RECENT ADVANCEMENTS IN DIGITAL COMMUNICATION

R.SRIRAMULU
Assistant Professor,
Department of ECE,
SCIENT INSTITUTE OF TECHNOLOGY,
Hyderabad, Telangana,[INDIA].

V.DEVENDER
Assistant Professor,
Department of ECE,
SCIENT INSTITUTE OF TECHNOLOGY,
Hyderabad, Telangana,[INDIA].

ABSTRACT: Digital communication is the physical transfer of data over Point-To-Point or Point-To-Multipoint communication channel. It is transfer of discrete messages. Digital communication plays a vital role in today's electronic world. Usage of the benefits of electrical communication has become an inseparable part of our lives now. Through this paper, I have tried to summarize various technologies that are important in the field of digital communication and have also included the recent advancements in the same field. The paper starts with the basic idea about the communication system followed by basic modulation techniques like amplitude, frequency and phase modulation. The paper then explains the analog to digital conversion techniques including the basics about sampling theorem, pulse-code modulation, quantization of signals followed by digital modulation techniques like Amplitude shift keying, Frequency shift keying, Phase shift keying, Binary Phase Shift Keying, Binary Frequency Shift keying, M-ary digital Modulation technique and Quadrature Amplitude Shift Keying . It then covers the problems of occurrence of noise and error in various modulation systems and the methods of reducing it like coding for error detection and correction.

Keywords: Modulation; pulse code modulation; delta modulation; sampling theorem; quantization; graphene modulator; underwater acoustic communication.

I INTRODUCTION

In the design of large and complex digital systems, it is often necessary to have one device communicate digital information to and from other devices. One advantage of digital information is that it tends to be far more resistant to transmitted and interpreted errors than information symbolized in an analog medium.This accounts for the clarity of digitally-encoded telephone connections, compact audio disks, and for much of the enthusiasm in the engineering community for digital communications technology. However, digital communication has its own unique pitfalls, and there are multitudes of different and incompatible ways in which it can be sent.Hopefully, this chapter will enlighten you as to the basics of digital communication,itsadvantages,disadvantages, and practical considerations.Suppose we are given the task of remotely monitoring the level of a water storage tank. Our job is to design a system to measure the level of water in the tank and send this information to a distant location so that other people may monitor it.Measuring the tank’s level is quite easy, and can be accomplished with a number of different types of instruments, such as float switches, pressure transmitters, ultrasonic level detectors, capacitance probes, strain gauges, or radar level

detectors.Information source or may be termed as input transducer is the source of information that is to be transmitted. It may have digital (telegraphic signal) information or analog (audio, video signal) information. The source encoder then provides with the efficient conversion of the output of the preceding stage into a sequence of binary digits. Channel encoder then adds the extra bits to the source encoded bits in order to cope with the noise which makes digital communication system more immune towards noise. The digital modulator then performs the task of converting the binary digits into a waveform for the purpose of transmission through the channel which may be wired/ wireless. The digital demodulator then performs the task of regenerating the previous bit pattern from the received waveform. After all of these processes are performed the channel decoder and the source decoder then works in conjunction with the channel encoder and source encoder to perform the decoding technique since the decoding technique would be the same as the encoding technique.The output signal is then converted into a desirable form by using the appropriate transducer and the output is received. Information source, source encoder, channel encoder and the digital modulator forms a part of transmitter section while digital demodulator, channel decoder, source decoder and output transducer forms a part of receiver section.

II DIGITAL COMMUNICATION TECHNIQUES

2.1 Sampling theorem

The most important role of this theorem is to convert continuous-time signal to an equivalent discrete-time signal. The theorem can be explained in two parts: First, If a signal x(t) does not contain any frequency beyond W Hz, then the signal is completely described by its instantaneous uniform samples with sampling interval of $Ts<1/(2W)$ sec. Second, the signal can be reconstructed from the set of uniform instantaneous samples by passing the samples sequentially through an ideal low-pass filter with bandwidth B, where $W \leq B < fs-W$ and $fs=1/T$.

2.2 Analog to digital conversion

Before the signal is converted into digital form, its preprocessing is required to be done since most of the A/D convertors quantizes accurately only if the signal is within specific range and most of the signals are random in nature. Only after the signal has been processed to a desired range, it can be converted into its corresponding digital form. Pulse Code Modulation is a technique that is used for the conversion. Following is the block diagram of the process in which the analog input signal is assumed to posses zero mean and suitable variance such that the signal samples at the input of the A/D convertor lie satisfactorily within acceptable signal range.

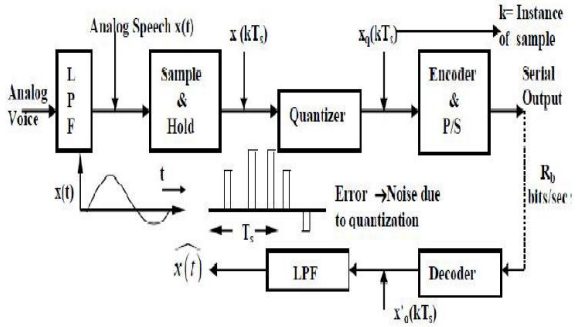

Fig 1 : *Schematic diagram of Pulse Code Modulator coder-decoder.*

Another such technique is Delta Modulation which is based on the principle that if the

signal is sampled at a rate which is much faster than Nyquist sampling rate, the adjacent samples will then have a high correlation. The sample to sample amplitude difference will be very small, so one may even think of 1-bit quantization of the difference signal.

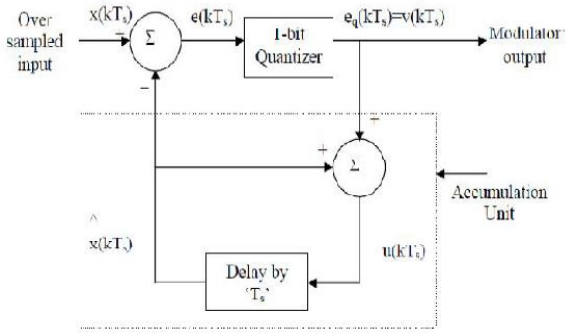

Fig 2 : *Block diagram of Delta Modulator.*

2.3 Modulation

The very basic process in any communication system is the process of modulation which is performed on the signal to be transmitted in order to enable it to acquire an acceptable form. In the analog domain, modulation refers to the process of changes in the parameters of the carrier signal with respect to the variations in the modulating signal. As per the variations in the parameters the modulation techniques are amplitude modulation, frequency modulation and phase modulation. Similarly, there are various digital modulation techniques as well such as Amplitude Shift Keying, Frequency Shift Keying and Phase Shift Keying. Amplitude Shift Keying is a process of shifting the amplitude of carrier signal between two levels depending on whether 1 or 0 is to be transmitted. Frequency Shift Keying is a process of shifting the frequency of the carrier signal between the two levels depending on whether 1 or 0 is to be transmitted and Phase Shift Keying is defined as the shifting in the phase of the carrier signal depending on whether 1 or 0 is to be transmitted. Apart from the basic techniques, other variants in the form of Binary Amplitude Shift Keying, Binary Frequency Shift Keying and Binary Phase shift Keying is also available. In these types of modulation the amplitude, frequency and phase of the carrier signal can take only two values respectively and that is why the term binary. Another variant to these modulation technique is M-ary Digital Modulation techniques which differ from the binary techniques as in binary techniques the parameters (amplitude or phase or frequency) of the carrier can take only two values while in M-ary modulation techniques the parameters(amplitude or phase or frequency) of the carrier can take M different values. Lastly, the Quadrature Amplitude Modulation technique which is a variant of amplitude modulation to conserve bandwidth in which the two message signals can be transmitted on the same bandwidth using two carriers having same frequency but separated by a phase shift of $\pi/2$.

III ADVANCEMENTS IN DIGITAL COMMUNICATIONS

3.1 Use of Graphene Modulators to upgrade the speed of Digital Communication

Researchers at the University of California, Berkeley have exhibited another innovation that could break the current speed limits in computerized correspondence. A group of specialists drove by Professor Xiang Zhang assembled a minuscule optical gadget that employments graphene, a one iota thick layer of solidified carbon, to turn light here

and there. This exchanging capacity is the essential attribute of a system modulator, which controls the speed at which information bundles are communicated. The quicker the information beats are conveyed, the more noteworthy the volume of data that can be sent. As indicated by Professor Xiang, graphene empowers us to make fantastically minimal modulators that conceivably perform at the accelerate to multiple times quicker than the current innovation. Additionally, the scientists had the option to tune the graphene electrically to retain light in frequencies utilized in information correspondence which adds another favorable position to graphene. Graphene based modulators give sped up as well as empower more noteworthy measures of information parcels and consequently "rather than broadband we will have 'extremeband', as cited by Professor Xiang.

3.2 Advances in Underwater Acoustic Communication

As of late, submerged acoustic (UWA) correspondences have gotten a lot consideration as their applications have moved from military towards business. Advanced correspondences through UWA channels vary significantly from those in other media, for example, radio channels, because of extreme sign debasement brought about by multipath spread and high fleeting and spatial changeability of the channel condition. The plan of submerged acoustic correspondence framework has until depended on the utilization of non-rational regulation strategies. Anyway to accomplish high information rates on the seriously band-constrained UWA channels, data transmission productive regulation procedures must be thought of. The new age of submerged correspondence frameworks, utilizing stage intelligible balance strategies, has the capability of accomplishing in any event a significant degree increment in information throughput. Ebb and flow research centers around advancement of effective sign preparing calculations, multiuser correspondences within the sight of impedance and structure of productive regulation and coding plans.

3.3 Developments utilizing Phase Shift Keying on High Frequency

It is hard to comprehend that genuine rational demodulation of Phase Shift Keying would ever be accomplished in any non-cabled framework since arbitrary stage changes would present uncontrolled stage ambiguities. By and by, we have the innovation to coordinate what's more, track transporter frequencies precisely; anyway following transporter stage is another issue. As an issue of common sense hence, we should return to differentially sound stage demodulation. Another commonsense issue worries that of image, or baud rate; traditional RTTY runs at 45.45 baud. This generally long image time have been supported as being impervious to HF multipath impacts and accordingly credited to its strength. Image rate additionally assumes a significant job in otherworldly inhabitance. In the event of a 45.45 baud RTTY waveform, the normal unearthly inhabitance is some 91Hz for every one of the two information tones. For a two tone Frequency Shift Keying flagging arrangement of continuous phase recurrence move keying paced at 170Hz, this framework would involve around 261Hz.

IV CONCLUSION

It may not be an exaggeration that "data highways" are considered as the basic elements of national foundation in the walk of current society. Correspondence has involved a significant piece of our lives without which data trade can't be envisioned. Despite the fact that simple correspondence framework is a lot simpler to execute however advanced correspondence framework is considered to be obviously better than its simple partner. It has picked up such an extensive amount notoriety that practically all the correspondence forms in the present period is acted in advanced area. It is substantially more invulnerable towards incorrect signs, commotion and the other wanderer signals that can possibly taint the helpful data. Discussing the past also, the as a matter of first importance the correspondence framework was likewise a computerized one which is a message framework in 1830's. Since it is so significant a framework, thorough examination is being conveyed out and different advances have likewise been designed so as to build its productivity.

REFERENCES

[1] George Kennedy, Bernard Davis, SRM Prasanna(2012), Electronic Communication System, Tata McGraw-Hill Publishing Company Limited ,pp.33-138

[2]Herbert Taub, Donald L. Schilling(1994), Principles of CommunicationSystem, Tata McGraw-Hill Publishing Company Limited

[3] S. Haykin (1988) ,Digital Communication, John Wiley & Sons

[4] Milica Stojanovic, (1996), Article in IEEE Journal of Oceanic Engineering, VOL.21, No.2, Recent Advances in High Speed Underwater Acoustic Communication.

[5] www.nano.org.uk/news/1411/

[6]http://www.sciencedirect.com/science/article/pii/

[7] nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Digi%20Comm/New_index1.html