CSE-3215
Data Communication

Lecture-13

Ahmed Salman Tariq
Lecturer
Dept. of CSE

A digitized voice channel is made by digitizing a 4-kHz bandwidth analog voice signal. We need to sample the signal at twice the highest frequency (two samples per hertz). We assume that each sample requires 8 bits. What is the required bit rate

Solution
The bit rate can be calculated as

$$2 \times 4000 \times 8 = 64{,}000 \text{ bps} = 64 \text{ kbps}$$

What is the bit rate for full high-definition TV (FHD TV)?
(Let, 24 bits are needed for representing each pixel)

Solution

FHD TV uses digital signals to broadcast high quality video signals. The FHD TV screen is normally a ratio of 16 : 9. There are 1920 by 1080 pixels per screen, and the screen is renewed 30 times per second. Twenty-four bits represent one color pixel.

$$1920 \times 1080 \times 30 \times 24 = 1{,}492{,}992{,}000 \text{ or } 1.5 \text{ Gbps}$$

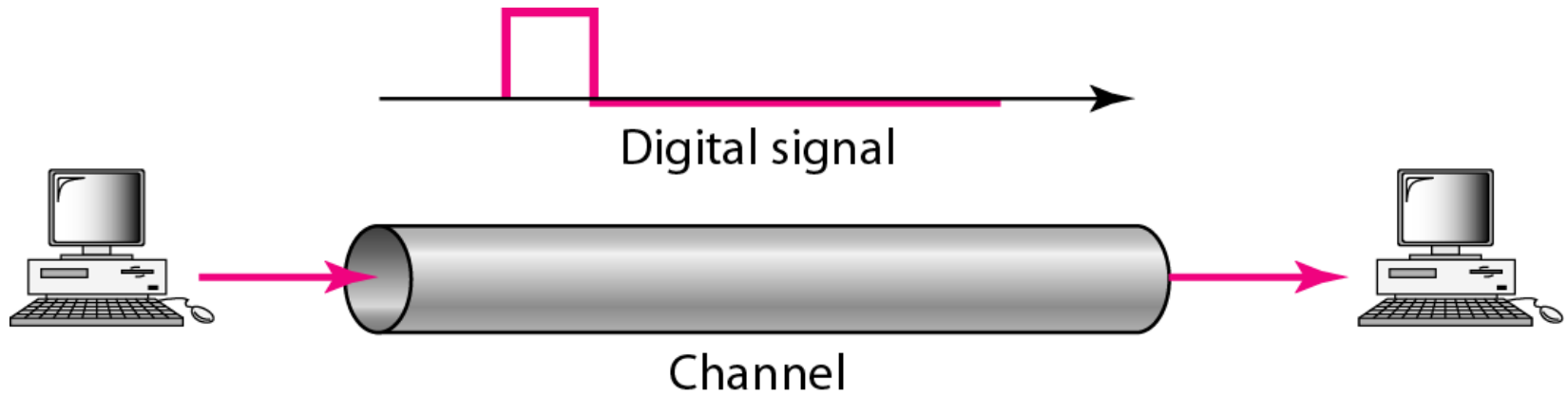The TV stations reduce this rate to 20 to 40 Mbps through compression.
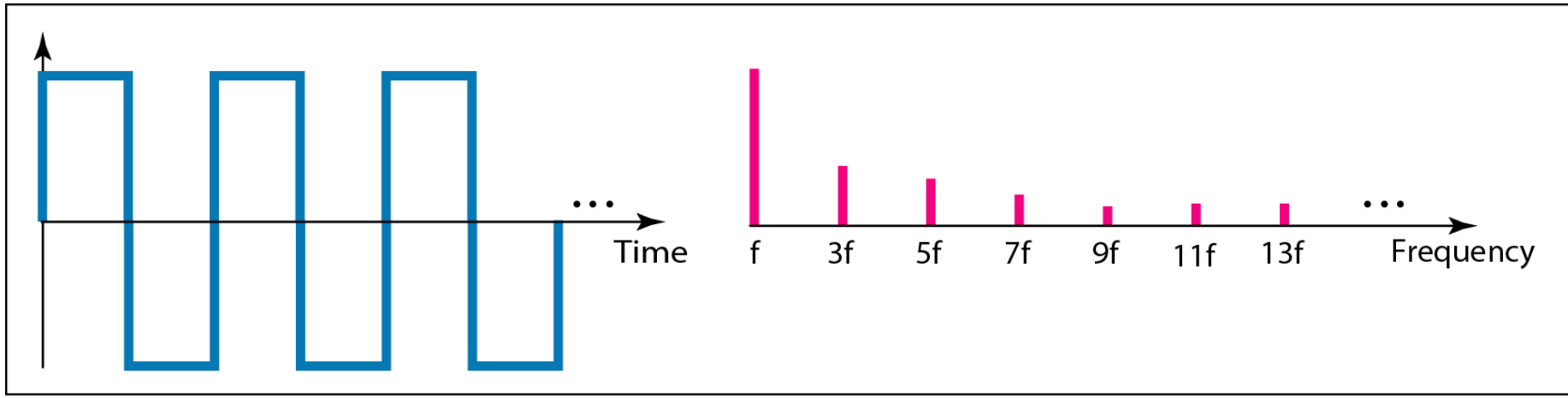
a. Time and frequency domains of periodic digital signal
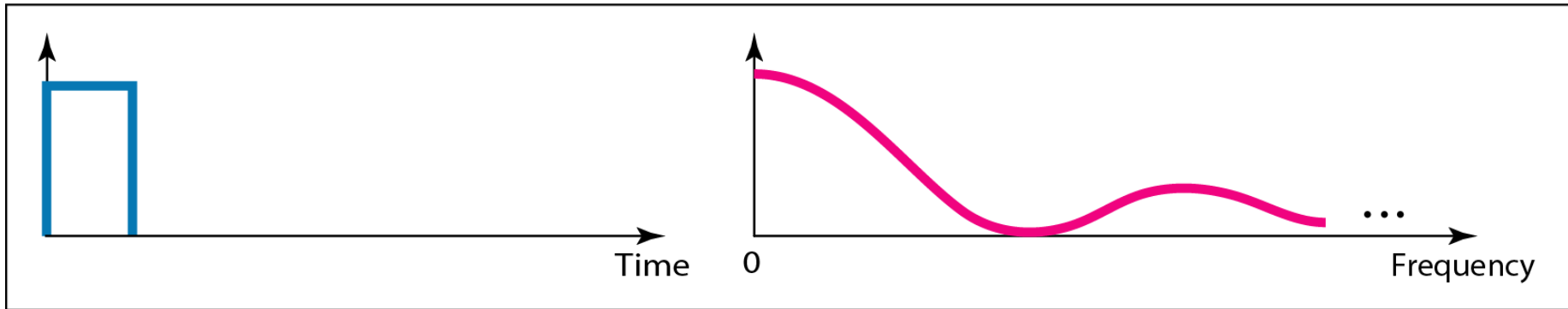
b. Time and frequency domains of nonperiodic digital signal

Figure 1: *The time and frequency domains of periodic and nonperiodic digital signals*

Digital signal

Channel

Figure 2: *Baseband transmission*

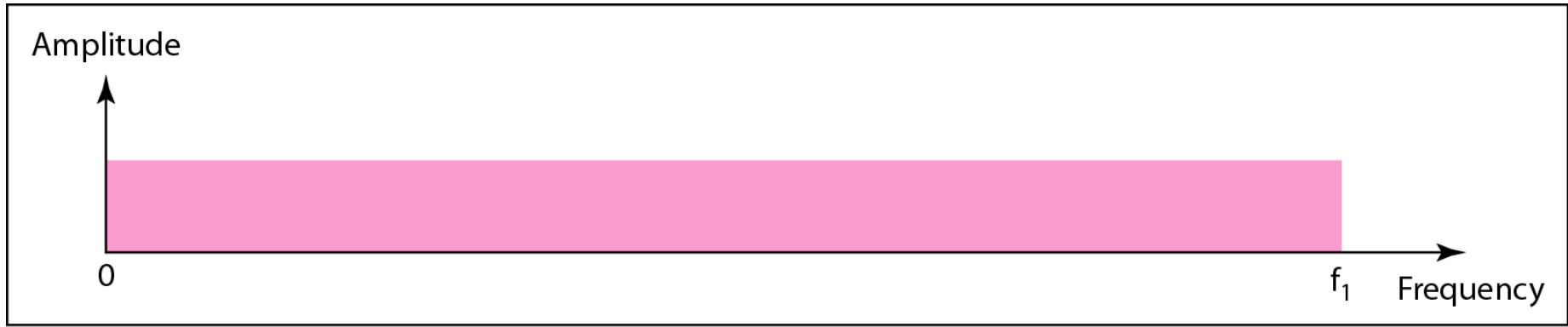| BASEBAND TRANSMISSION	BROADBAND TRANSMISSION
Baseband Transmission is a transmission technique that one signal requires the entire bandwidth of the channel to send data.	Broadband Transmission is a transmission technique that many signals with multiple frequencies transmit data through a single channel simultaneously.
Baseband Transmission uses digital signals.	Broadband Transmission uses analog signals.

Digital Signal (Baseband)

Modulated Analog Signal (Broadband)

Workstation

Modem
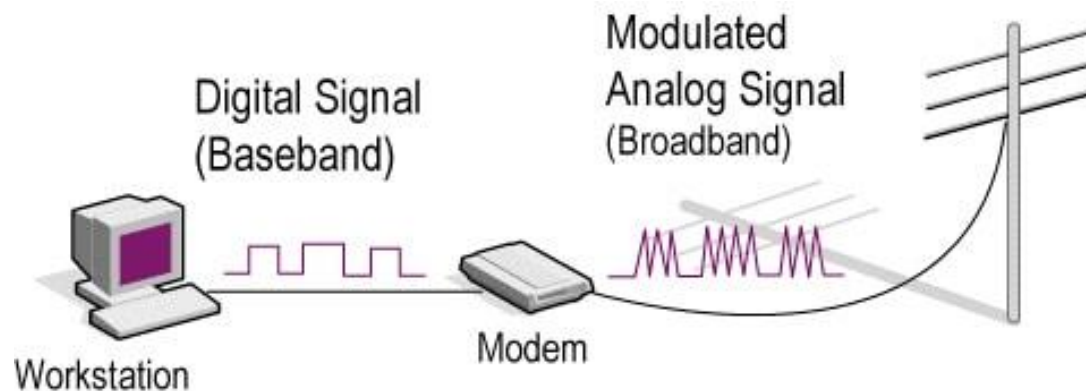
Figure 3: *Baseband and Broadband*

Note

A digital signal is a composite analog signal with an infinite bandwidth.
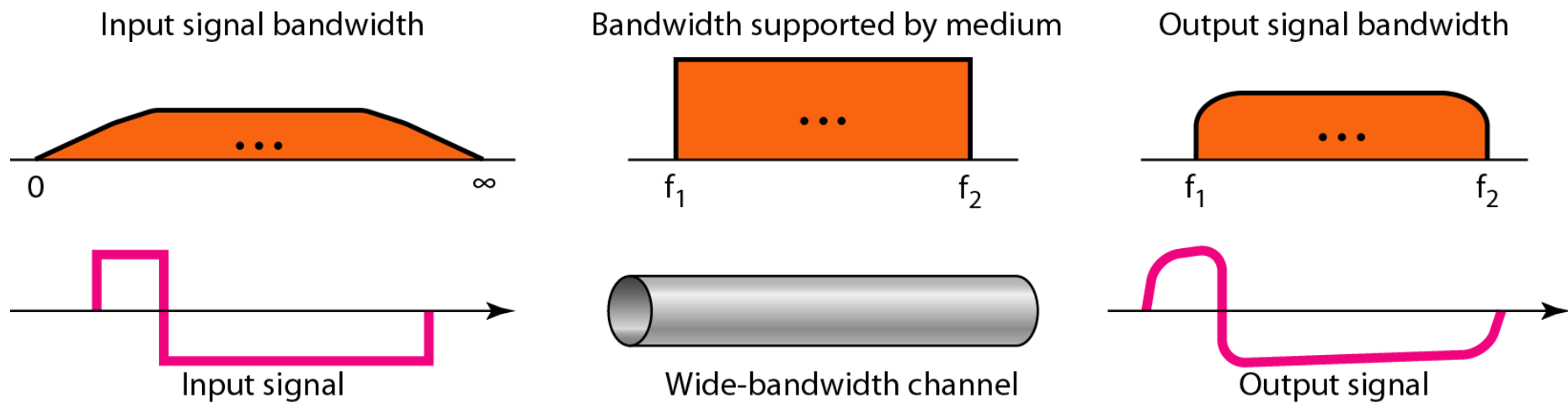
a. Low-pass channel, wide bandwidth

b. Low-pass channel, narrow bandwidth
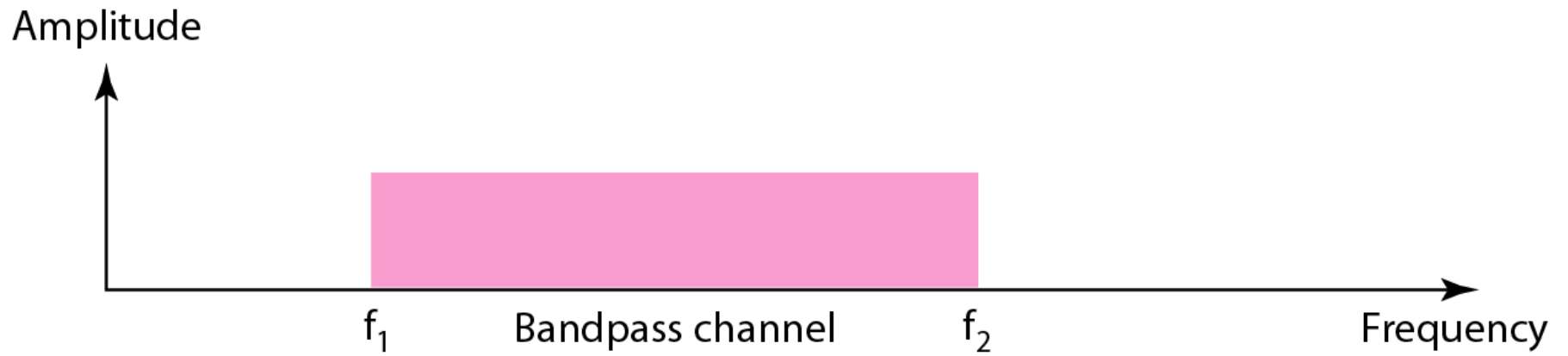
Figure 4: *Bandwidths of two low-pass channels*

**Figure 5:** *Baseband transmission using a dedicated medium*

Note

Baseband transmission of a digital signal that preserves the shape of the digital signal is possible only if we have a low-pass channel with an infinite or very wide bandwidth.

Figure 6: *Bandwidth of a bandpass channel*

Note

If the available channel is a bandpass channel, we cannot send the digital signal directly to the channel; we need to convert the digital signal to an analog signal before transmission.
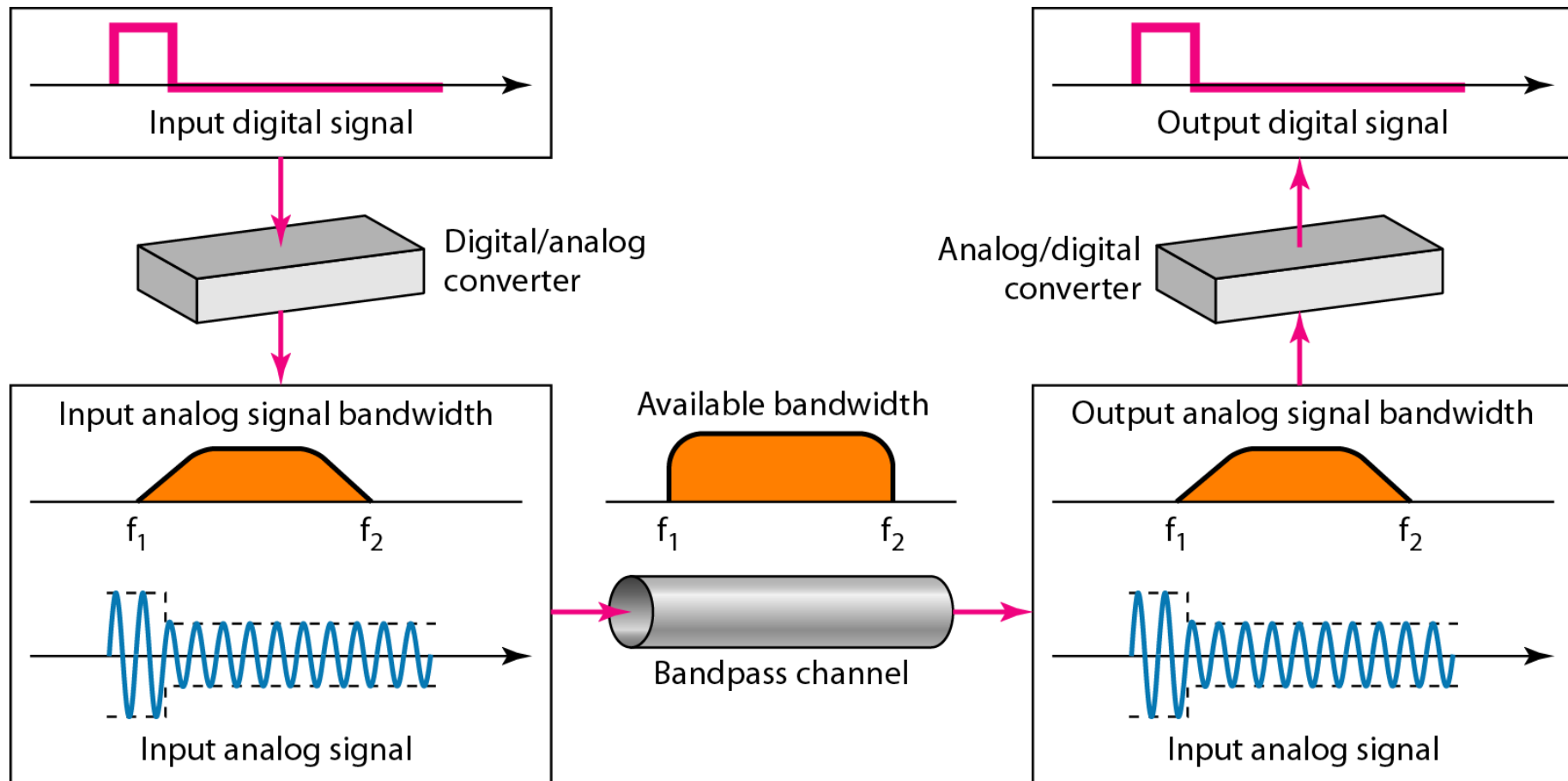
Figure 7: *Modulation of a digital signal for transmission on a bandpass channel*

An example of broadband transmission using modulation is the sending of computer data through a telephone subscriber line, the line connecting a resident to the central telephone office. These lines are designed to carry voice with a limited bandwidth. The channel is considered a bandpass channel. We convert the digital signal from the computer to an analog signal, and send the analog signal. We can install two converters to change the digital signal to analog and vice versa at the receiving end. The converter, in this case, is called a modem
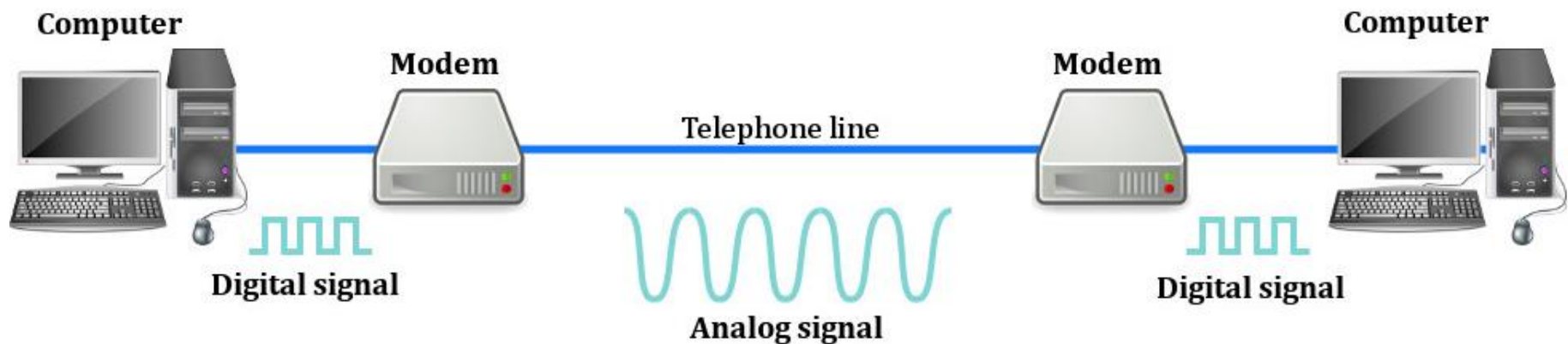
Figure 8: *Modem as A/D and D/A converter*

That's all for today

Thank You