

Influences of Buffer Size and E_b/N_o on Very Small Aperture Terminal (VSAT) Communications

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Abstract

In data communication of the signal transmitted from the transmitter (Tx) to receiver (Rx) stations is very influential. Buffer and E_b/N_o are two parameters that influence the quality of signal. This research measures those parameters and the relationship among them. This research employs data collected on the Link STM-1 side in Makassar and Timika operated by PT. Telkom Metra Bogor. The period of data is carried out for 56 days taken by using Simple Management Network Protocol (SNMP). To analyze the relationship among those two parameters, we use product moment correlation (PMC) method. The result correlation of the data buffer and E_b/N_o with a level of real is 0.05 and then buffer set in modem CDM 700 is 50% with threshold E_b/N_o 12.1 dB and the modulations used 64-QAM. That resulted correlation of side in Makassar is 0.648 and the p-value is 0.000. Correlation of side in Timika is 0.722 and the p-value is 0.000. These results suggest that the two parameters are correlated strong and significant.

Keywords: buffer, E_b/N_o , product moment correlation, link STM-1, Tx, Rx

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1. Introduction

VSAT represents one of communication technologies, which is often used at communication services via satellite or communications without cable [1]. This technology is very appropriately applied in the State of Indonesia, which consists of many islands [2]. However, Indonesia including the countries that are included in the category tropical climate with high rainfall intensity [3]. The condition will interfere with the transmitted signal intensity weakened so that the value of E_b/N_o is going to be outside the normal threshold. The weakening of the power of the signal will cause errors in data communication service [4].

The signal information is damaged or fails to be received at the receiver (destination) will affect the performance of the parameter buffer. The buffer is in receiver satellite modem in the device type CDM 700 with the percentage of buffer is 50% [5] on link STM-1 side Makassar and Timika. Where the declare status field data are already filled to capacity on storage media. If the number of data packets that are transmitted are < 50% identify that emptying the buffer data and when the number of data packets that come > 50% identify that currently populate the data. In the event of congestion, which long enough, then the buffer will be filled [6].

As a result, the new data packet sent is unacceptable (packet loss) on the side of the receiver. Packet loss occurs because of a failure occurred while transmitting data packets which resulted in the data packets do not reach the receiver. Performance buffer will run into problems if E_b/N_o is outside the normal threshold [7]. Performance buffer will run into problems if E_b/N_o is outside the normal threshold. Performance disturbed buffer will cause congestion long, so the buffer will be full [8]. Failure in data transmission between link STM-1 side Makassar and Timika inflicts of damage or loss of data packets.

The packets of data transmitted will be accommodated in the buffer. The performance of the buffer and E_b/N_o can be effective if it provided a service routine control applications that can provide information directly (live). The performance of both parameters can be evoked with better, if available a service of network management [9]. The specified network management is utilize the Simple Network Management Protocol (SNMP) because compatible with various

operating system types. This SNMP is very often exploited for the exchange of management information between devices in a network.

The research conducted is to analyze the big of the strength of the relationship between the parameter buffer to E_b/N_o . Web-based monitoring system is constructed to control the status of both parameters directly and actual. Implementation of the system applied to link STM-1 side of Makassar and Timika. Hypothesis early in this research if E_b/N_o value in beyond the bounds of the normal threshold, then the performance buffer becomes annoyed.

2. Research Method

2.1 Problem analysis

Monitoring the availability of communications services directly to the STM-1 link side of the Makassar and Timika is currently still not able to monitor live or historical (log). In particular the E_b/N_o parameters and Buffers. This is because the status on any of the parameters are only displayed on the display modem type CDM 700. When it appeared impaired communication between links, the technician could not directly deal with problems that arise. For that reason, needed a web-based system that is able to provide the information up to date.

2.2 System Requirements Analysis

Model of system approach used is the traditional approach which is adapted for requirement of admin and user [10]. The result expected is available an information service directly (live) or by real-time through SNMP. This protocol expected is able to give the real-time data capture for link STM-1 side Makassar and Timika.

2.3 System Implementation

At this stage, the implementation of a web-based system designed to provide information in real-time between links. The goal is to make it easy for handling and controlling in the event of disruption of communication on both sides of the link.

2.4 Preprocessing of Data

Data preprocessing is adjusted with the original purpose of the early research. Accurate data cover the data parameter of the buffer and E_b/N_o through CDM 700 satellite modem at the link STM-1 side of Makassar and Timika. The initial action is to make the data preprocessing phase consisting of data retrieval and data processing.

2.4.1 Data retrieval

This research used 2 attributes to perform a correlation between them. They are E_b/N_o represented as the X-axis and buffer size represented as Y-axis on the data table in our experiments and evaluations.

The process draws the data of the parameter of the buffer and E_b/N_o through the modem of satellite CDM 700 using SNMP. The data are organized in server by using MySQL. The programming language used to build web-based monitoring system is PHP.

2.4.2 Data processing

Overall of parameter data of the buffer and E_b/N_o is sorted, converted, and filtered to categorize pursuant to the original purpose of the research. This stage is carried out to ensure correlation between E_b/N_o parameters with Buffer. The result of this data processing will be used process evaluation and data analysis using statistical measurement, between the Product Moment Correlation and EWMA.

2.5 Evaluation and Data Analysis

2.5.1 Product Moment Correlation

Correlation of Product Moment represents the statistic term used to measure the big relation correlation coefficient usher the variable x to the variable y . Correlation usually expressed with the symbol " r (rho)" by range $-1 \leq r \leq +1$ [10]. The formula used is shown in Equation 1:

$$r_{xy} = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{\{n \sum x^2 - (\sum x)^2\} \{n \sum y^2 - (\sum y)^2\}}} \quad (1)$$

n represent the number of a couple of data x and y . Variable x is the buffer and variable y is E_b/N_0 . \sum_x is totalizing amount from a variation of the buffer and \sum_y is totalizing amount from variable E_b/N_0 . \sum_x^2 is an amount total from a variable of the buffer and \sum_y^2 is an amount from a variable E_b/N_0 . \sum_{xy} is the multiplication result from the amount of variation of buffer and variable E_b/N_0 . Realistic level (α) or p-value used is 0,05. The value 0.05 is 5% deviation from the normal distribution. It is meaning between the variable one with the other variable differ the reality or correlated. In Table 1 show Interpretation of the correlation coefficient r is:

Table 1. Interpretation of The Correlation r

Interval coefficients	The level of the relationship
0.00 – 0.19	Very low
0.20 – 0.39	Low
0.40 – 0.59	Medium
0.60 – 0.79	Strong
0.80 – 1.00	Very strong

2.5.2 Exponential Weighted Moving Average (EWMA)

EWMA control chart aims to detect signals out of control when happened the friction process that very small [11]. Formula EWMA control limit consists of the Up Center Line (UCL), Center Line (CL), and Lower Center Line (LCL) which can be seen in Equation 2-4. Up Center Line (UCL) is a chart the up control limits who can declare for which can express whether process the data plot reside inside or beyond the bounds of control limits up Equation 2:

$$UCL = \mu_0 + L\sigma \sqrt{\frac{\lambda}{(2-\lambda)}} [1 - (1-\lambda)]2^i \quad (2)$$

The middle control limits (CL) represent chart control limits middle value which can declare the mean value of the process result plot the data Equation 3:

$$CL = \mu_0 \quad (3)$$

The lower control limit (LCL) represents control limits under which can declare whether process the data plot inside or beyond the bounds of control under Equation 4:

$$LCL = \mu_0 - L\sigma \sqrt{\frac{\lambda}{(2-\lambda)}} [1 - (1-\lambda)]2^i \quad (4)$$

This method is employed to estimate volatility in the future by giving greater weight for the result of data of observation of variable of the buffer and E_b/N_0 nowadays compared to data of variable of the two parameters a period of previous. Parameter λ showing weight scale for the perception of data of buffer and E_b/N_0 newest no with the data of the buffer and E_b/N_0 previous with the value of $0 < \lambda < 1$. If λ coming near 1, hence volatiles progressively persistent. Assess α representing the value of a certain belief level. Value α that used in research is equal to 0.4.

3. Results and Discussion

3.1 Problem analysis

The weakening of the emissivity of transmitting signals makes the E_b/N_0 is beyond the normal threshold. So the link between communication services disrupted. The packets of data transmitted cannot be accommodated in the buffer. To keep the value of the buffer remains stable, then the value of E_b/N_0 threshold should be at normal based on the modulation that is

used between the links. The normal threshold limit value of E_b/N_0 is used in this research was 12.1 dB with 64-QAM modulation for the STM-1 links side of the Makassar and Timika.

In addition, other preventive measures have been undertaken to maintain the performance of the information signal is transmitted to the receiving. Preventive action in question is to raise the value of the parameter E_b/N_0 above the threshold of 2-3 dB with a standard threshold E_b/N_0 originally was 12.1 dB. This is done to anticipate the disruption of communication between link STM-1 when weather conditions deteriorate or damage their device. So, the performance of E_b/N_0 indirectly is outside normal limits and did not interfere with the performance of the link in receiving the information signal.

3.2 Environmental Analysis Research

Monitoring architecture design to control the condition of link STM-1 on the side in Makassar and Timika consists of hardware and software. The hardware used is a satellite Apstar 6 operated in Hongkong, satellite modem CDM 700, monitoring computer, ADSL modem that everything is connected directly to the web server. Generally, modem and monitoring computer CDM 700 is connected with a cable Local Area Network (LAN). Monitoring computer is provided specifically to control live (historically) link STM-1 conditions Makassar and Timika side by utilizing the SNMP protocol on CDM modem 700. The modem IP address of the monitoring computer CDM 700 on the side in Makassar and Timika given a different IP in the same network.

Data parameters that have been withdrawn from the satellite modem CDM 700 is then sent using an internet connection via an ADSL modem and then stored in MySQL. The script (command) that is designed to run on a regular basis using a task application scheduler provided in Windows. MySQL as the database and Apache as it is web server is located at PT. Telkom Metra Bogor.

3.3 System Requirements Analysis

Based on observations, analysis of system requirements is focused on the needs of the user admin and hardware and software. The hardware uses a 700 CDM satellite modem, ADSL Speedy modem, and computer monitoring (Makassar and Timika city). The software use is composed by the operating system (OS) for computer monitoring using the Windows version 7 Professional SP1, OS for monitoring server using Linux Centos version 6 database addressable by using a MySQL version 5.6, server monitoring using Apache version 2.2, the programming language used PHP version 5.3.1 for building web, using application MIB OID Explorer browser version 10.0 to see the OID of the parameter buffer and E_b/N_0 . OID buffer used is 1.3.6.1.4.1.6247.32.1.4.1.3.1.3.0. OID E_b/N_0 is 1.3.6.1.4.1.6247.32.1.3.14.0.

3.4 System Implementation

Implementation of this system is applied to a web-based monitoring system with access to its web URL is <http://database.metrasat.net/ds3mon>. Web-based monitoring system is built using the PHP programming language and MySQL database. Implementation of a web-based monitoring system is customized based on user requirements. The data obtained from the monitoring computer shipments in the Makassar and Timika using PHP script. SNMP is used to pull data buffer parameter and E_b/N_0 of satellite modems CDM 700 and then passed to MySQL.

3.5 Results Of Data Preprocessing

Results preprocessing data in this research consists of a process of data collection and data processing.

3.6.1 Data retrieval

The period of data collection was done during the 56 days in May, June, July and August 2015. At this stage, every month data collection is done only every 1-14. The type time chosen for the data collection process is per 1 minute. The results of data retrieval link STM-1 on the side in Makassar and Timika are stored in the form of CSV. Total raw data monitoring results are as much as 65530 data.

3.5.2 Results of Data Processing

The results of the acquisition of raw data that is processed again using the technique of sorting data. The process is done is to find the average value of the total amount of data overall raw data. Filtering process done to filter data outliers from both the parameter data before performing the correlation analysis phase. Additionally, in this study the value of the buffer in percentage (%) is converted to a decimal number. The average value obtained after the sorting is done for link STM-1 on the side in Makassar to the buffer is 50%, E_b/N_0 is 14.1 dB, and the conversion result buffer is 0.50. The average value for Timika get a buffer of 49%, E_b/N_0 is 14.3 dB, and the conversion buffer of 0.49. The results obtained based on Table 2 are as many as 80638 data.

3.6 Evaluation and Data Analysis

Evaluation and data analysis performed in this research Product Moment correlation analysis, time series process, and EWMA.

3.6.1 Product Moment Correlation

Tests conducted on the correlation stage using Minitab version 14. The number of application data to be tested at this stage is as much as 80638 data. The variables x and y variables are buffer is E_b/N_0 . The results of testing that was done on the Makassar get the correlation " r " value of 0.648 and p-value of 0.000. Then Timika was getting the correlation " r " value of 0.722 and p-value of 0.000. Based on test results that have been made stating that these two variables in terms of Makassar and Timika correlated positive, strong or close to positive one and significantly significantly different.

3.6.2 Time Series Process

Based on the results observed data E_b/N_0 to the Makassar and Timika varied enough to change its threshold conditions. While variations buffer is not too significant as shown in Figure 1. Process time series for link STM-1 on the side in Makassar and Timika is divided into a data buffer and E_b/N_0 .

Observations were made directly from a web-based monitoring system that provides information services direct (live). Based on observations, the time pattern of occurrence of data buffer fluctuating not change at any time on the Makassar as shown in Figure 2. The above conditions can be caused by a failure at the time of the execution process script, internet connection broke. Program scheduler in windows failed to execute the script. Another reason is the connection between your computer and modem monitoring CDM 700 impaired or interrupted.

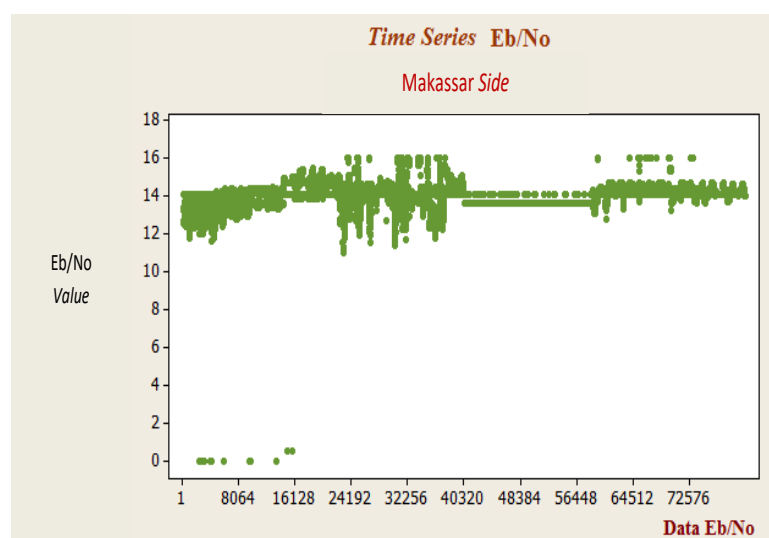


Figure 1. Time Series E_b/N_0 Side in Makassar

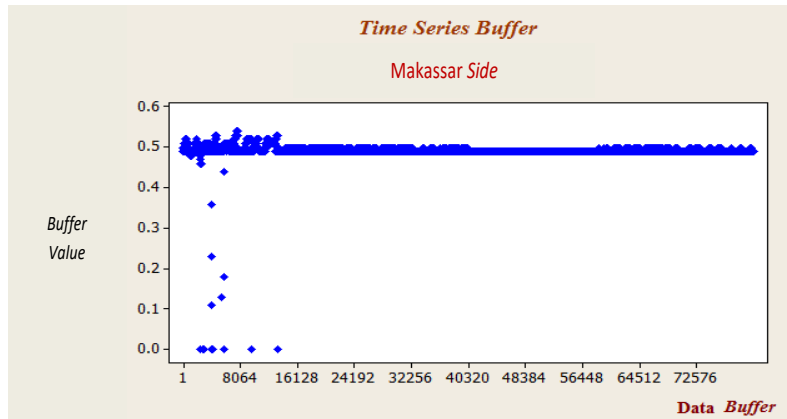


Figure 2. Time series buffer side in Makassar

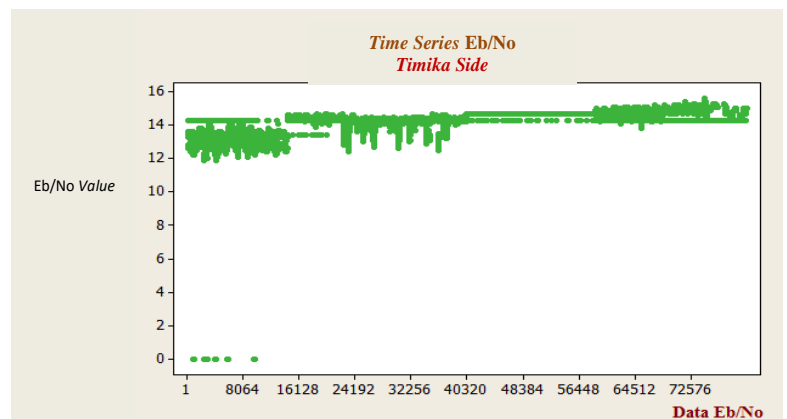


Figure 3. Time series Eb/No side in Timika

This is because the performance of the service quality of the signal in the data transmission process in good condition. The time pattern of the data incident E_b/N_o fluctuating is beyond the normal threshold. The pattern of the data buffer time of the incident in Timika also be known side fluctuating not change significantly as shown in Figure 4. Results of monitoring the time pattern of events for data E_b/N_o side fluctuating Timika also not changed significantly.

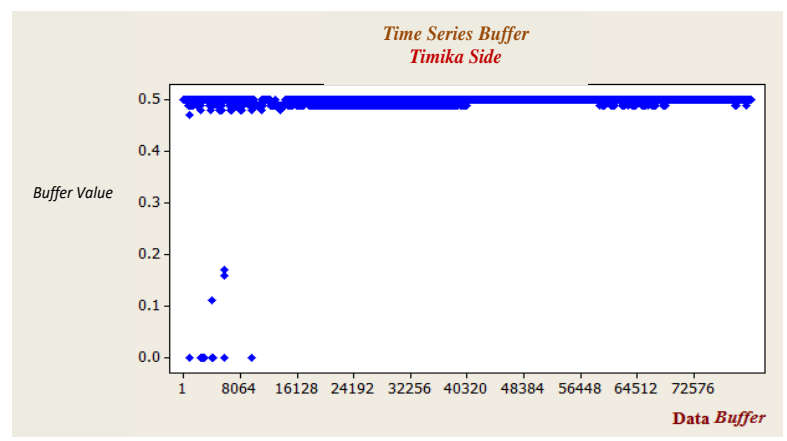


Figure 4. Time series E_b/N_o side in Timika

3.6.3 Exponential Weighted Moving Average (EWMA)

EWMA used in the study with the reasons for detecting signals a shift out of control when the data process buffer and E_b/N_0 is a very small (Equation 2-4). Based on test results obtained from the UCL buffer value of 0.4938. UCL variable E_b/N_0 on 14.16. Λ value specified is 0,4. The CL buffer value of 0.4938. The CL value of the variable E_b/N_0 that is 13.98. While the value of the variable LCL buffer of 0.4938 and E_b/N_0 is 13.80.

The results of the testing carried out to the side of Makassar. On the side Timika UCL values obtained in the variable buffer is 0.4957. The UCL E_b/N_0 on 14.45. Λ value specified 0.4. Value of 0.4957 and a buffer CL value E_b/N_0 that is 14.22. While the value of LCL buffer of 0.4957 and LCL value E_b/N_0 is 13.99.

4. Conclusions

Based on the research that has been done that the web-based monitoring system to link STM-1 on the side in Makassar and Timika is able to be represented well. The result parameter data buffer and E_b/N_0 can be controlled at all directly (live). The results of the analysis to measure the magnitude of the relationship using Product Moment Correlation Makassar side is 0.648 and Timika is 0.722 with p-value of 0.000. It resulted and hypothesis testing conducted states that the variable buffer with E_b/N_0 positively correlated with each other a strong and significant real different.

References

- [1] M. Ginano. Performance Analysis of Network Quality Car VSAT Internet Service Center District of North Sulawesi. *E-journal Tek Elektro and Komp.* 2015; 72–79.
- [2] Parlindungan. VSAT Link Access Method SCPC Telkomsel Case Studies MSc Jayapura - Merauke Bsc. PhD Skripsi. Jakarta: Postgraduate UI; 2008.
- [3] Anhar. Performance Analysis of Network Communication Very Small Aperture Terminal (VSAT). *Journal Teknologi Sains and Industri.* December 2003; 1(1): 1-28.
- [4] Natalia G. Suwadi. Suryani T. Decoder Implementation and Cyclic Redundancy Check Encoder on TMS320C6416T. *Journal of POMITS Technique.* 2014; 3 (1). A92 - A97. ISSN: 2337-3539
- [5] Comtech. CDM 700 High Speed Satellite Modem installation and Operation Manual. USA. Version fifth. December 12; 2008.
- [6] Malayusfi, Hidayat R. Comparative Performance-Work at the Transport Protocol and no MPLS MPLS Network: A Case Study of the Electrical Engineering Department Bandung State Polytechnic. *Proceedings of CITEE.* Interlaken. 2009; 79-84.
- [7] Syirajuddin MS. Design and Implementation of Monitor and Control Software Modem Satellite Communications Facility S using Embedded Distant-end Monitor and Control (EDMAC). PhD Skripsi. Jakarta: Postgraduated UI; 2009.
- [8] P. Reza, A. Achmad, S. Eko. Design of Network Monitoring Applications by Using Simple Network Management Protocol. *Journal TEKNIK POMITS.* 2013; 2(1). ISSN: 2301-9271, pp. A154-A159.
- [9] Satzinger JS, Jackson RB, Burd Elementary School. *Systems Analysis and Design in a Changing World.* Fifth Edition. Course Technology. Cengage Learning, Boston-USA; 2010.
- [10] Frisca. PR. Setyady ST. Sari Y. Isa SM. Analysis of the Effectiveness of Advertising on Mobile Applications and Its Affecting Factors. *Journal of Information Systems.* April 2011; Vol 7 (1) .42-54.
- [11] Khoo, Michael BC. An Extension for the Univariate exponentially Weighted Moving Average Control Chart, Malaysia; 2004.