

Sampling Theorem

Chapter 3

There are two kinds of methods which can be used for voice transmission.

- I. Analogue
- II. Digital

Waves that vary with time are called Analogue waves. When we talk or play a musical instrument we produce analogue signals. For example our voice signals are analogue. Waves that vary between two definite values are called digital signals. Both these methods can be used for signal transmission. But digital method is most widely used. Digital signal transmission is achieved by Sampling Theorem.

Sampling Theorem means taking samples of an electrical signal in a certain time period. To achieve sampling theorem the following aspects should be taken into consideration.

- I. The signal should be band limited.
- II. The sampling frequency should be equal or greater to the maximum frequency of the sound wave.
- III. After sampling, the sampled values should be transmitted through a transmission medium to a receiving end to be reproduced.
- IV. The original transmitted signal has to be reproduced at the end by low pass filtering.

As discussed earlier telephone signals are band limited signals of 0-4kHz. Therefore to achieve the second condition the sampling rate should be equal or greater than 8kHz.

$$\text{Frequency} = 1 / \text{Time Period}$$

$$\begin{aligned} \text{Sampling time period for telephone} &= 1 / 8000 \\ &= 125 \mu\text{s} \end{aligned}$$

Hence telephone signals are sampled every 125 μs .

A problem arose when using the sampling theorem practically, concerning the third aspect stated above. When some kind of information is received first it is necessary to verify whether that certain information can be true or false. For example if a newspaper says that it is snowing in Australia in mid August first you think whether it is possible or not which is very difficult to say. But if some other information say that it is snowing in USA in December the verification is very easy as we know that it is highly possible. The same thing happens in signal transmission.

Suppose that there are two robots operating two exchanges as can be seen on next page. When R1 sends some sampled signals to R2, R2 have to verify the incoming samples. In the transmission medium noise is introduced and the received sample can be different from the sent one. It is very difficult to verify the values it receives, as this can be any value between -127V to +127V. Therefore it was necessary to find a solution to make verification easier.

Figure 3.1

