MODEL TRANSMISSION LINE CAPACITY MEASUREMENT SYSTEM EFFECT DUE TO SIGNAL AND NOISE LEVEL DIGITAL COMMUNICATION SYSTEM

Hafsah Nirwana, Nuraeni Umar[1)]
1) Education Staf at Politeknik Negeri Ujung Pandang

Abstract : This study was made to clarify the understanding of the concept of a channel or channel capacity issues in digital communication systems. According to the theory that the channel capacity is affected by the level of information signal and noise or disturbance. Measuring instruments that had been used only measures signal strength regardless of size or width of transmission line or how much external noise on the channel and signal level. In connection with this it should be there is a technique for measuring the capacity of the channel to be used for digital communication system taking into account the parameters used and the level of signal noise that occurs in the transmission line.
The study is in the form of a model to measure the capacity of the channel under the influence of signal and noise levels. This method is a prototype both hardware and software support, which can measure the channel capacity with different parameters with optimal levels of reliability. The results of this study consists of modules for a variety of parameters such as signal and noise levels. The benefits of this research will provide information on the amount of channel capacity digital communication systems due to the signal level information, Bandwidth, SNR (Signal to Noise) and BER (bit error rate).

Keywords: channel capacity, signal level, Signal to Noise, Bit Error Rate

I. INTRODUCTION

One requirement that telecommunications system that serves to distribute media information signal. Media can be onwire and wireless, both media called channels or channel transmission. Analog or digital information signal transmitted through an appropriate transmission medium. Specifically related to digital signal transmission and signal charge can only be transmitted only at a certain distance before attenuation, noise, and interference (noise) that jeopardize data integration. In a communication system, the received signal may not correspond to the signals sent it is probably caused by the presence of transmission impairments commonly called noise.
In digital communication systems disruptions resulted bit error occurs [1], it is known as the Shannon theory. But according to Nyquist theory that affect the process of sending the signal level. In digital communication systems, each character data / information transmitted is encoded in a variety of signal levels, such as 4-bit, 7-bit, 8 bit or 16 bit and even 32 bit.

In the process of data transmission there are many disorders that can disrupt and destroy the signal. For digital data, the question will arise at the level of what these disorders are able to limit the data rate to be achieved. In connection with the matter, the maximum speed is limited transmission line data is allowed through the channel, the condition is known as channel capacity (Channel capasity). Channel capacity is affected by the signal level and SNR (signal to noise).

Conditions of channel capacity due to both parameters is obvious in theory Niquist and Shannon, but the problem is how to measure the capacity of the channel due to both parameters on network conditions and similar data. It is very important in building a digital communication system. With this measure is therefore before building a digital communication system will be designed in a variety of circumstances in advance so that the digital system will work optimally. To facilitate understanding of the measure is constructed in the form of simulation models for a variety of circumstances, ie the signal level, Bandwidth, SNR and BER (bit error rate).

The main purpose is of research capacity transmission line measurement tool specifically for digital communications. This is due to the development of the telecommunications system used by digital communications systems. The parameters that influence the quality of an information signal is the noise level, the signal generated by a digital communication system. In addition this tool can also be useful as props to the student when giving lectures on Digital Communication Systems, as long as the student understands the material is difficult because the little nuances of the virtual world. With this tool the learning process will be better because dipersentasikan realistically.

1.1 Information Theory

The theory of information about the signals in communications systems more emphasis on processing a given signal. This theory is useful in analyzing the signals, but does not provide a clear specification of what is meant by information. The theory of information handling 3 basic concepts, namely the size of the source of information, the information capacity of a channel and coding, which is associated in a statement as follows: If the speed of information sources does not exceed the capacity of a channel of communication, there is a coding technique such that the information can be sent over the channel with a very small error, even with the presence of noise.
The process of digital communication systems is as simple as in Figure 1 below.

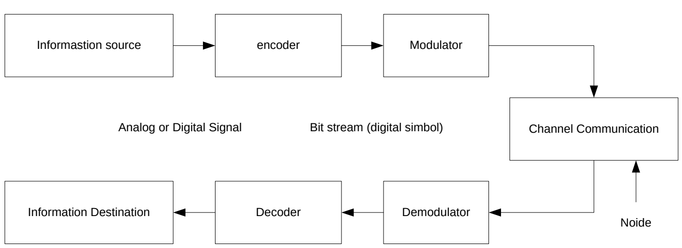

Figure 1. Digital Communication Systems

In a digital communication system, the message issued by the source is generally converted into another form more efficient. The process is done in the source encoder, which information from a source is converted into an efficient binary row by the number of binary digits used are as little as possible. Channel used is basically a channel continuous wave (analog channel).
This channel can not directly transmit binary digits of the source row. It required a device to convert digital information into information in the waveform corresponding to the characteristics of the channel used. The device is called a modulator, which is part of the channel coding. And it is understood that the speed of information sources can not exceed the capacity of the channel.
In general, there is no ideal. All channels can have a frequency response characteristic which is not ideal. And again, the noise and interference will damage signaling information. Examples are thermal noise in communications devices and crosstalk (interference) from the adjacent canal. Disturbances will
result in an error (error) in the received signal.

1.2 Channels of Communication

Elements of communication systems (digital binary) can be divided into three main parts: a transmitter, receiver, and a physical channel. The term understanding and communication channel has different characteristics, depending on the termination and function.

In Distrit channel, the transmitted signal is a discrete signal therein. Channel coding received a series of symbols on its input and produces a series of symbols on the output. Part of the continuous channel called channel modulation, where the wave form wave analog signal, such as telephone systems, high frequency radio system. Signal transmitted through this channel get some interference caused by the channel characteristics are not linear. Channel also weaken the signal amplitude attenuation. In addition, the noise also cause damage to the signal. All of these effects result in the difference between the signals sent and received, so it tends to cause errors in data transmission.

Shannon stated that transmitting information without errors on the communication channel-noise high-speed information can be obtained for R=C, wherein C is the capacity of the canal. Continuous channel model is most commonly known is the AWGN channel (white2 additive gaussian noise), which is defined to have the following properties:

1. Channels provide error-free tansmisi the bandwidth B, by providing reinforcement to handle the transmission losses.
2. Limit the input channel from the source as a limited tape signal x (t) with
   average power S.
3. The signal received at the destination by the sum contaminated with gaussian white noise n (t) with bandwidth B, and the noise power N = CB, where ç is the noise power spectral density.
4. Signal and noise are independent, so that r (t) = x (t) + n (t) and
   r2 (t) = x2 (t) + n2 (t) = S + N

Modeling AWGN channel is shown in figure 3 below:

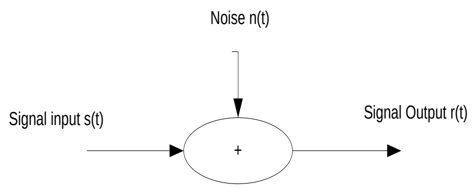

Figure 3. AWGN channel

Channel capacity can be formulated as follows:

$$Cs = B \log 2 (1 + S / N) \text{ bps.}$$

The equation is known as the Shannon-Hartley Law.
Note: The white noise is the noise power spectral density evenly on all frequency components.

1.3 Nyquist Bandwidth

According to Nyquist to measure the capacity of the channel or channels in digital communications systems that only take into account the width of the channel (bandwidth denoted B) and data (date rate) and does not account for noise or disturbance. The formula for this problem, stating that if the speed of signal transmission is 2B, then a signal with a frequency greater than B is not sufficient to produce a velocity signal. The converse is also true: a certain amount of bandwidth B then teringgi rate that can be generated is equal to 2B. This limitation is due to interference effects intersimbol distortions such as those caused by the delay. When the signals are transmitted in the form of binary (level 2) max data rate that can be supported by Bandwidth is 2B bps. Thus the channel capacity according to Nyquist signaling mulilevel as follows:

$$Cn = 2B\log 2M \text{ bps}$$

(Where: M = the signal level; B = Bandwidth)

Thus the amount of channel capacity in a digital communication system can be measured by the second formula above.

2. METHODS

The study was planned to create engineering models measuring channel capacity digital communication system, which is caused by the signal level and noise or disturbance. The results will provide a basis for designing a digital communication system in terms of the channel capacity. As for the design or implementation of the research design as follows:

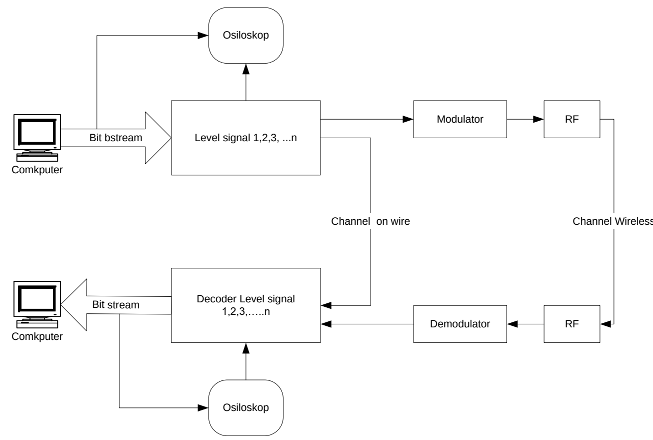

Figure 4. Model Line Capacity Measurement Techniques

The system consists of two parts, namely the sender and receiver. At the sender consists of parts; computer, forming signals, modulator and RF radio transmitter. At the receiver consists of parts; computers, signal decoder, demodulator and RF radio receiver.

3. RESULTS

3.1 Model digital signal

Design of signal generator created 2 forms in the form of hardware and software. The results obtained are as follows:

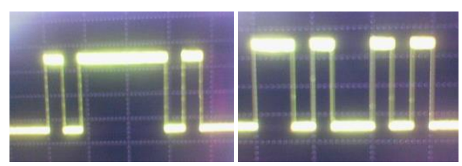

Figure 5.
The results of testing the digital signal generator (00101111010001101001010)

Figure 6.
The results of testing the digital signal generator (0110100101001011101001)

3.2 Model Digital signal level

Modules for digital signal level model drancang to 3 bytes or 24 bits with the same hardware module above. Signal level is only reached level 3 course is for n=1, n=2 and n=3, where n is juml; ah bit / segment. So that the signal level dihasil also three levels (symbol signal level M, where M = 2n). Model simulations done using the program Deplhi version 7. The results of the modeling as follows.

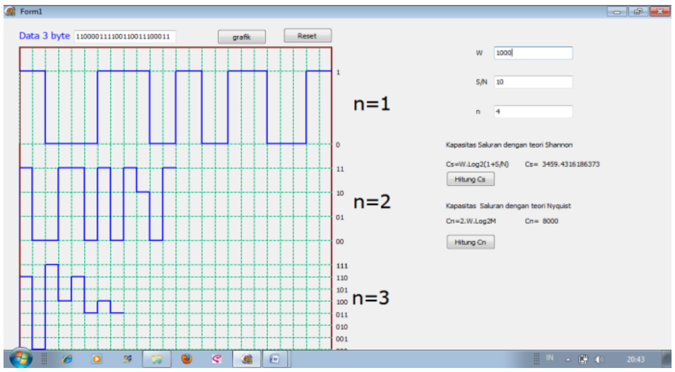

Figure 7. Results from Pilot Module Signal Level and Channel Capacity (110000111100110011100011)

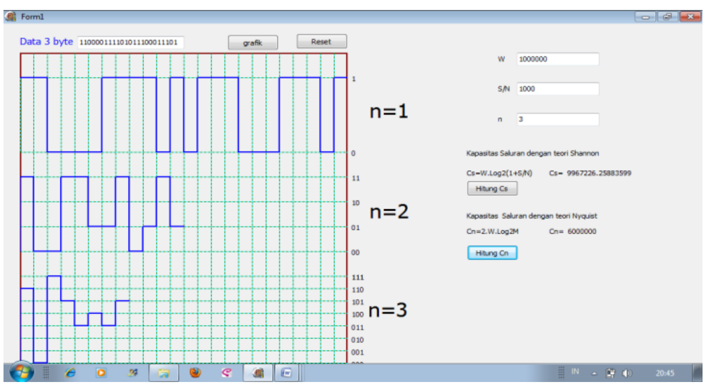

Figure 8. Results from Pilot Module and Signal Level Channel Capacity (110000111101011100011101)

Simulation results for the signal level has seen a comparison between the level of the signal with different values of n. In this simulation props very quickly became apparent that the time used for signal levels greater very quickly compared to the signal level is low, so it can save the use of the transmission channel.

5. SUMMARY

- Digital signal generator module that generated as much as 23 bytes
- Shannon and Nyquist channel capacity model correlated
- These results appply to undergraduate student
- Parameters that most influence the capacity of the transmission lione is bandwidth otherthan S/N and signal level

REFERENCES

1. E.Ziemer, Rodger, L.Peterson, Roger, 2009. Dogital Communication and Spread Spectrum Systems, Motorola, Inc.Scottsdale, Arizona.
2. Haykin, Simon (2008), Communication Systems, John Willey & Sons Inc..
3. Proakis, G.John, 2000, Digital Communications, McGraw-Hill, Inc..
4. Sklar, Bernard, 2006. Digital Communication Fundamentals ang Applications, PTR Prentice Hall Englewood Cliffs, New Jersey.
5. Stallings, W., 2005, Data and Computer Communications, 6th edition, Prentice-Hall, New Jersey.
6. Widodo Nugroho, 2002, Delphi Programming Tips and Tricks, Elex Media Komputindo.