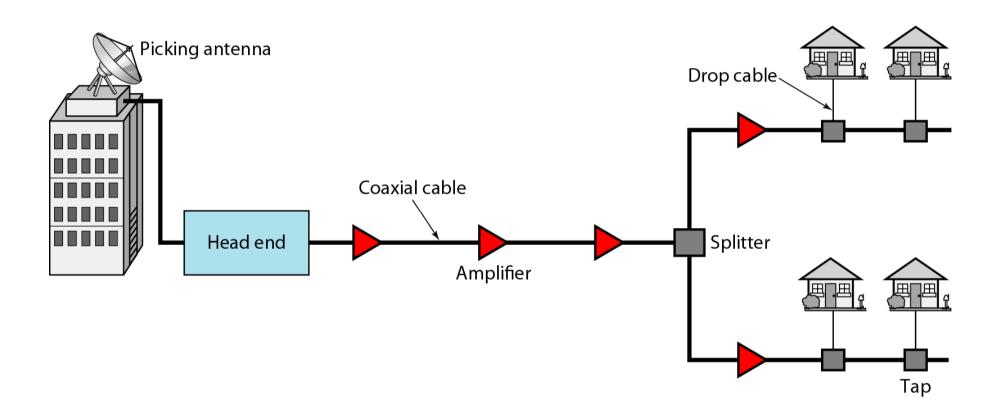
9-4 CABLE TV NETWORKS

The cable TV network started as a video service provider, but it has moved to the business of Internet access. In this section, we discuss cable TV networks per se; in Section 9.5 we discuss how this network can be used to provide high-speed access to the Internet.

Topics discussed in this section:

Traditional Cable Networks
Hybrid Fiber-Coaxial (HFC) Network

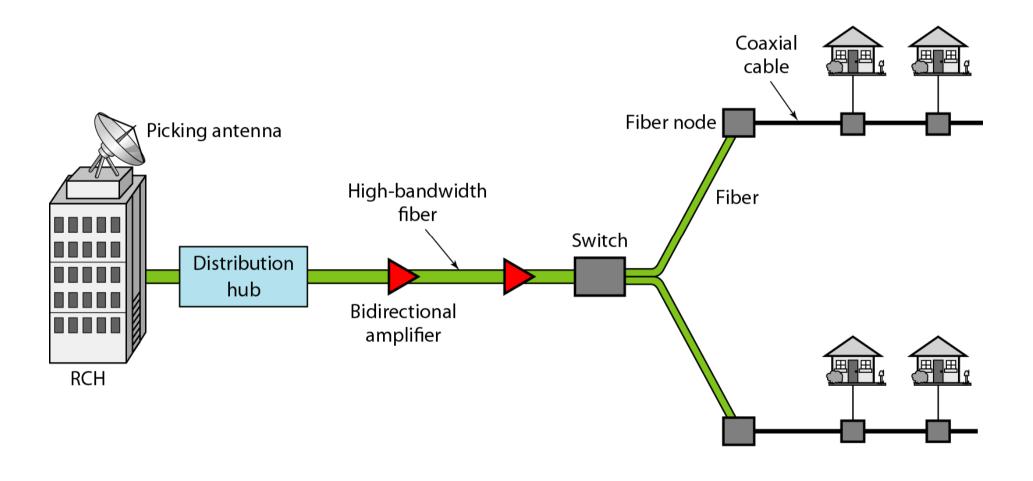
Figure 9.14 Traditional cable TV network





Communication in the traditional cable TV network is unidirectional.

Figure 9.15 Hybrid fiber-coaxial (HFC) network





Communication in an HFC cable TV network can be bidirectional.

9-5 CABLE TV FOR DATA TRANSFER

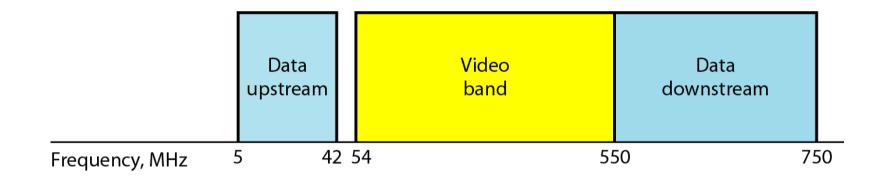
Cable companies are now competing with telephone companies for the residential customer who wants high-speed data transfer. In this section, we briefly discuss this technology.

Topics discussed in this section:

Bandwidth
Sharing
CM and CMTS

Data Transmission Schemes: DOCSIS

Figure 9.16 Division of coaxial cable band by CATV





Downstream data are modulated using the 64-QAM modulation technique.



The theoretical downstream data rate is 30 Mbps.



Upstream data are modulated using the QPSK modulation technique.



The theoretical upstream data rate is 12 Mbps.

Figure 9.17 Cable modem (CM)

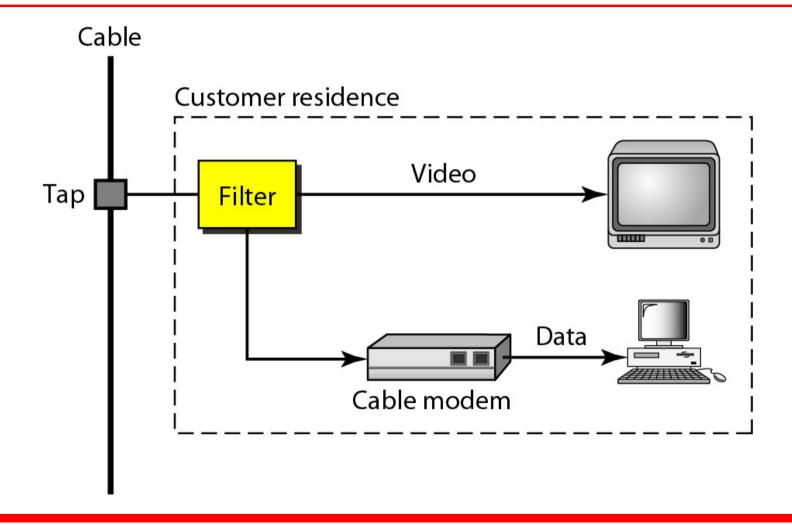


Figure 9.18 Cable modem transmission system (CMTS)

