

Using Telephone and Cable Networks for Data Transmissions

Outline

- Telephone lines
- Dial-up modems
- Digital Subscriber Line (DSL)
- Cable TV networks

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

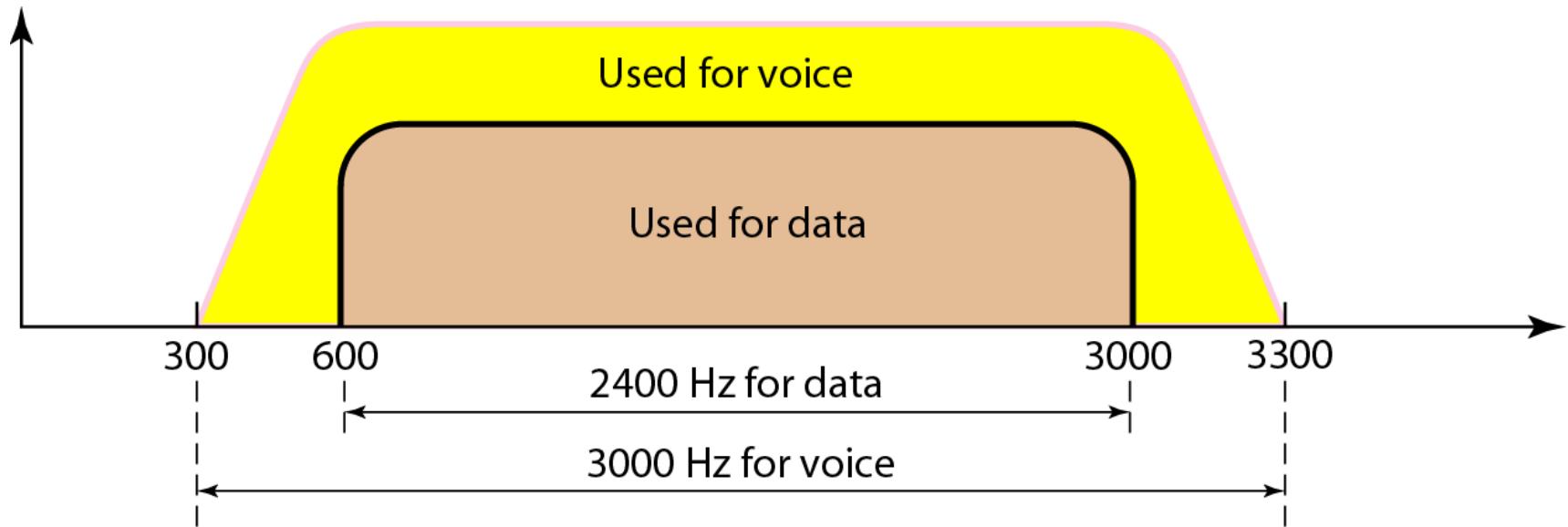
Signaling

Services Provided by Telephone Networks

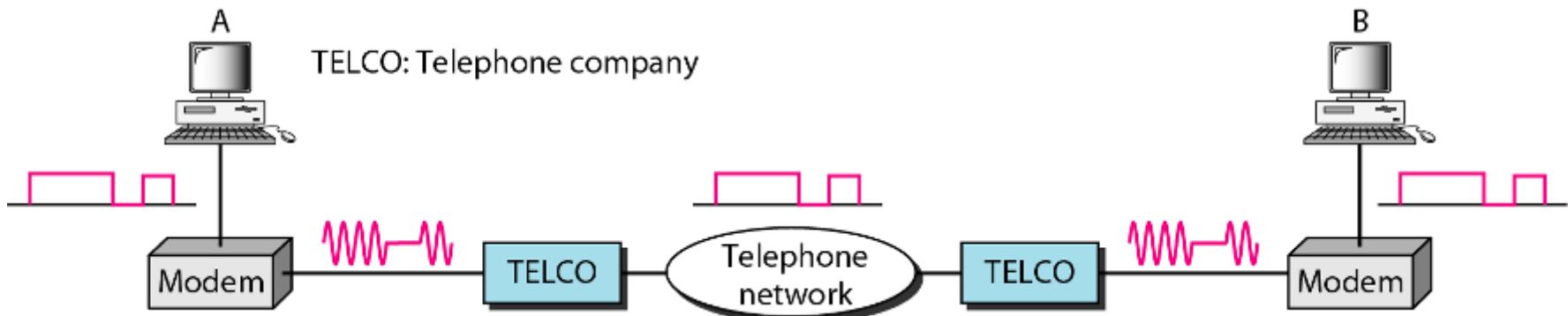
Telephone Lines

- 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
- Recently telephone companies began offering **digital** services to their subscribers.
- **Switched/56** service is the digital version of an analog switched line that allows data rates of up to 56 kbps.

Telephone Line Bandwidth

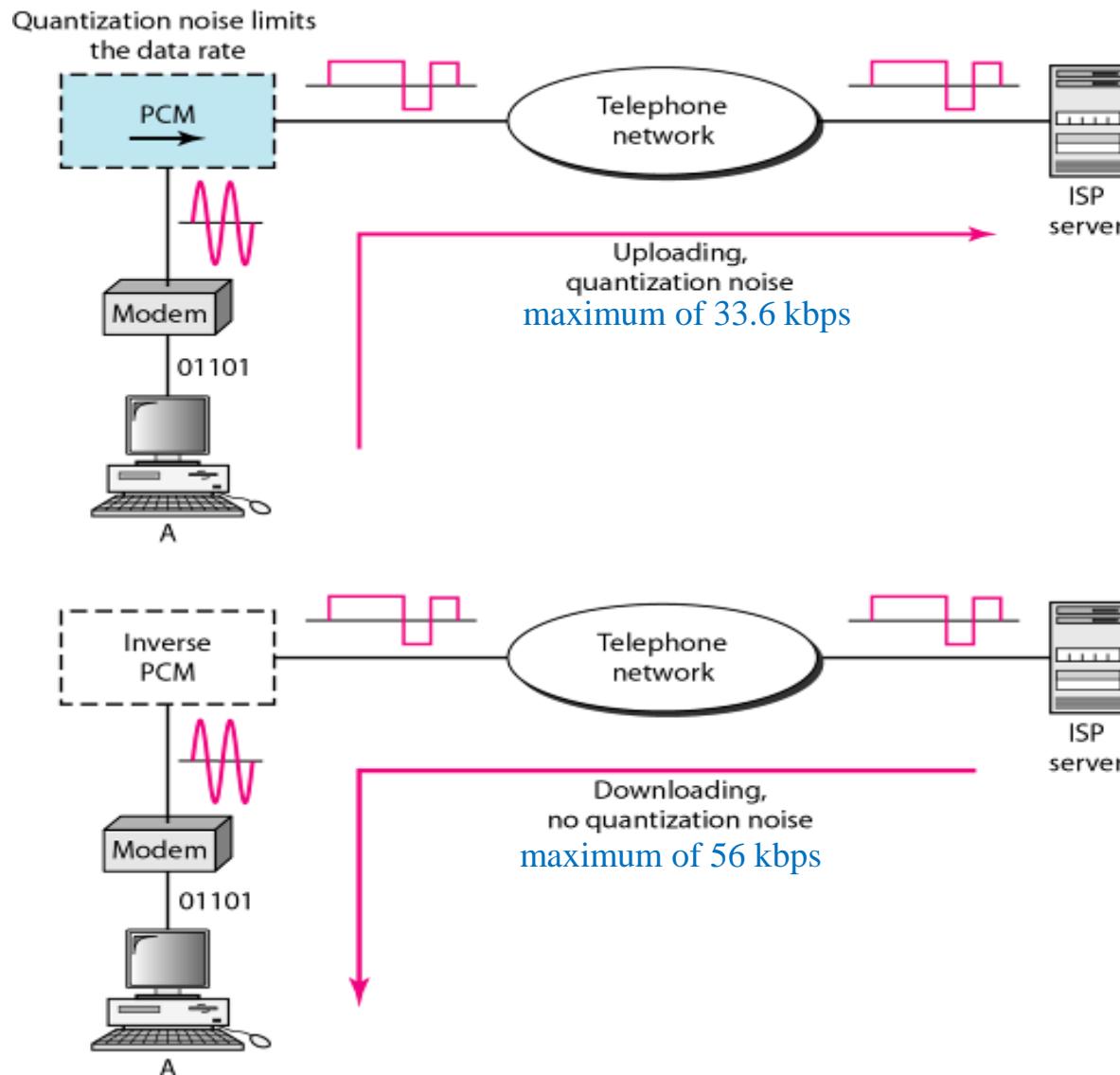


Dial-Up Modems



Modem
stands for modulator/demodulator.

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

Digital Subscriber Line (DSL)

- Supports high-speed digital communication over the existing **local loops**
- The existing local loops can handle bandwidths up to **1.1 MHz**.
 - The filter installed at the end office of the telephone company limits the bandwidth to **4 kHz** (sufficient for voice communication).
 - If the filter is **removed**, however, the entire 1.1 MHz is available for data and voice communications.

ADSL

- *ADSL* – Asymmetric Digital Subscriber Line
 - Downstream bit rate > upstream bit rate
 - Designed for residential users
 - Unsuitable for businesses
- ADSL operates on existing local loops
 - Local loops can handle up to 1.1 MHz of bandwidth
 - The distance limit is ~18,000 feet
 - The system uses a data rate based on the condition of the local loop line

Bandwidth Division in ADSL

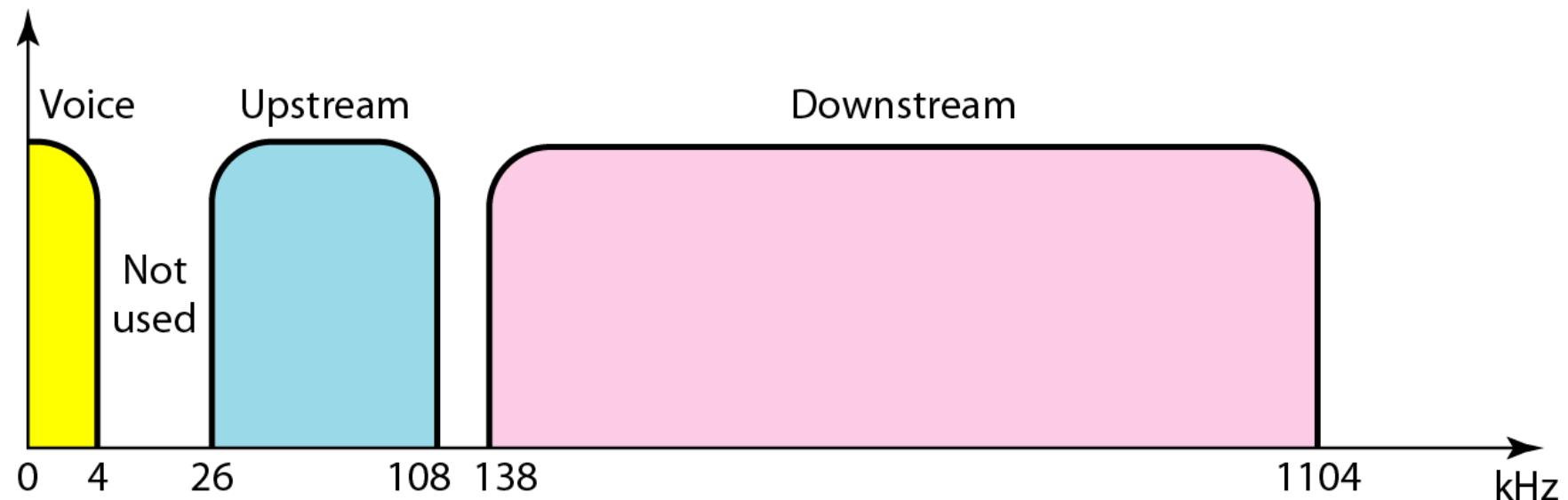
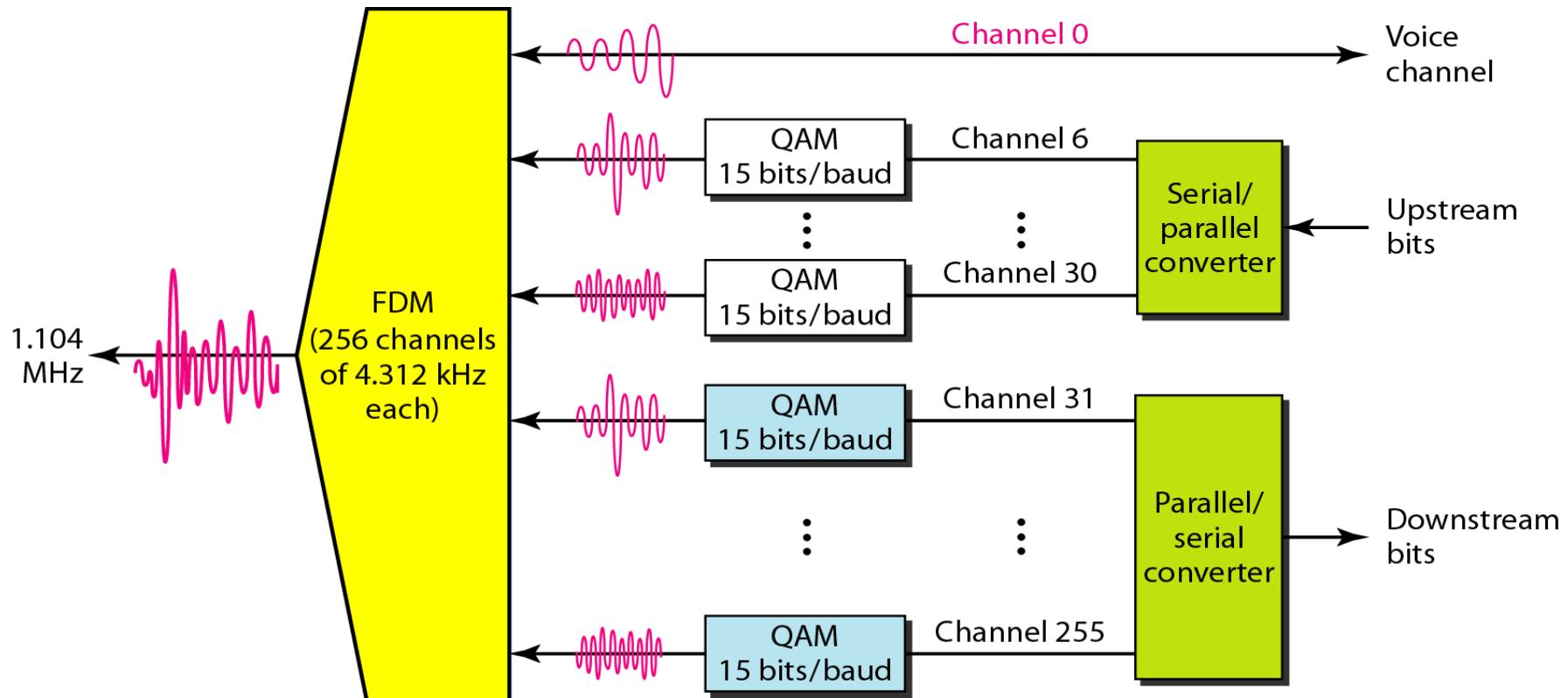
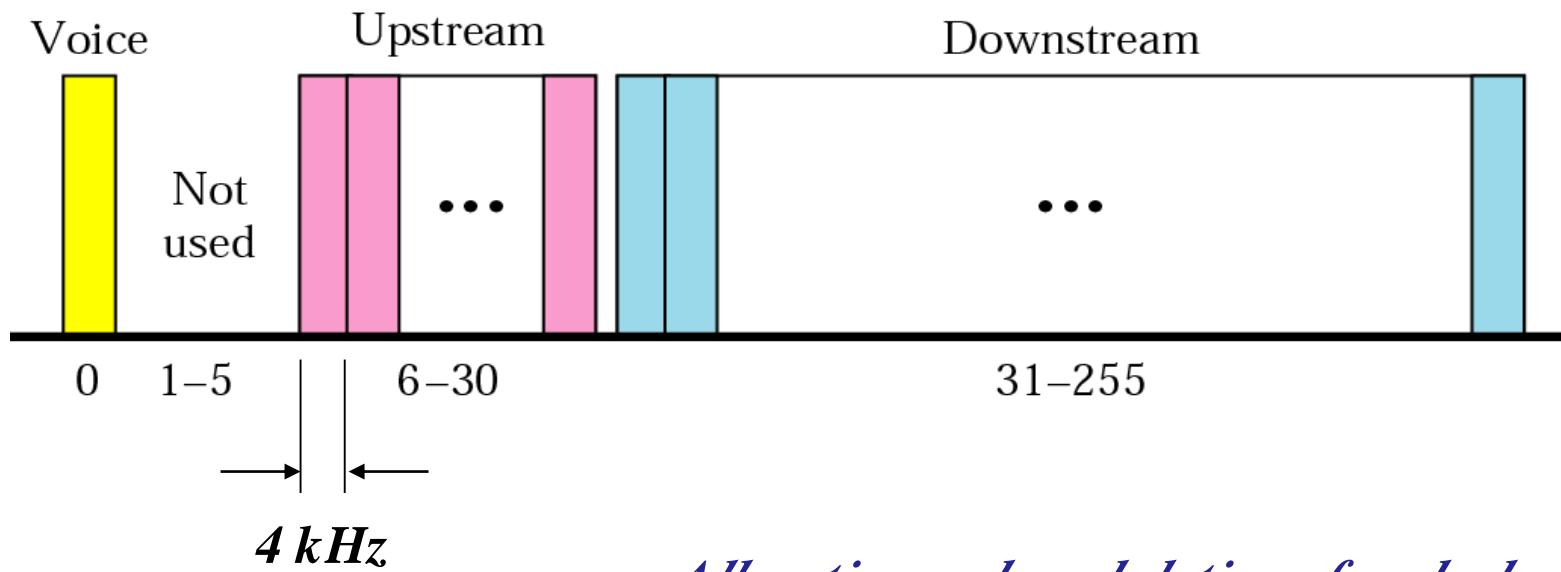


Figure 9.10 ADSL modulation technique (Discrete multitone technique-DMT)



Note: The available bandwidth of 1.104 MHz is divided into 256 channels. Each channel uses a bandwidth of 4.312 kHz.,

Bandwidth Division

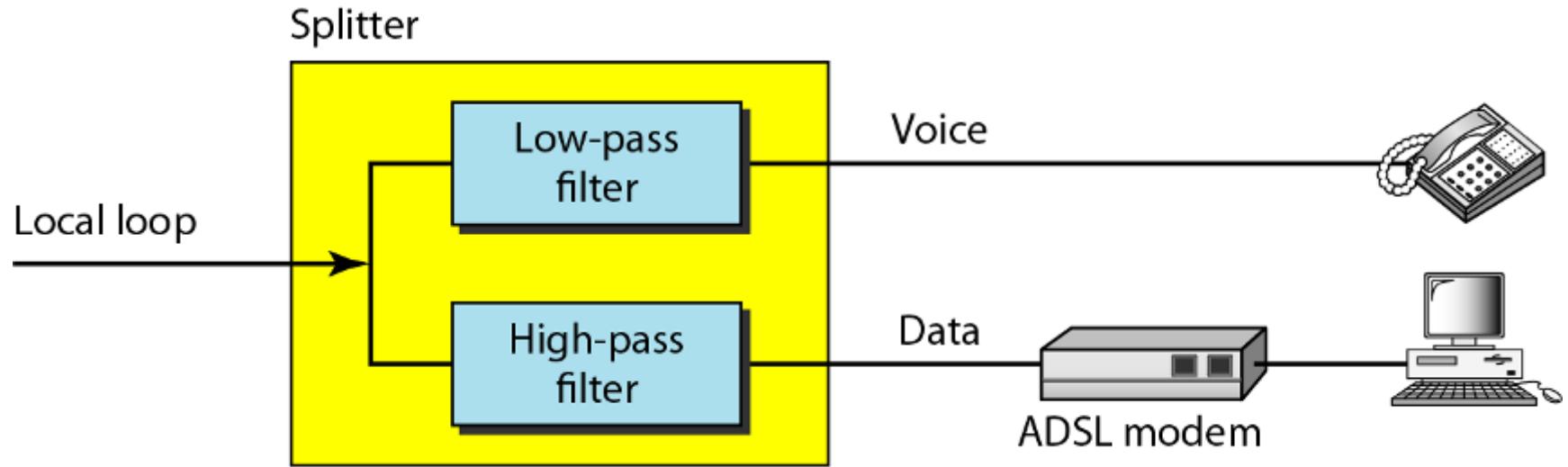


*Allocation and modulation of each channel
are determined adaptively*

Bandwidth Division

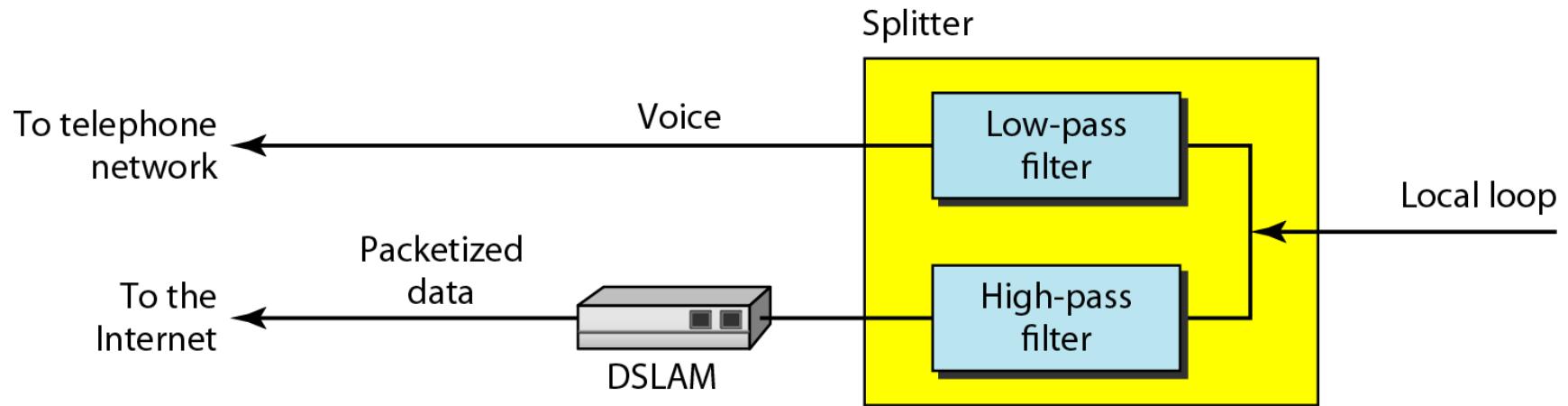
- *Voice* – Channel 0
- *Idle* – Channels 1-5
- *Upstream* – Channels 6-30
 - 24 data channels, 1 control channel
 - 1.44 Mbps (max) upstream bit rate
 - Actual bit rate: 64 Kbps to 1 Mbps
- *Downstream* – Channels 31-255
 - 224 data channels, 1 control channel
 - 13.4 Mbps (max) downstream bit rate
 - Actual bit rate: 500 Kbps to 8 Mbps

ADSL Customer Residence



DSL Access Multiplexer

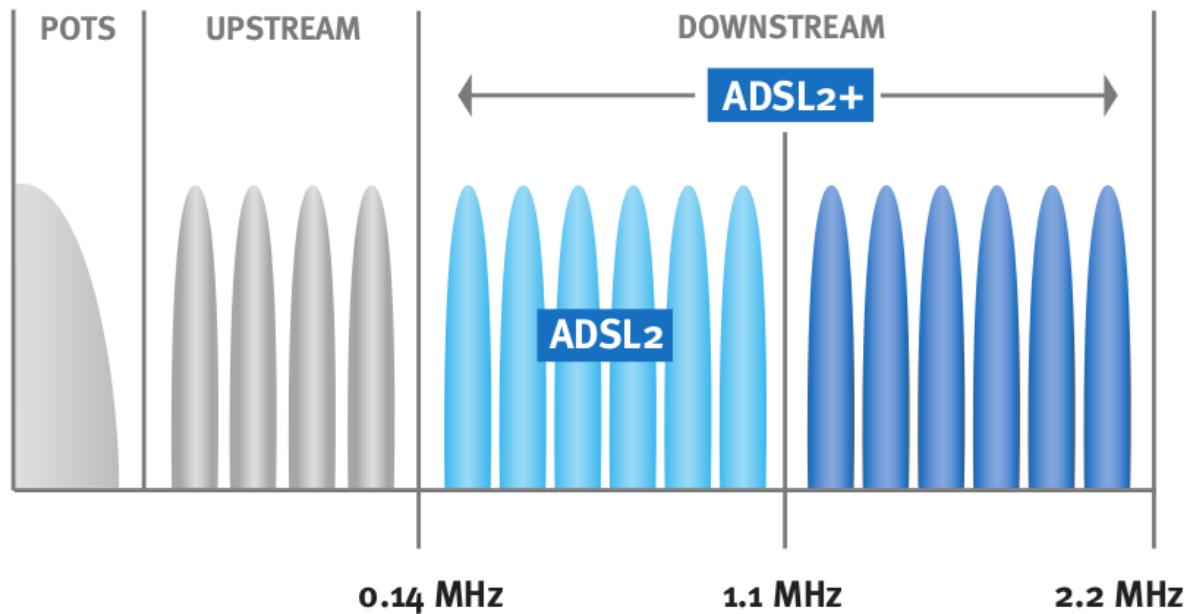
■ Or *DSLAM*



Other DSL Technologies

- HDSL – High-bit-rate DSL
- VDSL – Very-high-bit-rate DSL
- SDSL – Symmetric DSL
- ADSL2
- ADSL2+

*Source: AWARE. ADSL2 and ADSL2+
The new ADSL standard.*



- See also
 - http://en.wikipedia.org/wiki/Digital_subscriber_line

Table 9.2 Summary of DSL technologies

<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

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.*

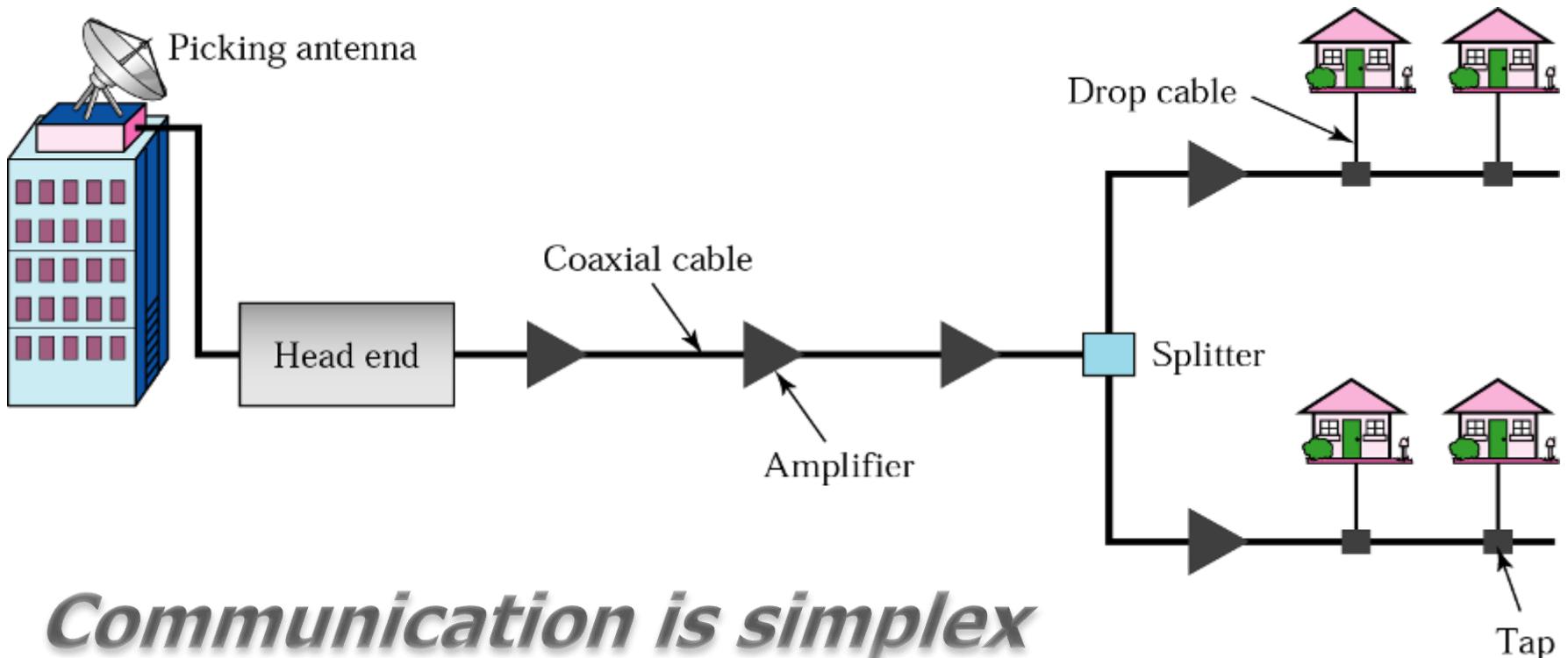
Topics discussed in this section:

Traditional Cable Networks

Hybrid Fiber-Coaxial (HFC) Network

Cable TV Networks

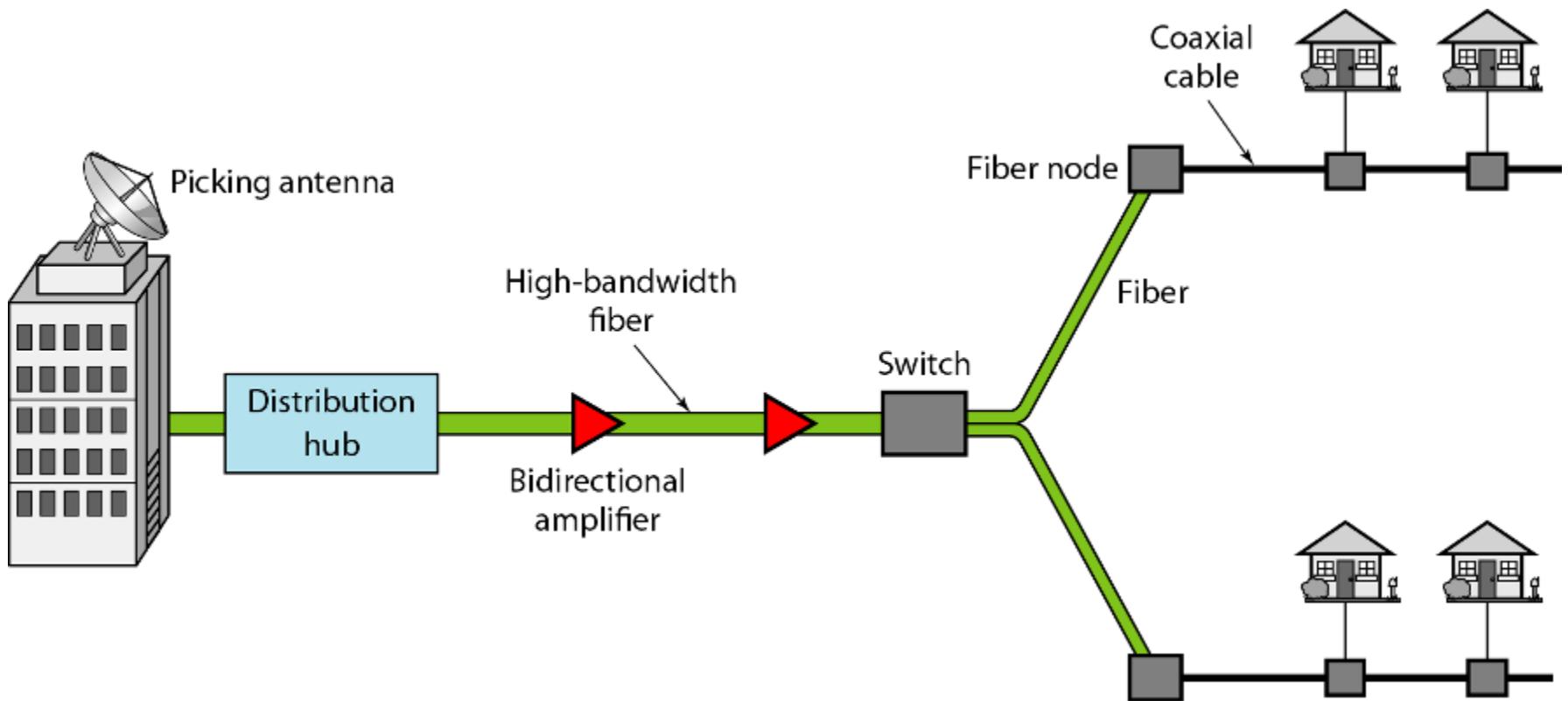
- Started as a video service provider, then moved to the business of Internet access



Communication is simplex

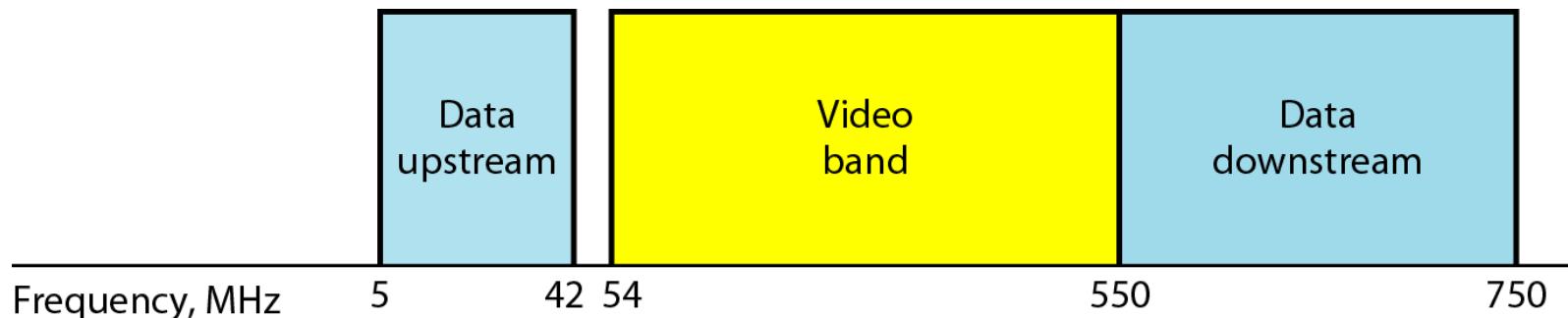
Hybrid Fiber-Coaxial Network

- Or *HFC*
- Bidirectional communication is achieved



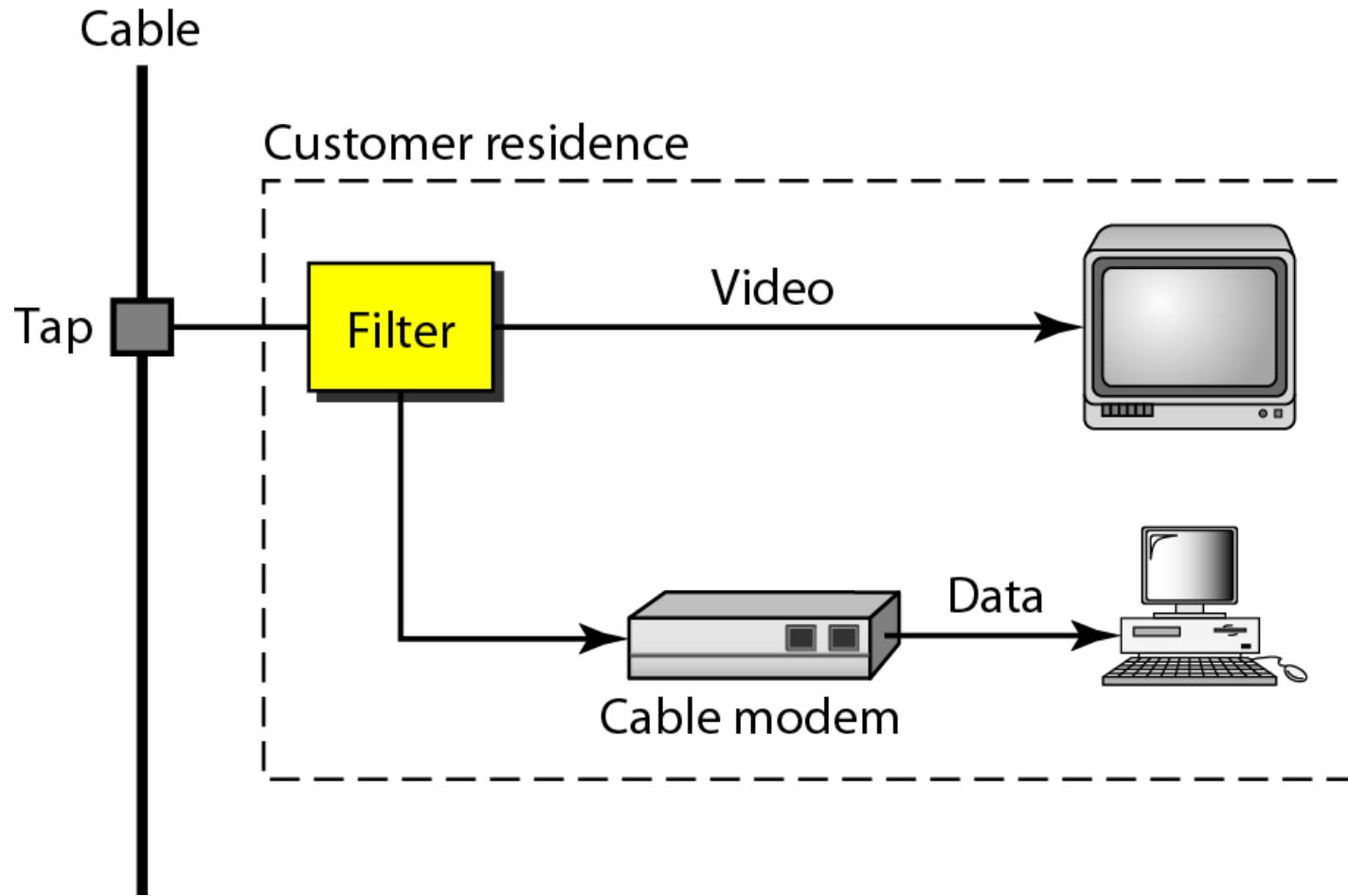
Data Transfer over CATV

- Standard: *DOCSIS* (Data Over Cable Service Interface Specification)
- Division of coaxial cable band by Cable TV



- Theoretical downstream data rate is 30 Mbps
- Theoretical upstream data rate is 12 Mbps

Cable Modem



Cable Modem Transmission System

■ Or *CMTS*

