

Computer Networks and Internets

《计算机网络与因特网》课件

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PART II Packet Transmission

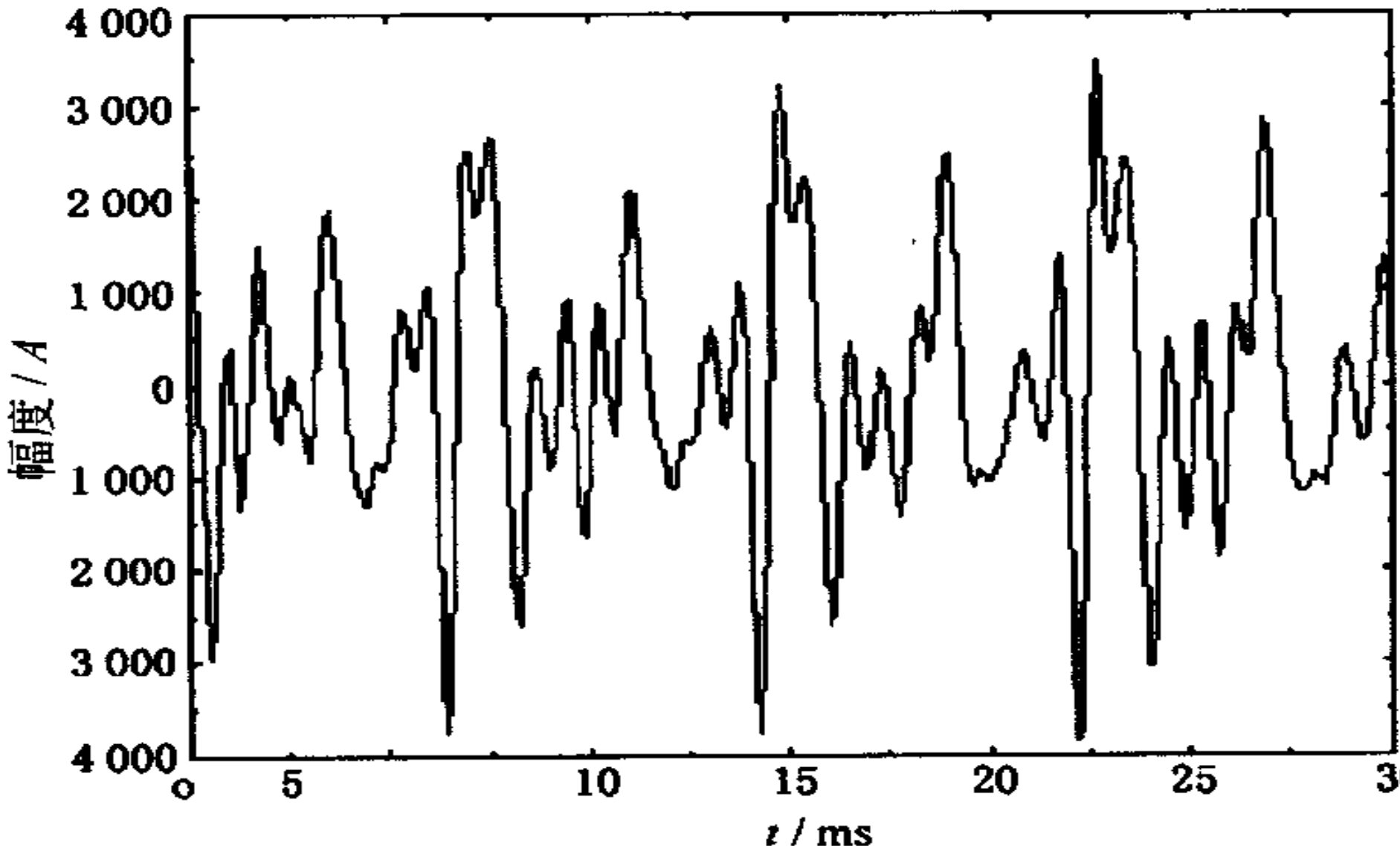
Chapter 12 Long-Distance Digital Connection Technologies

远程数字连接技术

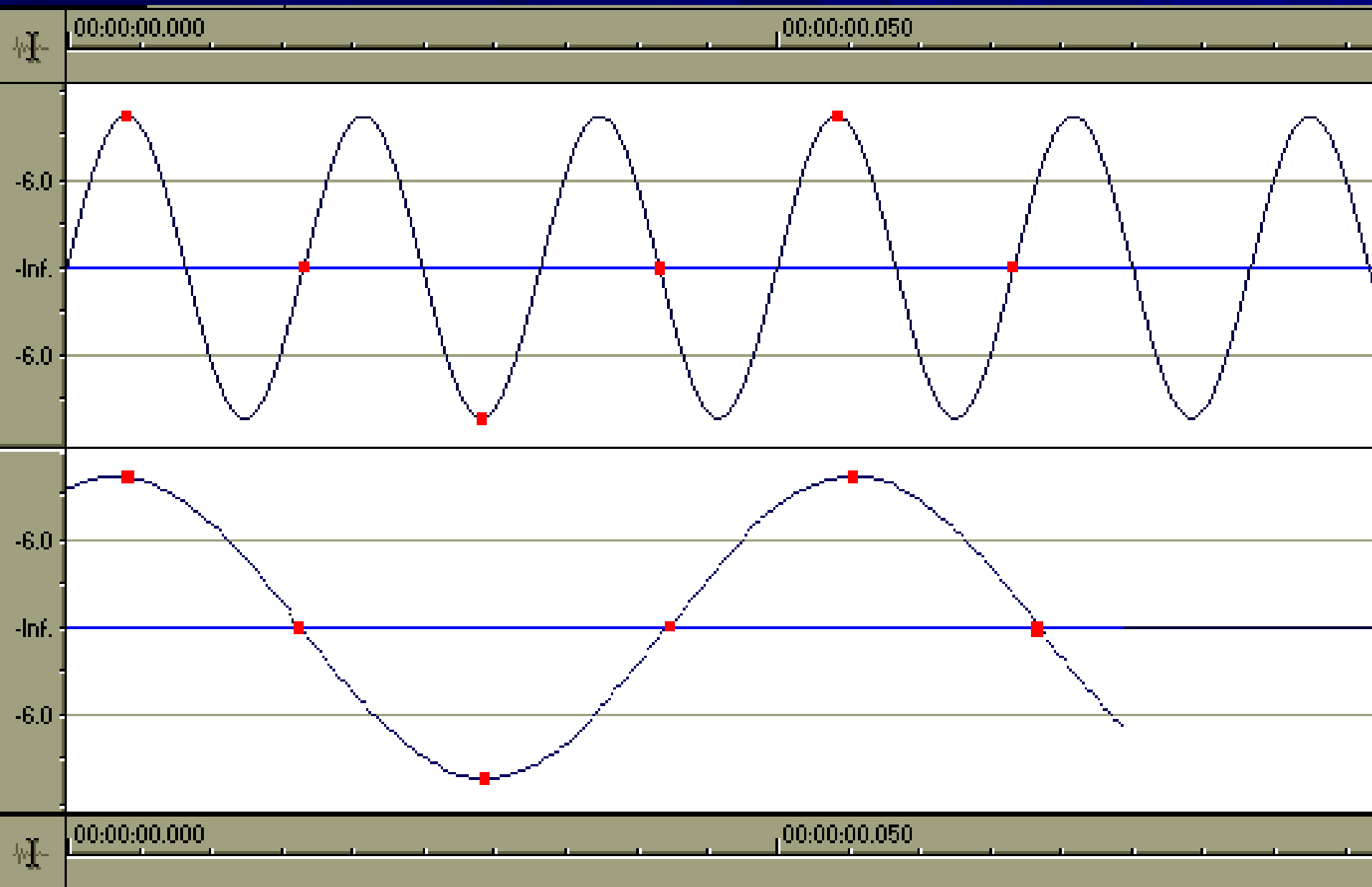
12.2 Digital Telephony 数字电话

- The motivation for studying digital communication.
- Digital communication avoids the problem of noise.
- The digital version of an analog audio signal is called digital audio.
- The process of converting an analog signal to digital form is called digitization(数字化).

声波举例



Sampling Rate(采样频率)



- **Nyquist's sampling theorem(采样定理)** states that if a continuous signal is sampled at a rate greater than twice the highest significant frequency, the original signal can be reconstructed from the samples(样本).
- **The tradeoff is between accuracy and data size.**
- **Pulse Code Modulation(PCM).**
- **PCM samples a signal once every 125 μ seconds(微秒) and converts each sample into a integer between 0 and 255.**

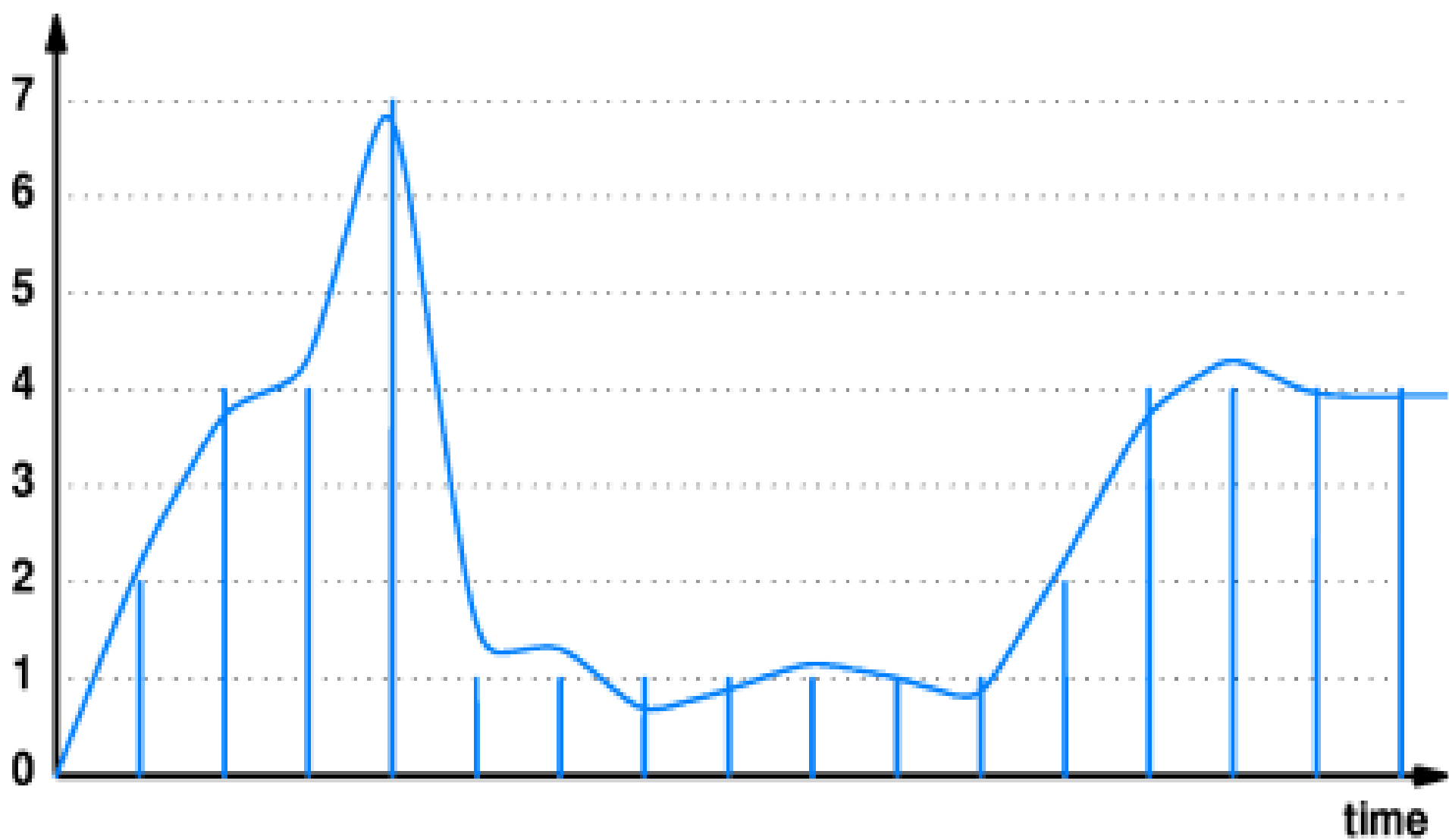


Figure 12.1 An illustration of digitization using eight values. Each vertical line represents an integer value chosen for one sample.

12.3 Synchronous Communication 同步通信

- **The facilities used for digitized voice differ from the system used for data.**
- **Voice systems use synchronous or clocked technology.**
- **Most data networks use asynchronous technology.**

- **A synchronous network consists of a system designed to move data at a precise rate.**
- **The telephone system is carefully designed to transmit additional information along with the digitized data and to ensure continuous transmission.**
- **Receiving equipment uses the additional information to synchronize its clock and ensure that data leaves the network at exactly the same rate as it entered.**

12.4 Digital Circuits and DSU/CSUs

- Digital circuits leased from common carriers.
- The standards for telephone system digital circuits differ from those used in the computer industry.
- DSU: Data Service Unit
- CSU: Channel Service Unit.

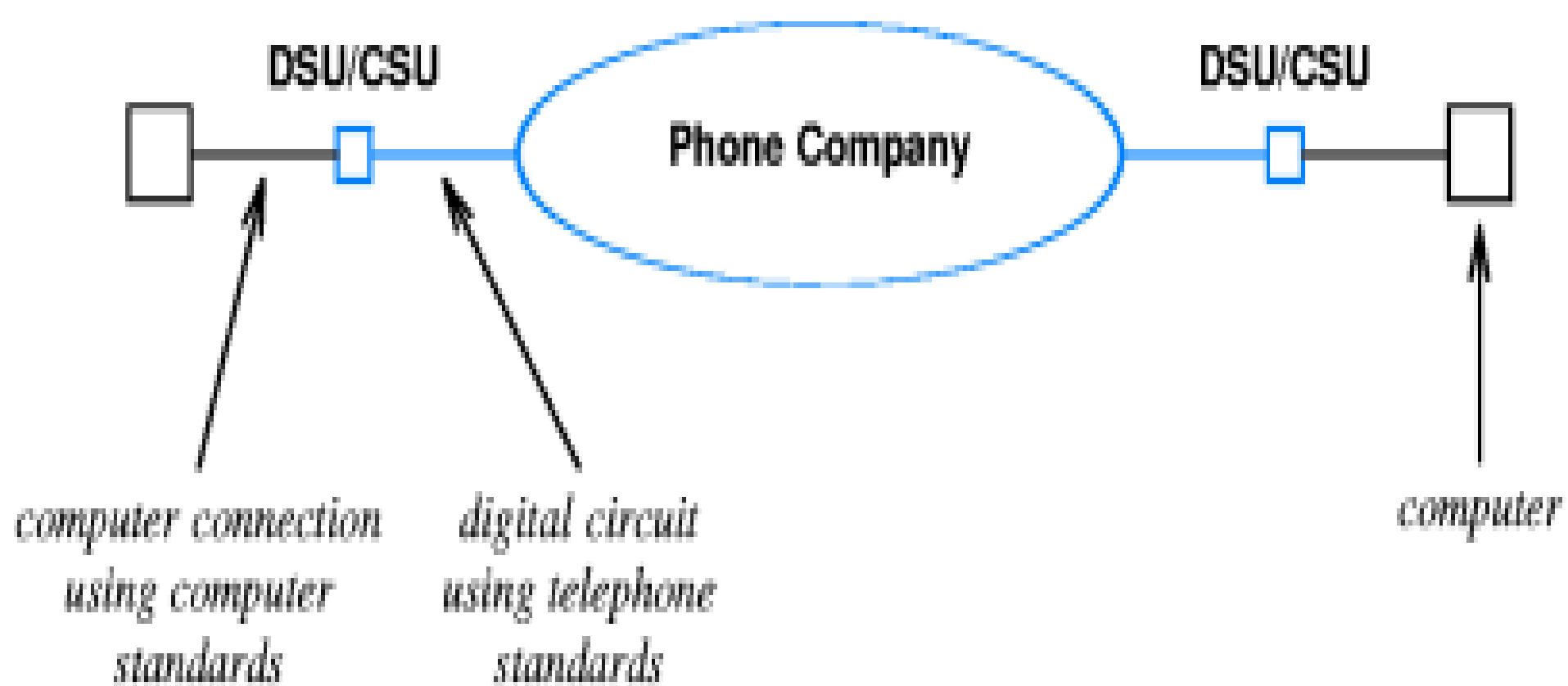


Figure 12.2 Illustration of a digital circuit with a DSU/CSU on each end. The DSU/CSU converts between the digital standards used in the telephone system and those used by computer vendors.

12.5 Telephone Standards

- In the U.S., standards for digital telephone circuits : T-series standards.
- Japan adopted a modified version of the T-series standards.
- Europe chose a slightly different scheme (E-series standards).

Name	Bit Rate	Voice Circuits	Location
–	0.064 Mbps	1	
T1	1.544 Mbps	24	North America
T2	6.312 Mbps	96	North America
T3	44.736 Mbps	672	North America
E1	2.048 Mbps	30	Europe
E2	8.448 Mbps	120	Europe
E3	34.368 Mbps	480	Europe

Figure 12.3 Data rates of popular digital circuit standards used in North America and Europe.

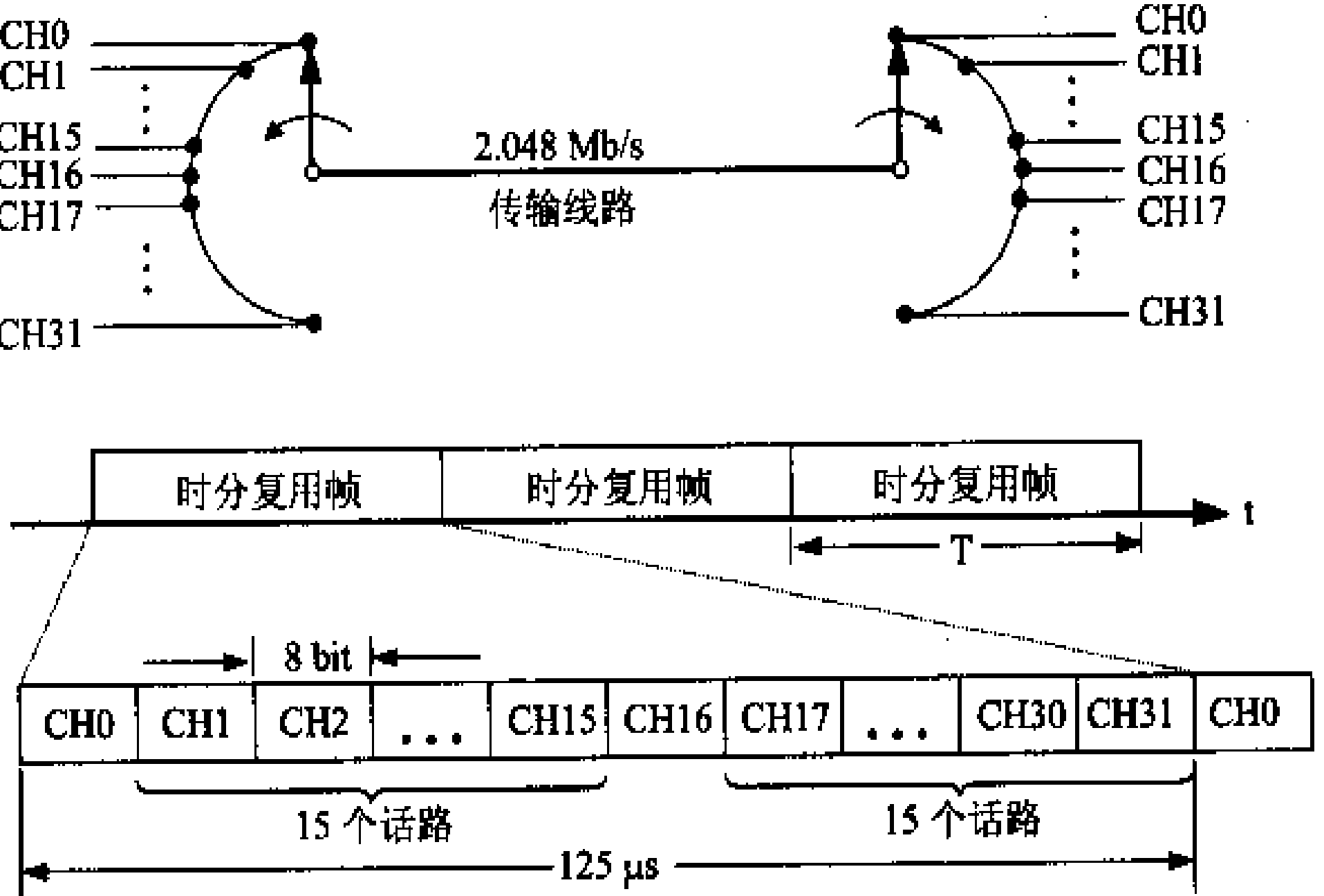


图 3-20 E1 的时分复用帧

12.6 DS Terminology and Data Rates

- A single voice channel requires 64kbps.
- T1 standard was chosen to allow the circuit to carry 24 independent voice calls(plus a small amount of overhead).
- T-standards define the underlying carrier system.
- DS standards(digital signal level) specify how to multiplex multiple phone calls onto a single connection.
- (DS-n 表示一个标准，而T-n表示符合一定标准的电路)

12.7 Lower Capacity Circuits

- Many companies do not need the capacity of a T1 circuit(1.544Mbps).
- One of the most popular fractional T1 capacities is 56kbps.

12.8 Intermediate Capacity Digital Circuits

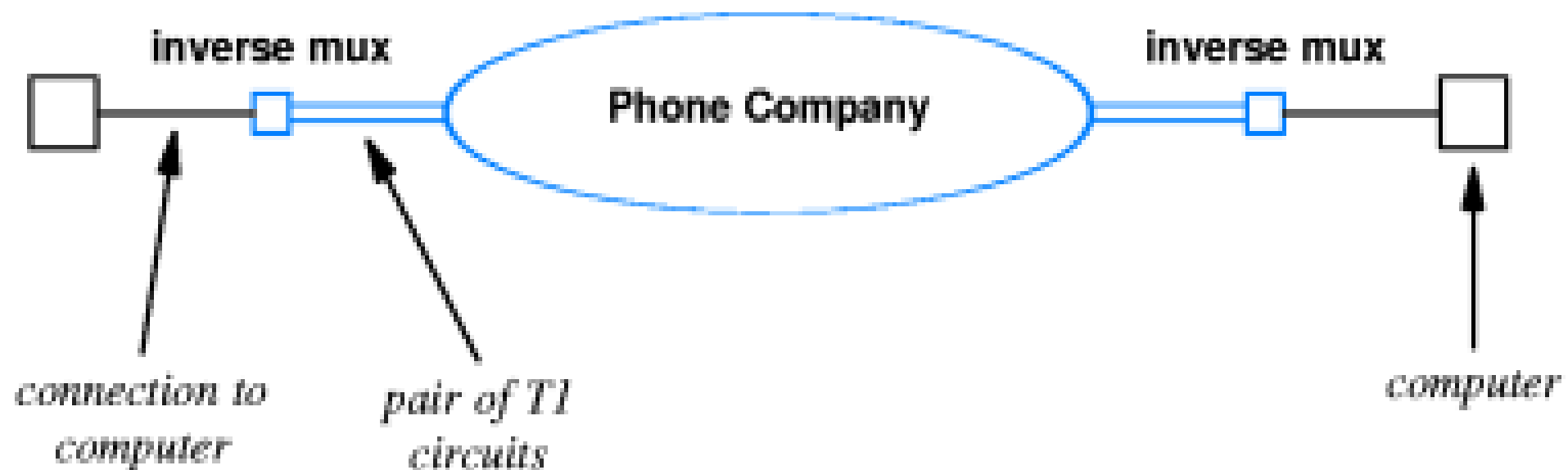


Figure 12.4 An inverse mux using two T1 circuits to provide a connection with twice the capacity. Inverse multiplexing is attractive economically for intermediate capacities because two T1 circuits are much less expensive than a T3 circuit.

12.9 Highest Capacity Circuits

- Trunk 干线.
- High-capacity digital circuit.
- STS(synchronous transport signal).

12.10 Optical Carrier Standards

光纤传输标准

- OC(optical carrier).
- The OC standards refer to the optical signals that propagate across the fiber.

12.12 Synchronous Optical NETwork(SONET) 同步光纤网

- **The phone companies have defined a broad set of standards for digital transmission.**
- **In North America, the standards use term synchronous optical network(SONET) .**
- **In Europe, they are known as the synchronous digital hierarchy(SDH).**

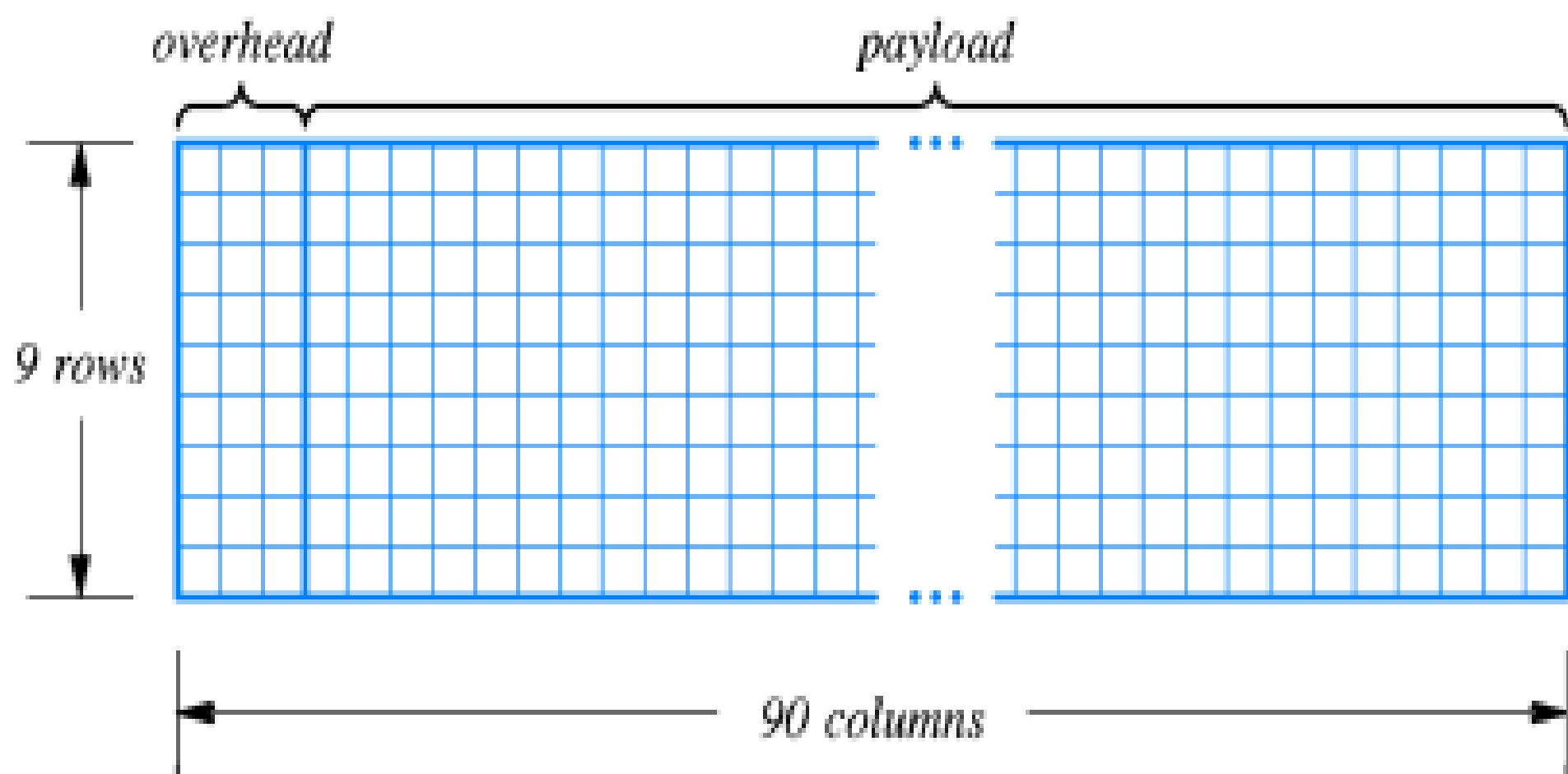
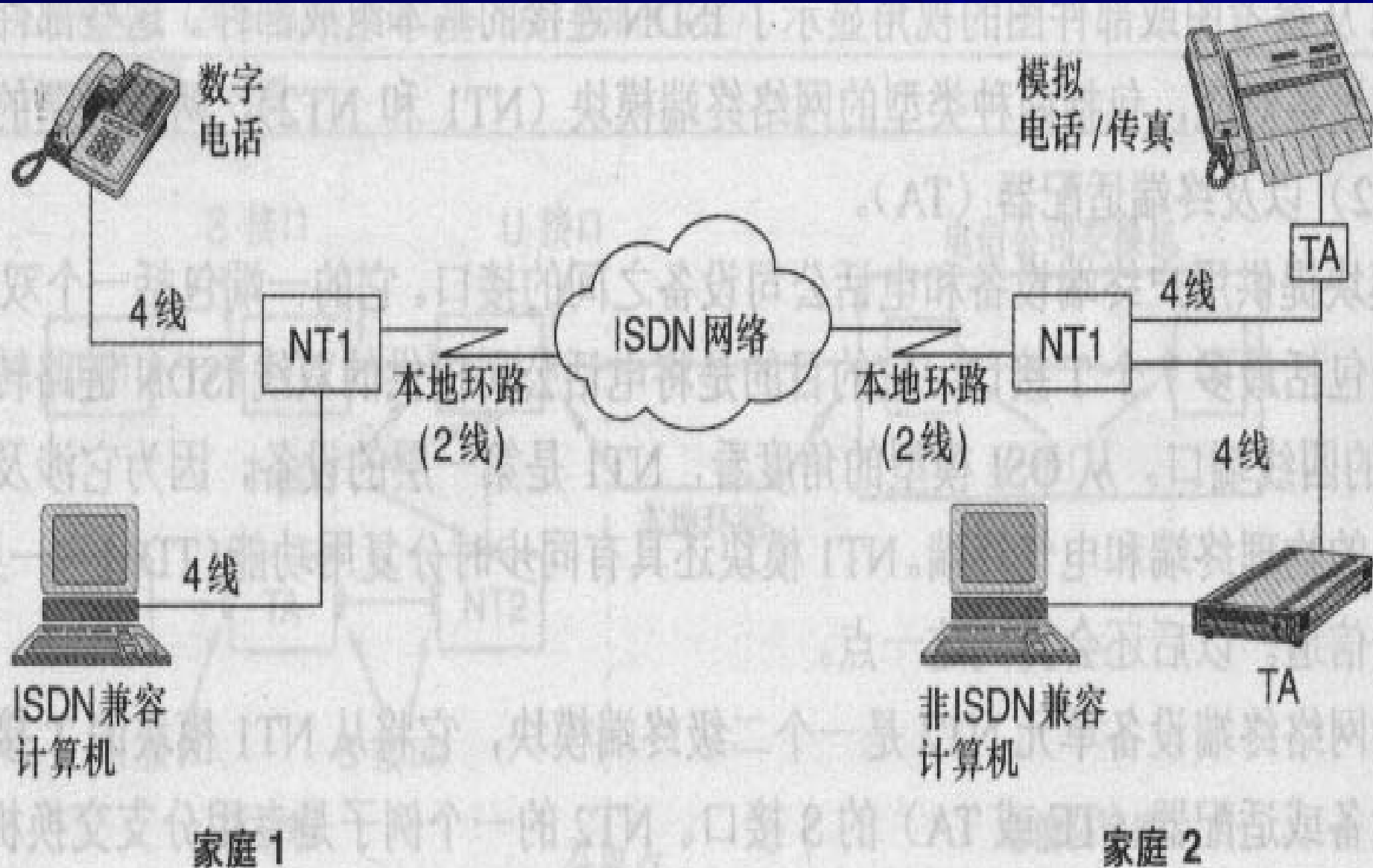


Figure 12.6 Illustration of an STS-1 SONET frame with 810 octets divided into 9 rows of 90 columns. Octets at the beginning of each row provide clock synchronization and maintenance information.

12.13 The Local Subscriber Loop 本地用户回路

- **Local loop or local subscriber line.**
- **To refer to the connection between the phone company central office and an individual subscribers's residence or place of business.**
- **To refer to the connections from a network provider to individual subscribers.**

12.14 ISDN



- **Integrated Services Digital Network (ISDN综合业务数字网).**
- **The 2B+D channels are known as the ISDN Basic Rate Interface(BRI)。**
- **2B+D (B: 64Kbps, D: 16Kbps).**
- **The two B channels are intended to carry digitized voice,data,or compressed video.**
- **The D channel is intended as a control channel.**

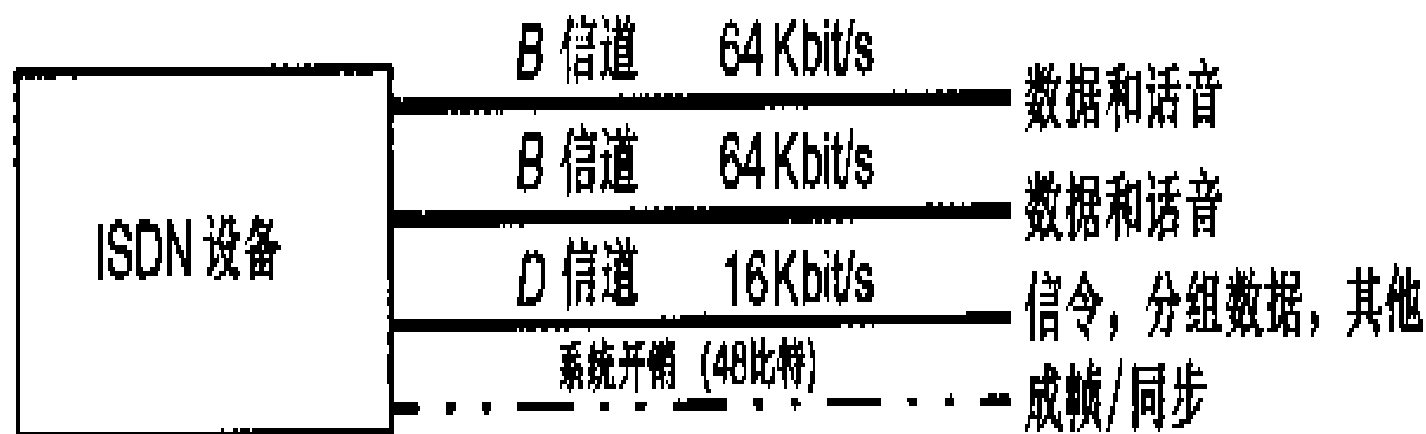


图 12.4 ISDN 的基本速率接口 (BRI) 是由电话公司提供的 $2B+D$ 的捆绑。BRI 由两个用于传输用户数据或话音 (或二者都有) 的 64 kbit/s 的 B 信道和一个用于传输信令和控制信息的 16 kbit/s 的 D 信道组成。如果当前没有信令或控制信息, D 信道也可同样用来传输数据。BRI 还包括附加的 48 比特用于成帧和同步

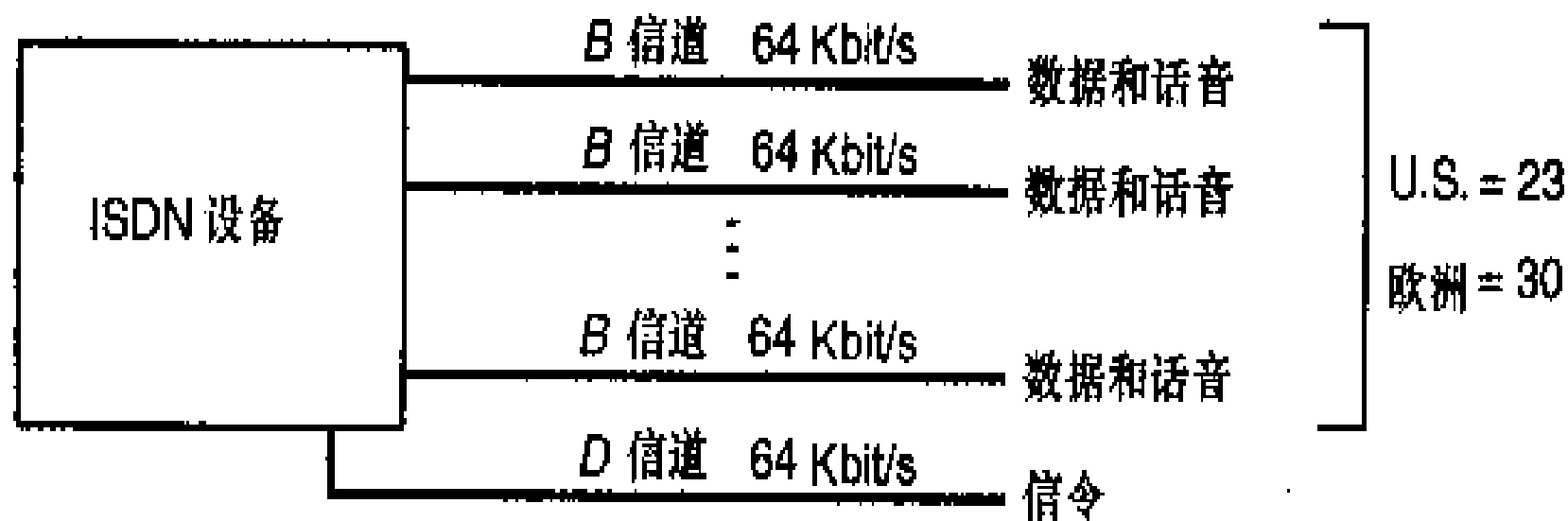


图 12.5 ISDN 的初等速率接口 (PRI) 以两种方式捆绑。第一种是 23B+D 配置, 基于北美的 DS-1 格式, 速率是 1.544 Mbit/s。第二种是 30B+2D 配置, 基于欧洲的 E-1 格式, 速率是 2.048 Mbit/s

12.15 Asymmetric Digital Subscriber Line Technology

不对称数字用户线技术

- ADSL is a local loop technology.

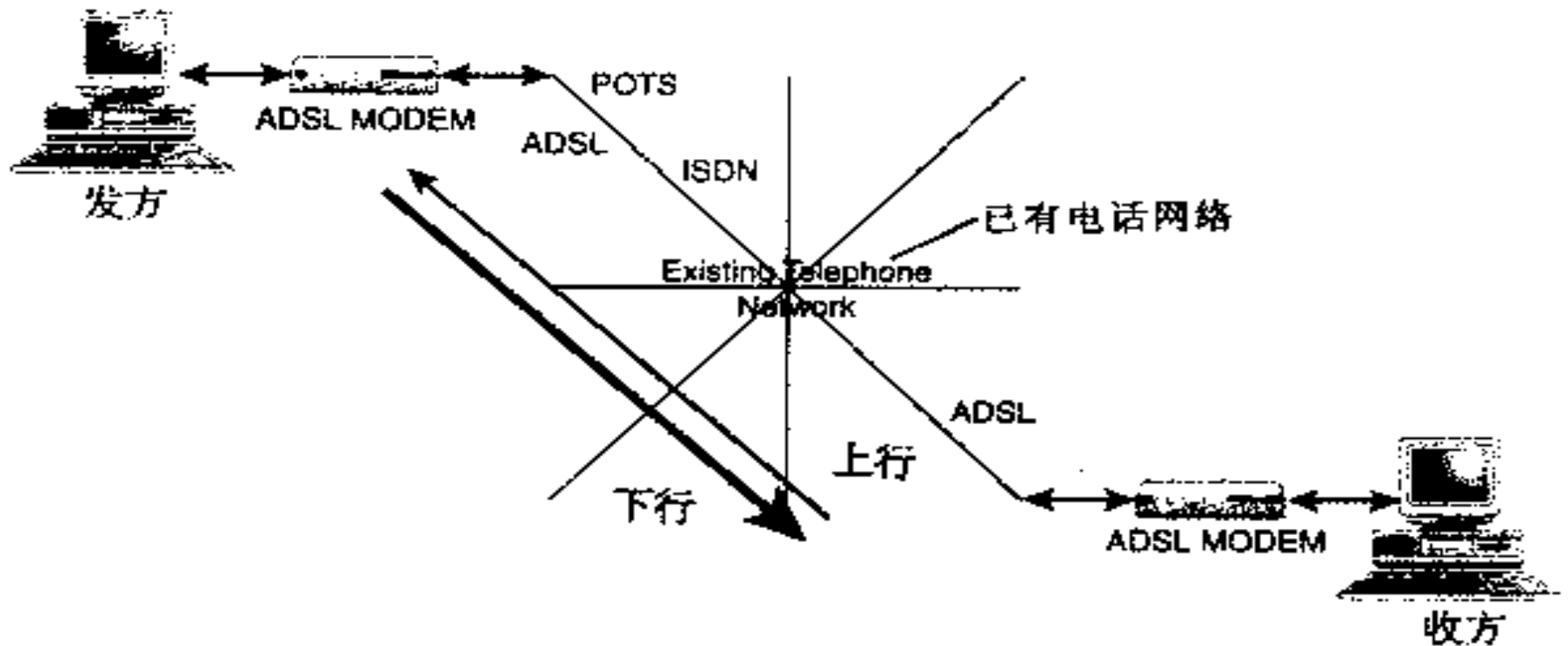


图 14.1 基本 ADSL

- Dividing the bandwidth into 286 separate frequencies, 255 frequencies used for downstream data transmission and 31 used for upstream data transmission, with 2 taken for control information.
- ADSL is adaptive.

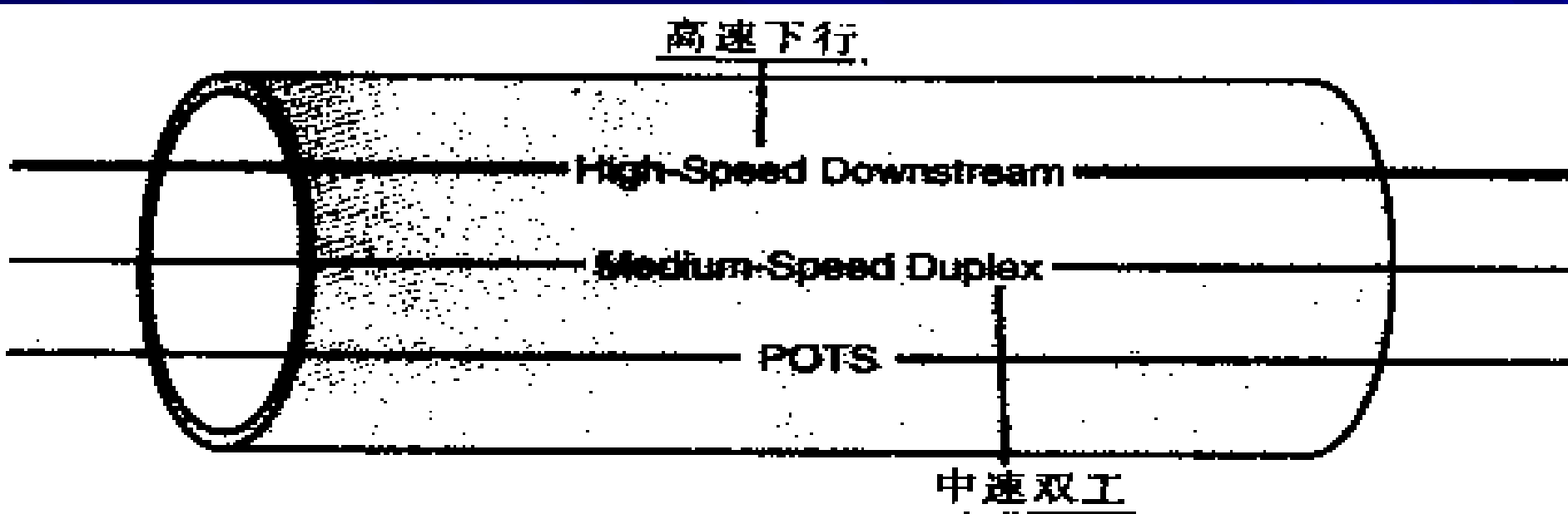


图 14.2 一个 ADSL 三信道管

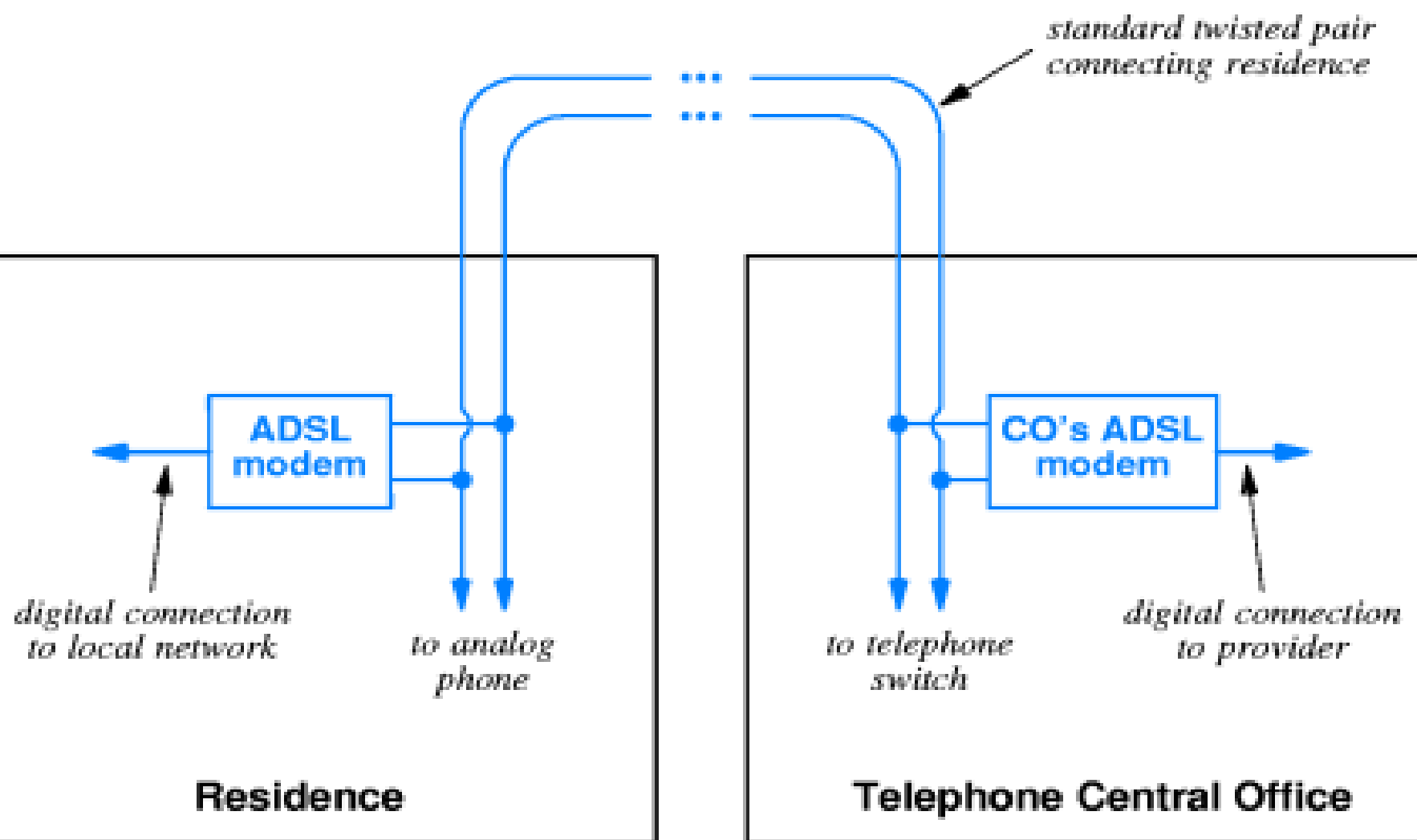


Figure 12.7 ADSL modems connected to existing local loop wiring. The modems can use a pair of wires simultaneously with analog telephone service.

12.16 Other DSL Technologies

表 14.4 DSL 交叉参考

名称	描述	速率	模式
DSL	数字用户线	192Kbps	双工
HDSL	高数据/位速率 DSL	1.544Mbps 2.048Mbps	双工
SDSL	单数据线 DSL	1.544Mbps 2.048Mbps	双工
ADSL	非对称 DSL	1.5 到 9Mbps 16 到 640Kbps	顺流 逆流
VDSL	超高速 DSL	1.3 到 52Mbps 1.5 到 23Mbps	顺流 逆流

12.17 Cable Modem Technology

电缆调制解调技术

12.18 Upstream Communication

上行通信

12.19 Hybrid Fiber Coax

混合光纤电缆

12.20 Fiber To The Curb

光纤到街道

作业

- 简述广域网有哪些通信标准和数据传输方法？