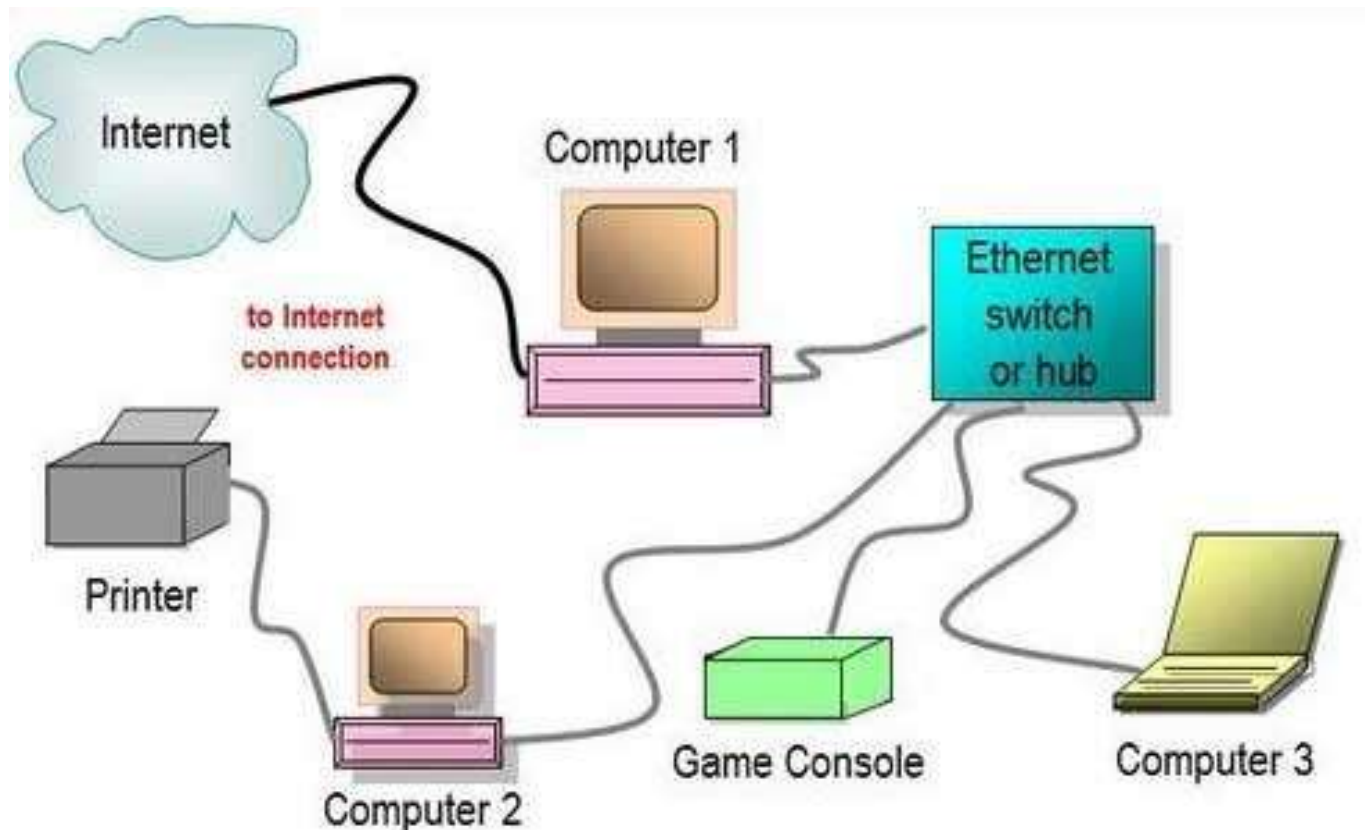# Chapter 14
Other Wired Networks

Objective

- Telephone network: a dial-up service or DSL service.

- Cable network.

- SONET with a fiber-optic technology for high-speed connection to carry data.

- ATM, which can use SONET as the carrier to create a high-speed wide area network (WAN).

Telephone Network

- The telephone network had its beginnings in the late 1800s. The entire network was originally an analog system using analog signals to transmit voice.

- With the advent of the computer era, the network, in the 1980s, began to carry data in addition to voice.

- During the last decade, the telephone network has undergone many technical changes. The network is now digital as well as analog.

Major Components

- The telephone network is made of three major components: local loops, trunks, and switching offices.

- The telephone network has several levels of switching offices such as end offices, tandem offices, and regional offices.
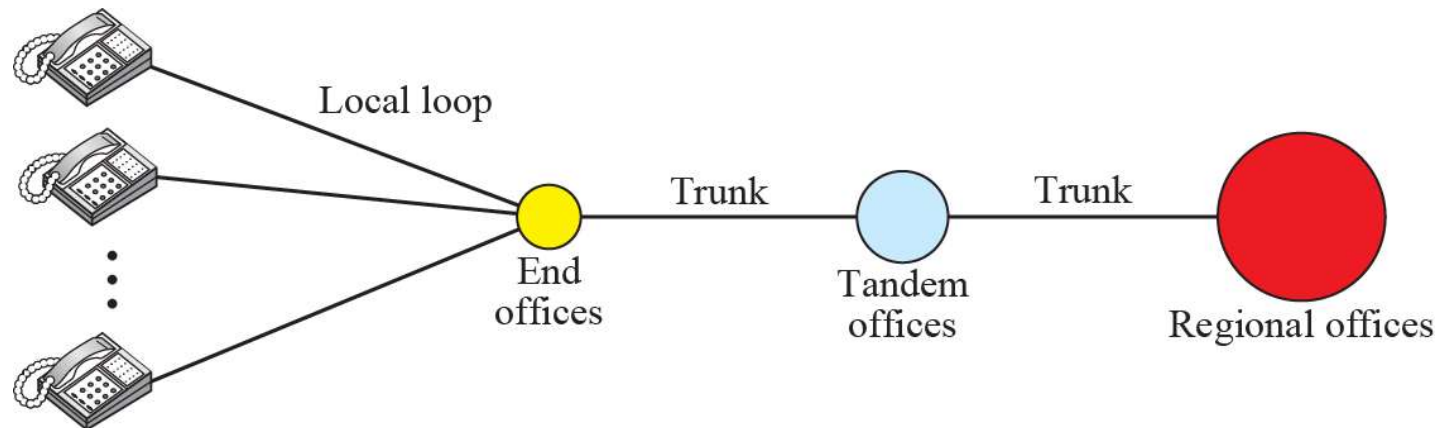

A telephone system

LATAs

- After the divestiture of 1984, the United States was divided into more than 200 local-access transport areas (LATAs). The number of LATAs has increased since then. A LATA can be a small or large metropolitan area.

- A small state may have a single LATA; a large state may have several LATAs. A LATA boundary may overlap the boundary of a state; part of a LATA can be in one state, part in another state.

Tandem (toll) offices

End offices

Local loops
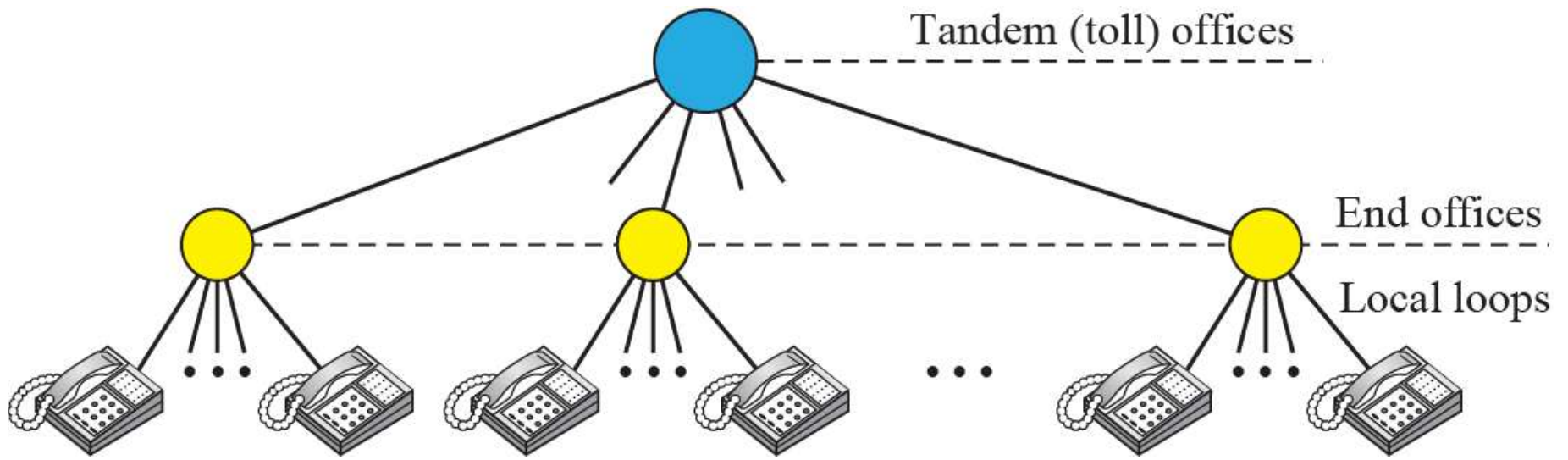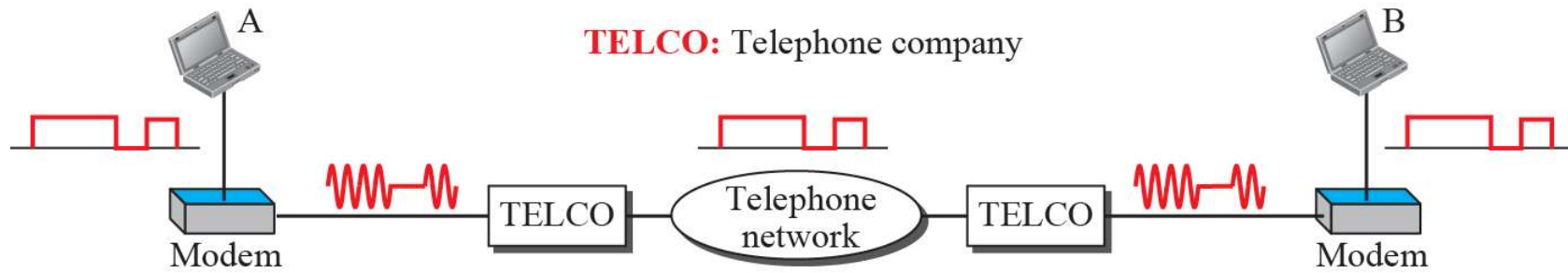
Switching offices in a LATA

14.6
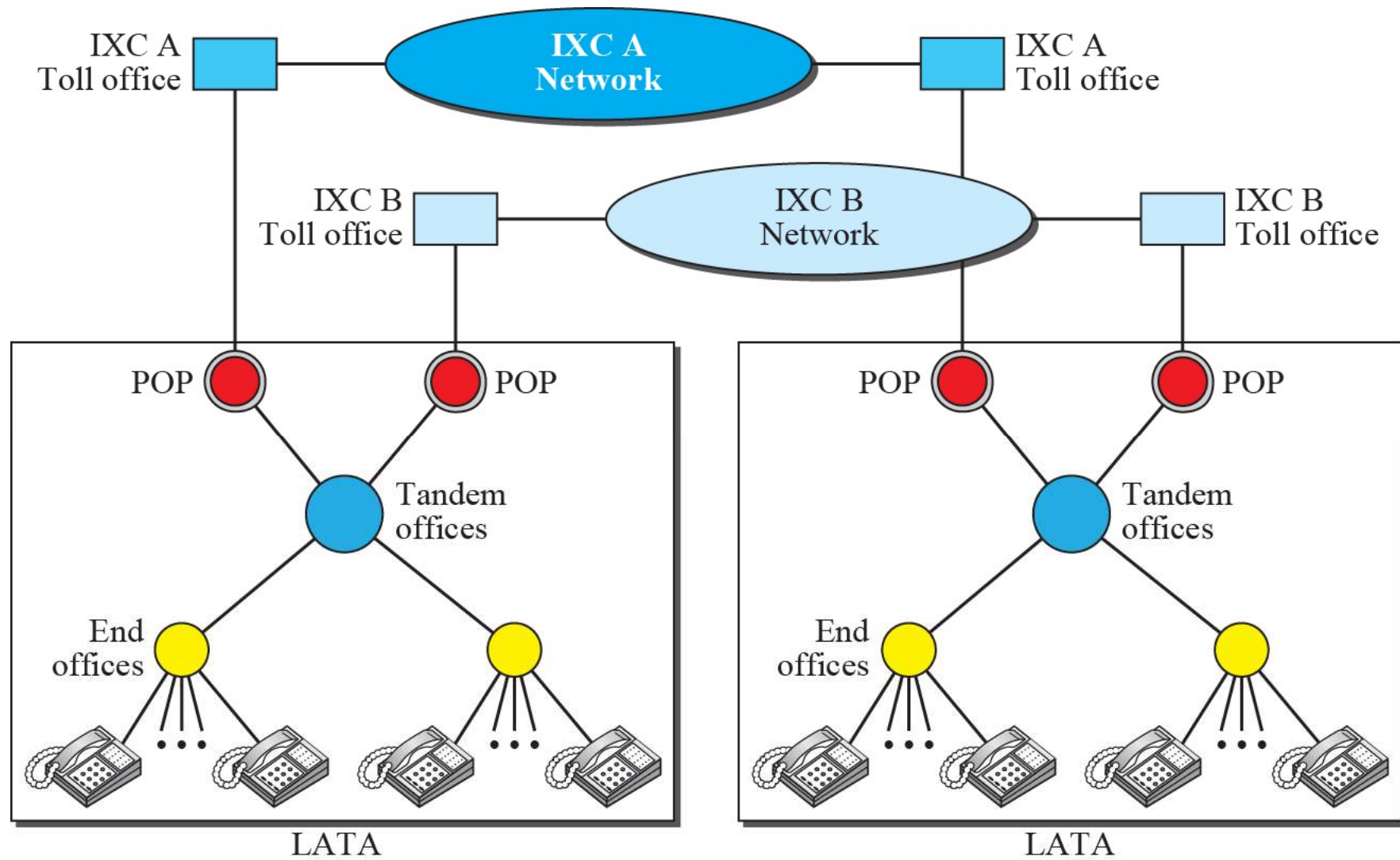
Points of presence (POPs)

Signaling

- The telephone network used a circuit-switched network with dedicated links to transfer voice communication.

- As telephone networks evolved into a complex network, the functionality of the signaling system increased.

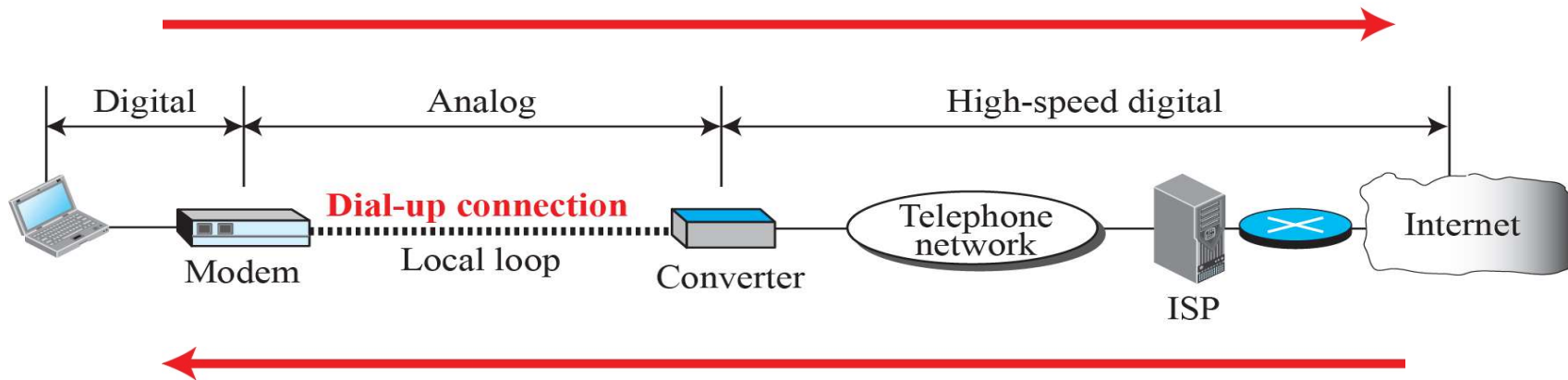- The signaling system was required to perform other tasks.

Services

- Telephone companies provide two types of services: analog and digital. Traditional telephone lines can carry frequencies between 300 and 3300 Hz, giving them a bandwidth of 3000 Hz.

- A dial-up service uses a modem to send data through telephone lines. The term modem is a composite word that refers to the two functional entities that make up the device: a signal modulator and a signal demodulator.

A

B

TELCO: Telephone company

TELCO

Telephone
network

TELCO

Modem

Modem

Modulation/demodulation

Uploading: 33.6 Kbps

Digital

Analog

High-speed digital

Dial-up connection

Local loop

Modem

Converter

Telephone
network

ISP

Internet

Downloading: 56 Kbps

Dial-up network to provide Internet access

Digital Subscriber Line (DSL)

- 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 to support high-speed digital communication over the existing telephone.

- DSL technology is a set of technologies, each differing in the first letter (ADSL, VDSL, HDSL, and SDSL).
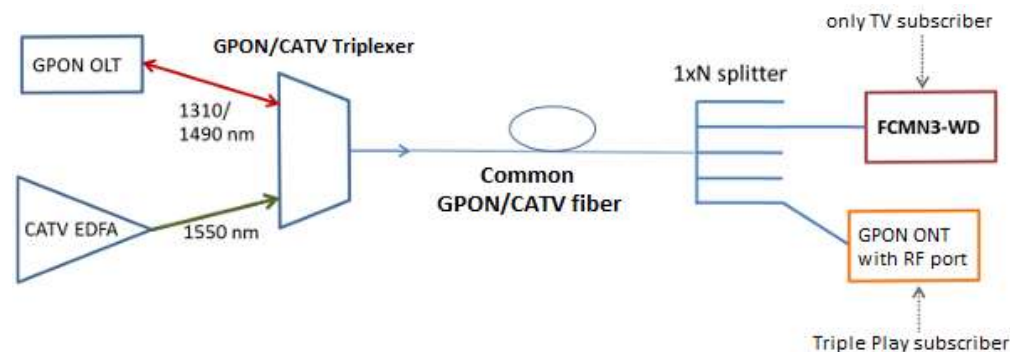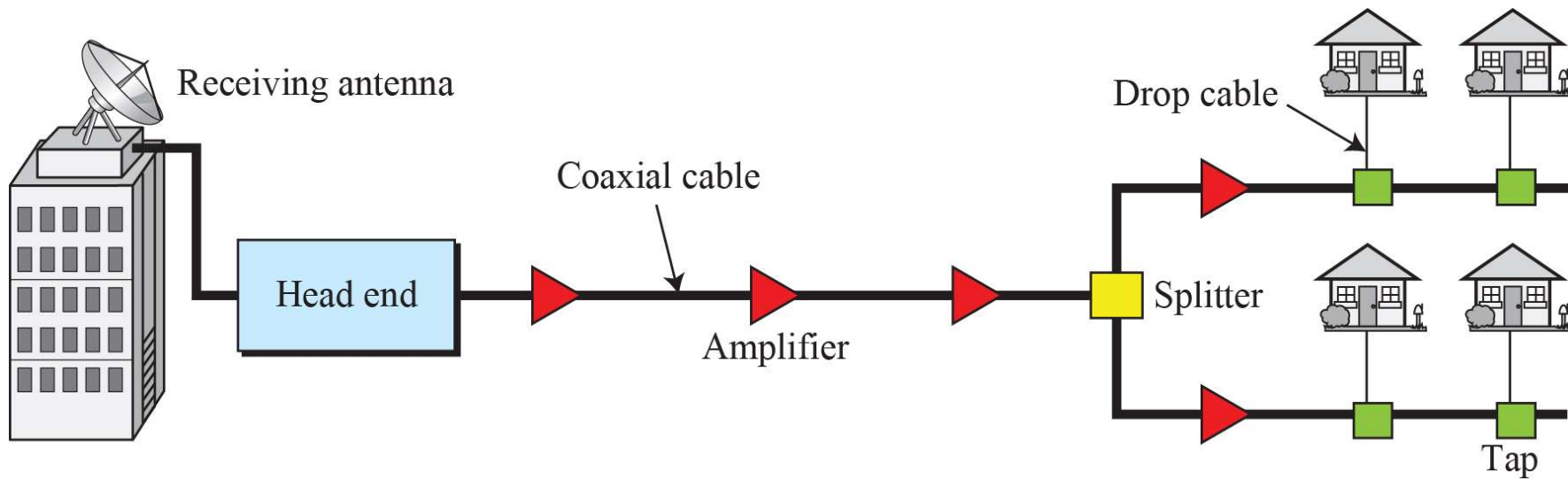
Cable Network

- The cable networks became popular with people who just wanted a better signal. In addition, cable networks enabled access to remote broadcasting stations via microwave connections.

- Cable TV also found a good market in Internet access provision, using some of the channels originally designed
for video.

Traditional Cable Networks

- Cable TV started to distribute broadcast video signals to locations with poor or no reception in the late 1940s.

- It was called community antenna television (CATV) because an antenna at the top of a tall hill or building received the signals from the TV stations and distributed them, via coaxial cables, to the community.

Traditional cable TV network

HFC Network

- The second generation of cable network is called a **hybrid fiber-coaxial (HFC)** network. The network uses a combination of fiber-optic and coaxial cable.

- The transmission medium from the cable TV office to a box, called the fiber node, is optical fiber; from the fiber node through the neighborhood and into the house is still
coaxial cable.
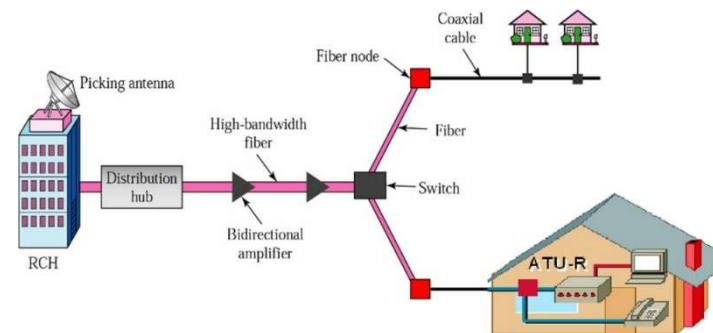
Cable TV for Data Transfer

- Cable companies are now competing with telephone companies for the residential customer who wants high-speed data transfer.

- DSL technology provides high-data-rate connections for residential subscribers over the local loop. However, DSL uses the existing unshielded twisted-pair cable, which is very susceptible to interference.

- This imposes an upper limit on the data rate. A solution is the use of the cable TV network.

14.16

SONET

- We introduce a wide area network (WAN). SONET is used as a transport network to carry loads from other WANs.

- We first discuss SONET as a protocol, and we then show how SONET can be constructed from the standards defined in the protocol.

14.17
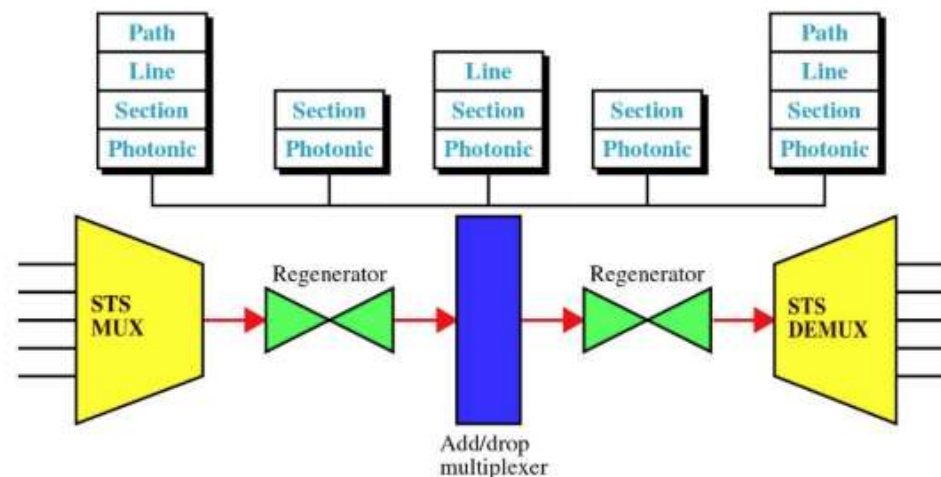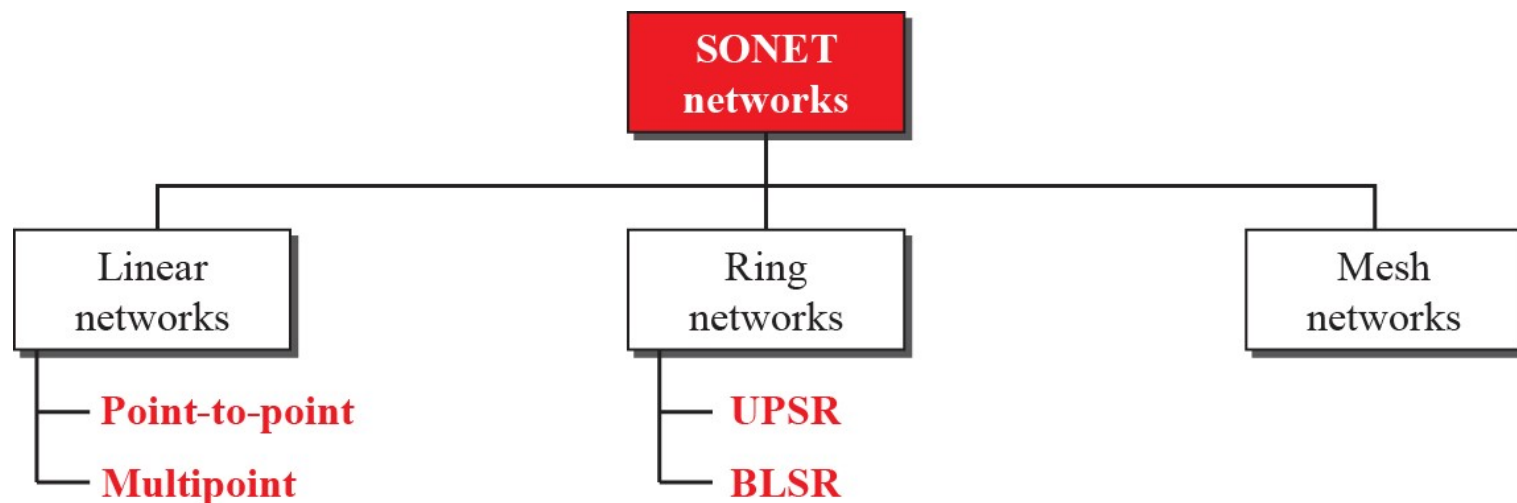
SONET Layers

- The SONET standard includes four functional layers: the photonic, the section, the line, and the path layer. They correspond to both the physical and the data-link layers .

Data link	Path layer	
	Line layer	
	Section layer	

|		
Physical	Photonic layer	
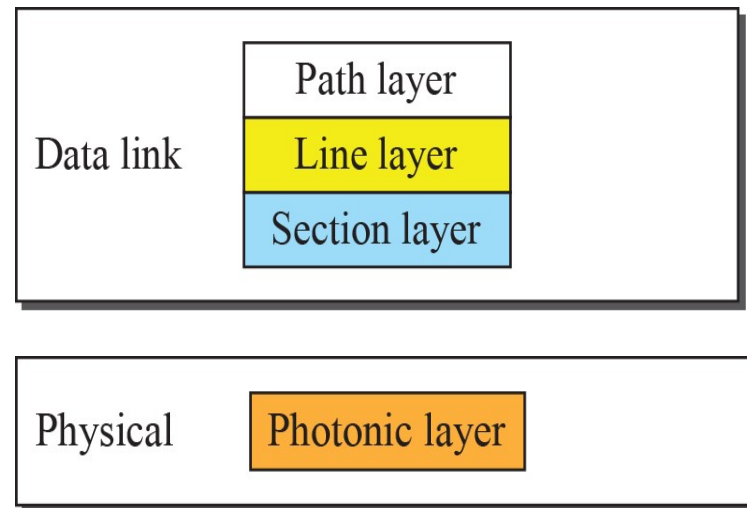
SONET layers compared with OSI or the Internet layers

SONET Networks

- Using SONET equipment, SONET can be used as a high-speed backbone carrying loads from other networks such as ATM or IP.

- SONET can be divided into three categories: linear, ring, and mesh networks.

```
                    ┌─────────────┐
                    │   SONET     │
                    │  networks   │
                    └─────────────┘
        ┌──────────────────┼──────────────────┐
  ┌──────────┐       ┌──────────┐        ┌──────────┐
  │  Linear  │       │   Ring   │        │   Mesh   │
  │ networks │       │ networks │        │ networks │
  └──────────┘       └──────────┘        └──────────┘
   ─ Point-to-point   ─ UPSR
   ─ Multipoint       ─ BLSR
```

ATM

- Asynchronous Transfer Mode (ATM) is a switched wide area network based on the cell relay protocol designed by the ATM forum and adopted by the ITU-T.

- The combination of ATM and SONET will allow high-speed interconnection of all the world's networks. In fact, ATM can be thought of as the "highway" of the information superhighway.

14.20
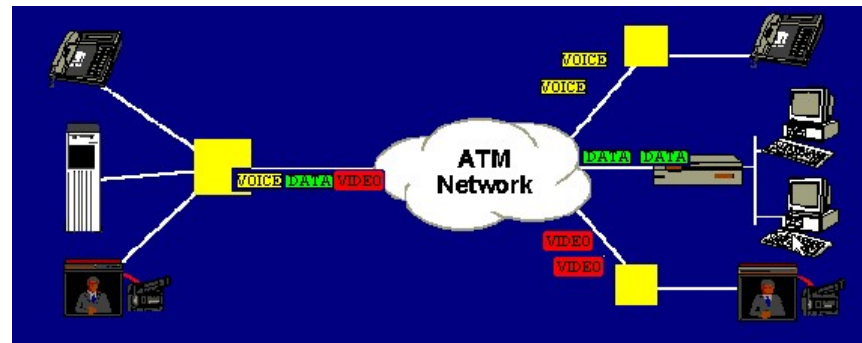
Design Goals

- Among the challenges faced by the designers of ATM, six stand out.

1. *The need for a transmission system to optimize the use of high-data-rate.*
2. *The system must interface with existing systems.*
3. *The design must be implemented inexpensively.*
4. *The new system must be able to work with and support the existing hierarchies*
5. *The new system must be connection-oriented.*
6. *Last but not least, one objective is to move as many of the functions to hardware as possible.*

Architecture

- ATM is a cell-switched network. The user devices, called the endpoints, are connected through a user-to-network interface (UNI) to the switches inside the network. The switches are connected through network-to-network interfaces (NNIs).