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Universal Technique For The Fastest Communication With The Minimum Uncertainty In Losing The Information

Mukesh Monga, *Member, IEEE*

***Abstract*— Any communication system involves the transmission from source to destination and after receiving all the information or a complete signal an acknowledgment is then sent to the source by the destination itself to let the source know that it (destination) has received the signal. In this paper we examine that how we can reduce the time of acknowledgment to make the communication faster. With the help of this paper we present a method of sending an acknowledgement signal, in which the last quantum (sample) of the signal is used to compute the time of acknowledgement. The formula for the time of acknowledgment in case of a continuous time signal and a discrete time signal is also derived in the paper. This technique is applicable for analog communication, digital communication and space-communication as well.**

***Index Terms*— Time of Acknowledgment, Quantum of Signal, Minimum Uncertainty in losing the information**

1 INTRODUCTION

1.1 Motivation and Background

COMMUNICATION is the process of establishing connection or link between two points for information exchange. It is a process of transferring information from one entity to another. Communication processes are sign-mediated interactions between at least two agents which share a repertoire of signs and semiotic rules. Communication is commonly defined as "the imparting or interchange of thoughts, opinions, or information by speech, writing, or signs". Although there is such a thing as one-way communication, communication can be perceived better as a two-way process in which there is an exchange and progression of thoughts, feelings or ideas (energy) towards a mutually accepted goal or direction (information). Communication is a process whereby information is enclosed in a package and is channeled and imparted by a sender to a receiver via some medium.

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Mukesh Monga is with the Electronics and Communication Engineering Department, HMR Institute of Technology and Management, Guru Gobind Singh Indraprastha University, Delhi, India (email: averagemind15@yahoo.co.in).

The receiver then decodes the message and gives the sender a feedback. All forms of communication require a sender, a message, and a receiver. Communication requires that all parties have an area of communicative commonality.
In the 1st Information Communication Revolution, the first written communication began, with pictographs. These writings were made on stone, which were too heavy to transfer. During this era, written communication was not mobile, but nonetheless existed. In the 2nd Information Communication Revolution, writing began to appear on paper, papyrus, clay, wax, etc. Common alphabets were introduced, allowing the uniformity of language across large distances. Much later the Gutenberg printing-press was invented. Gutenberg created this printing-press after a long period of time in the 15th century. In the 3rd information communication revolution, information can now be transferred via controlled waves and electronics signals.

Acknowledgment or is an integral part of a successful communication. An acknowledgment is a signal passed between communication processes to signify acknowledgment, or receipt of response. In other words an acknowledgment signal is a signal which informs the source that message has been received successfully by the receiver.

1.2 Background and Related work

Transmitted signals may be either continuous signals or pulse signals. Acknowledgments may be continuous or pulse signals. If pulse signaling is used, a signal may be repeated until it is acknowledged. When continuous signaling is used, signal is sent until the acknowledgement is received and the acknowledgment signal persists until the original has been removed. The present communication engineering involves the release of acknowledgment signal only when, all the information sent by the source is received successfully by the receiver. That means a receiver is committed to send an acknowledgment signal to the source if and only if all the information is received by the receiver. In other words we can say that receiver will not send the acknowledgment signal to the source if some part of the signal that is information is yet to be received. In this paper we aim at optimizing the mechanism of acknowledgment. In our modified technique of acknowledgment we have reduced the time of

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acknowledgment by sending the acknowledgment signal when only one quantum of signal is left.

2 Preliminaries

In the most fundamental sense, communication involves the transmission of information from one point to another through the succession of process which is as follows:

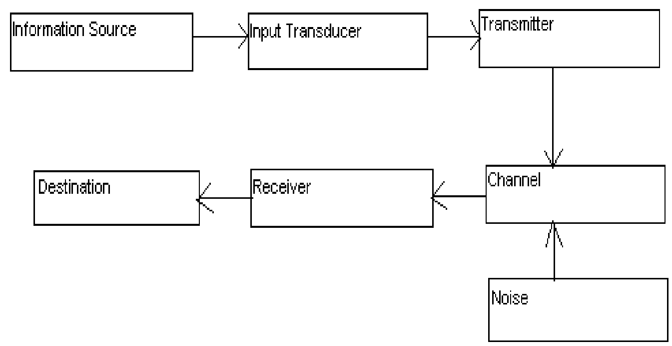

Fig 1 Basic communication system

Any process that generates successive messages can be considered a source of information. A transducer is a device that converts one type of energy to another. The conversion can be to/from electrical, electro-mechanical, electromagnetic, photonic, photovoltaic or any other form of energy. A transmitter is a device that transmits the signal to the receiver via a specified channel. A receiver is used to receive the signal. And the signal is further sent to the destination. Noise is anything that interferes with a message being transmitted from a sender to a receiver. It results from both internal and external factors.

2.1 Classification of signals

2.1.1 Analog Signals

Analog signals are continuous electrical signals that vary in time as shown in following figure. Most of the time, the variations follow that of the non-electric (original) signal. Therefore, the two are analogous hence the name analog.

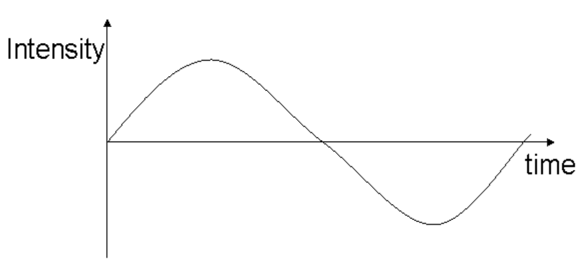

Fig 2 Analog Signal

Not all analog signals vary as smoothly as the waveform shown in Figure 4a. Analog signals represent some physical quantity and they are a 'MODEL' of the real quantity.

Example:

Telephone voice signal is analog. The intensity of the voice causes electric current variations. At the receiving end, the signal is reproduced in the same proportion. Hence the electric current is a 'MODEL' but not one's voice since it is an electrical representation or analog of one's voice.

2.1.2 Digital Signals

In computer architecture and other digital systems, a waveform that switches between two voltage levels representing the two states of a Boolean value (0 and 1) is referred to as a digital signal, even though it is an analog voltage waveform, since it is interpreted in terms of only two levels. Digital signals are non-continuous, they change in individual steps. They consist of pulses or digits with discrete levels or values. The value of each pulse is constant, but there is an abrupt change from one digit to the next. Digital signals have two amplitude levels called nodes. The value of which are specified as one of two possibilities such as 1 or 0, HIGH or LOW, TRUE or FALSE and so on. In reality, the values are anywhere within specific ranges and we define values within a given range.

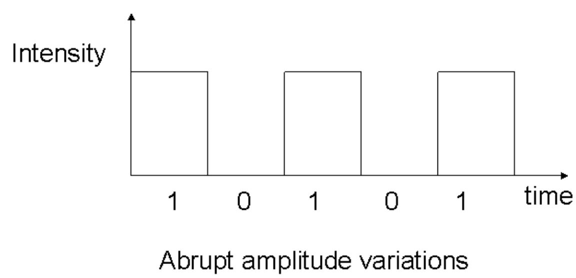

Fig 3 Digital Signal

2.1.3 Parts of a Wave

Picture of Wave

We will be considering the parts of a wave with the wave represented as a transverse wave as in the following diagram:

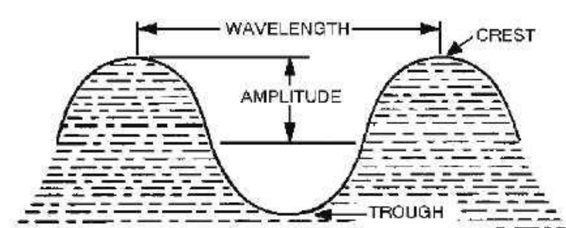

Fig 4 Wave

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The above figure is a cross section diagram of waves viewed from the side. The waves are a succession of crests and troughs. The wavelength (one 360 degree cycle) is the distance from the crest of one wave to the crest of the next, or between any two similar points on adjacent waves. The amplitude of a transverse wave is half the distance measured vertically from the crest to the trough. Water waves are known as transverse waves because the motion of the water is up and down, or at right angles to the direction in which the waves are traveling. Radio waves, light waves, and heat waves are examples of transverse waves.

Wavelength

The wavelength of a wave is the distance between any two adjacent corresponding locations on the wave train. This distance is usually measured in one of three ways: crest to next crest, trough to next trough, or from the start of a wave cycle to the next starting point. This is shown in the following diagram:

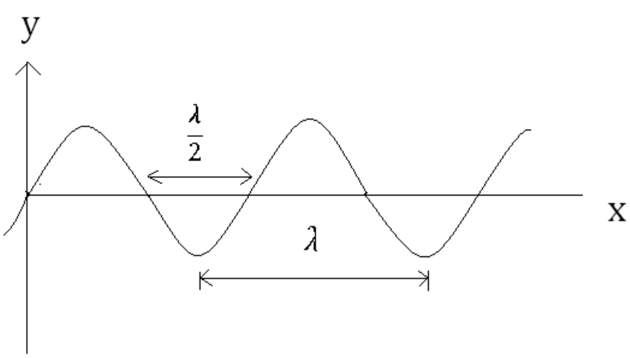

Fig 5 Sine wave

Wavelength of a sine wave, λ, can be measured between any two points with the same phase, such as between crests, or troughs, or corresponding zero crossings as shown.

Actually, the wavelength exists between any point on a wave and the corresponding point on the next wave in the wave train. A few of such distances are shown below:

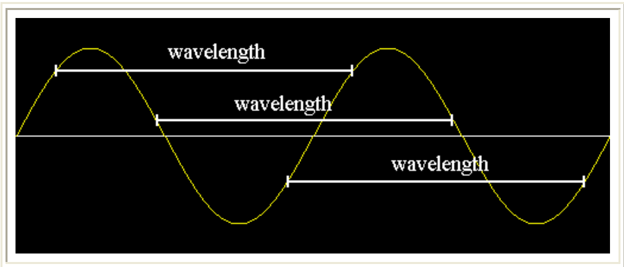

Fig 6 Wavelength

Frequency

Frequency refers to how many waves are made per time interval. This is usually described as how many waves are made per second, or as cycles per` second.

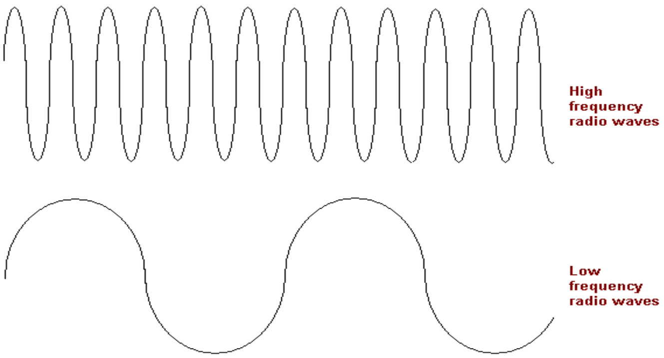

Fig 7 Frequency

1 cps = 1 Hertz

The unit Hertz is abbreviated this way:

1 Hertz = 1 Hz

3 Theory

3.1 Reduction in time of acknowledgment

The receiver in information theory is the receiving end of a communication channel. It receives decoded messages/information decoded messages from the sender, who first encoded them. Sometimes the receiver is modeled so as to include the decoder. Any standard receiver has the capability of receiving a signal. Generally a receiver takes time to receive the complete signal. Sometimes it happens that only some part of the signal is received while the remaining part is not received or rejected by the receiver. At the instant the receiver receives the signal completely, it then sends an acknowledgement to the source to let it know that it (receiver) has received the complete signal and source can send the next signal now. But now the time of acknowledgement is reduced. In this technique the receiver or an external circuit sends the acknowledgement to the source when only one quantum of the signal is left.

We have considered only one quantum of the information or signal because it gives the minimum uncertainty in losing the information.

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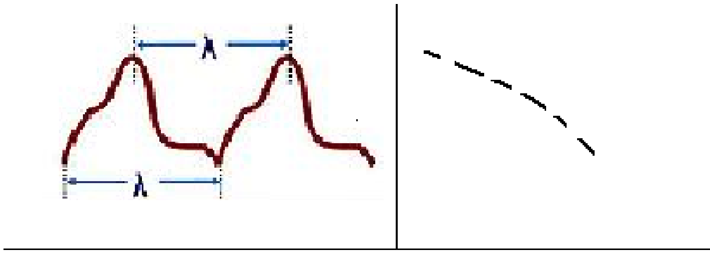

Fig 8 Wave as a Signal

The above figure best describes the analogy of reception of a signal by the receiver. On the left hand side, a wave of length λ is shown and the middle axis represents the barrier of the receiver. Received signal is shown on the right hand side of the barrier of the receiver in order to understand the quantum by quantum reception of a continuous time signal.

Here we have assumed that the acknowledgement is sent to the source when only one quantum of the signal (last sample) is left to be received. This means that when the last quantum of the signal or wave knocks the edge of the barrier of the receiver then at that point of time the acknowledgement is sent to the receiver. Now the source sends the next signal by receiving only one quantum (the first quantum) of the acknowledgement signal. Hence time of acknowledgement is reduced to great extent.

Let the instant of time at which the acknowledgement is sent to the source be $T_{K^{th}}$.

Time of acknowledgment is given by the following relationship.

$$\int_0^k dt_k = \int_0^n dt_n - \int_0^{\frac{\lambda_s}{N_s}} \frac{d\lambda}{c} \qquad (1)$$

$$\int_0^k dt_k = \int_0^n dt_n - \frac{1}{c} \int_0^{\frac{\lambda_s}{N_s}} d\lambda \qquad (2)$$

On solving the integrals and by applying the limits, we get,

$$T_{K^{th}} = T_{N^{th}} - \frac{\lambda_s}{N_s\, C} \qquad (3)$$

Where,

$T_{K^{th}}$ = Time of acknowledgement

$T_{N^{th}}$ = Instant of time at which the signal is Received completely

λ_s = Wavelength of the signal

N_s = Total no of quantums in the signal

C = Speed of light

3.2 Validity of the above technique in the digital communication engineering

Data transmission, digital transmission or digital communications is the physical transfer of data (a digital bit stream) over a point-to-point or point-to-multipoint transmission medium. Examples of such media are copper wires, optical fibers, wireless communication media, and storage media. The data is often represented as an electro-magnetic signal, such as an electrical voltage signal, a radio wave or microwave signal or an infra-red signal. For some applications we do need to convert an analog signal into digital signal. With the help of sampling and quantization, an analog signal can be converted into a digital signal. We know that after sampling we get the sampled signal. So the same technique can be applied to the digital communication as well.

Case 1: When the digital pulse is sampled

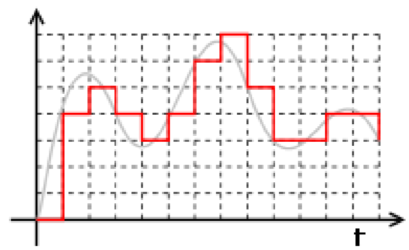

Fig 9 Digital signal (sampled, quantized): discrete time, discrete values

Let us consider that we have' N 'number of samples of a digital pulse and each sample has a width equal to'τ'. We know that signal is defined at the specified time instants only. So we can consider 'τ' as the quantum of the sampled signal. In this case the acknowledgement is sent to the source when the time equal to $\frac{\tau}{c}$ is left for the signal to be received completely. So the formula for the time of acknowledgement can be given by the following relation:

$$T_{K^{th}} = T_{N^{th}} - \frac{\tau}{C} \qquad (4)$$

Where, τ = width of a quantum or sample of the signal

Case 2: When the digital pulse is not sampled

Let us consider a digital pulse which is not sampled. So we can say that a bit is transferred as pulse and this pulse is continuous over a specified interval of time. If the width of a complete pulse is equal to 'τ'then a set of $d\tau$ completely represents the signal. Then in this case the acknowledgment is sent to the source when the time equal to $\frac{\tau}{c}$ is left for the signal to be received completely. So the time of acknowledgement can be given by the following relationship:

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$$\int_0^k dt_k = \int_0^n dt_n - \int_0^{\frac{\lambda_S}{N_S}} \frac{d\tau}{c} \qquad (5)$$

$$\int_0^k dt_k = \int_0^n dt_n - \frac{1}{c} \int_0^{\frac{\lambda_S}{N_S}} d\,\tau \qquad (6)$$

$$T_{K^{th}} = T_{N^{th}} - \frac{\tau_s}{N_s\, C} \qquad (7)$$

Where, τ_s = width of the pulse

4 CONCLUSION

It is hence concluded that with the application of the above derived results, a significant reduction in the time of acknowledgement can be achieved. This method of acknowledgement makes the communication faster. This technique is universal in nature because it can be applied to any kind of communication.

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