2.3 PULSE CODE MODULATION:

Pulse code modulation refers a form of source coding. It is a form of digital modulation techniques in which the code refers a binary word that represent digital data.With PCM, the pulses are of fixed length and fixed amplitude.

Block Diagram of Transmitter

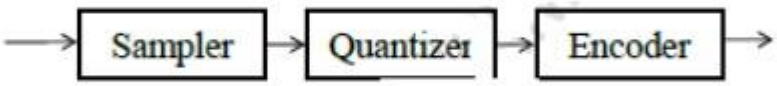

Figure 2.3.1 PCM Transmitter

Block Diagram of Receiver

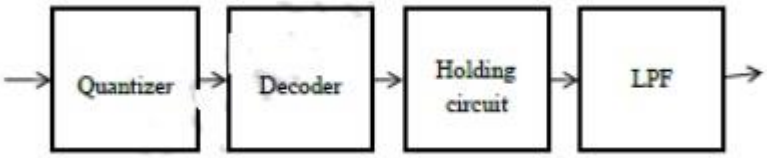

Figure 2.3.2 PCM Receiver

Pulse position modulation

The position of a carrier pulse is altered in accordance with information contained in sampled waveform.

Sampling rate

The sampling rate fs must be atleast two times the highest frequency component of the original signal to be accurately represented fs>=2fm

Baseband signal receiver.

A baseband signal receiver increases the signal to noise at the instant of sampling.

This reduces the probability of error. The baseband signal receiver is also called optimum receiver.

Matched filter.

The matched filter is a baseband signal receiver, which works in presence of white

Gaussian noise. The impulse response of the matched filter is matched to the shape of the input signal.

The impulse response of matched filter

Impulse response is given as,

$h(t) = [2k/N0]\{x1(T - t)\}$

Here T is the period of sampling x1 (t) and x2 (t) are the two signals used for transmission.

The value of maximum signal to noise ratio of the matched filter

Maximum signal to noise ratio of the matched filter is the ratio of energy of the signal to psd of white noise.

Correlator: It is the coherent receiver. It correlates the received noisy signal f (t) with the locally generated replica of the known signal x (t). Its output is given as,

$r(t) = 0\mathbf{D}T\ f(t)\ x(t)\ dt$

Matched filter and correlator are functionally same.

The advantages of QPSK as compared to BPSK

1. For the same bit error rate, the bandwidth required by QPSK Is reduced to half as compared to BPSK.

2. Because of reduced bandwidth, the information transmission rate of QPSK is higher.

3. Variation in QPSK amplitude is not much. Hence carrier power almost remains constant.

DPCM Transmitter

The DPCM Transmitter consists of Quantizer and Predictor with two summer circuits. Following is the block diagram of DPCM transmitter.

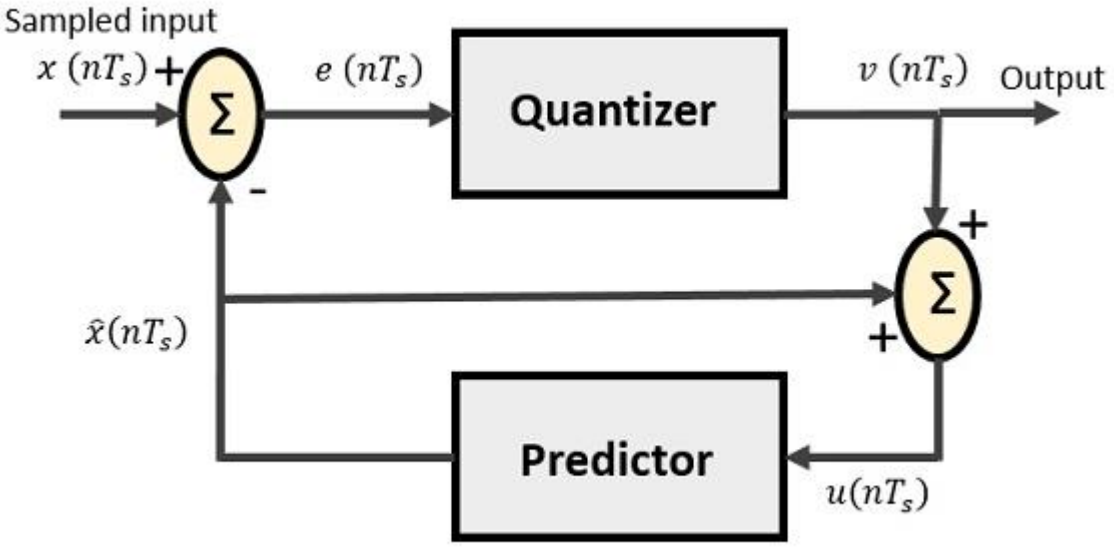

Figure 2.3.3 DPCM Transmitter

The signals at each point are named as −

- x(nTs)x(nTs) is the sampled input
- xˆ(nTs)x^(nTs) is the predicted sample
- e(nTs)e(nTs) is the difference of sampled input and predicted output, often called as prediction error
- v(nTs)v(nTs) is the quantized output
- u(nTs)u(nTs) is the predictor input which is actually the summer output of the predictor output and the quantizer output

The predictor produces the assumed samples from the previous outputs of the transmitter circuit. The input to this predictor is the quantized versions of the input signal x(nTs)x(nTs).

Quantizer Output is represented as −

$$v(nTs)=Q[e(nTs)]v(nTs)=Q[e(nTs)]$$

$$=e(nTs)+q(nTs)=e(nTs)+q(nTs)$$

Where **q (nT$_s$)** is the quantization error

Predictor input is the sum of quantizer output and predictor output,

$$u(nTs)=x\hat{}(nTs)+v(nTs)u(nTs)=x\hat{}(nTs)+v(nTs)$$

$$u(nTs)=x\hat{}(nTs)+e(nTs)+q(nTs)u(nTs)=x\hat{}(nTs)+e(nTs)+q(nTs)$$

$$u(nTs)=x(nTs)+q(nTs)u(nTs)=x(nTs)+q(nTs)$$

The same predictor circuit is used in the decoder to reconstruct the original input.

DPCM Receiver

The block diagram of DPCM Receiver consists of a decoder, a predictor, and a summer circuit. Following is the diagram of DPCM Receiver.

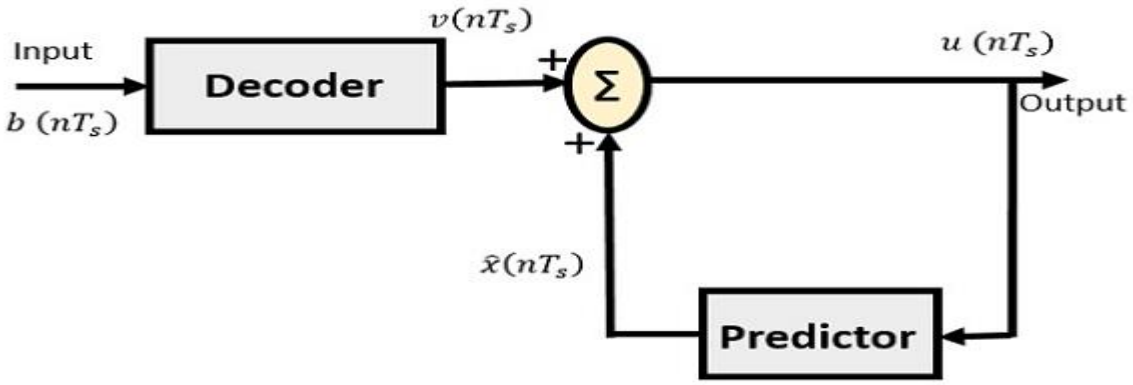

Figure 2.3.4 DPCM Receiver