Reconstruction of Black Box Testing in Communication Data Processing Applications Based on Internet Protocol

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ABSTRACT: *This application is intended for processing communication test results on ip based with the case of the MALE UAV satellite communication. Mathematical formulas and calculation algorithms that exist in the calculation of quality of service (QoS) communication are translated into algorithms and programming languages. To prove the reliability of this application requires a series of tests. Black box testing is considered to be a solution to answer the reliability of this application. This black box can be divided into 2 things, namely a function-oriented black box and a result-oriented black box. Function-oriented black box is carried out with the help of smartmeter software. Accuracy-oriented black box is done by comparing the results of QoS parameters in the form of dellay, jitter and packet lost from the application with manual calculations. From these 2 black box tests, an application that is functionally reliable and results accurate will be obtained.*

KEYWORDS -*php, postgresql, python, black box, quality of service, delay, jitter, packet lost*

I. INTRODUCTION

Indonesia is a vast archipelagic country, with an ocean area that is wider than the mainland. In addition, Indonesia still has control of the waters in the Indonesian Exclusive Economic Zone (ZEEI) (Nugraha, 2021). This requires technological support, one of which is with unmanned aircraft.

Unmanned aircraft have many names ranging from Unmanned Aircraft (PTTA), Unmanned Aerial Vehicle (UAV) to Remotely Payload Vihicle (RPV). Unmanned aircraft have been developed from the days of the first world war starting from the flying bomb. This flying bomb is controlled by the radio frequency of the accompanying aircraft (Priyono, 2011).

The development of unmanned aircraft nationally has been going on for quite a long time, both the government, namely the National Aeronautics and Space Agency (LAPAN) and the Agency for the Development and Application of Technology (BPPT) as well as private industry and State-Owned Enterprises (BUMN) have developed many kinds of unmanned aircraft. . This is enough to lead to a wide community of unmanned aircraft in Indonesia, both in production, research and use. In 2019 through the Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia number 38 of 2019, a joint study under the name Unmanned Aircraft Technology was formed with the coordinator of BPPT and members of the Research and Development Agency of the Ministry of Defense (Balitbang Kemhan), LAPAN, Director General of Potential Defense Ministry of Defense (Pothan Kemhan) and involves universities and

industry. The product of this research is a prototype suitable for the PTTA industry and its supporting policies. Meanwhile, the product of the specified innovation is Unmanned Armed Aircraft (Regulation of the Minister of research, technology and higher education of the Republic of Indonesia number 38 of 2019). From this ministerial regulation, the National Research Priority Consortium for Unmanned Aircraft with Medium Altitude Long Endurance (PRN PUNA MALE) was formed.

The Line Of Sight (LOS) Operating System is used if communication between GCS and UAV can be connected directly without obstacles and in real time, if communication is lost between GCS and UAV because LOS cannot occur, the Beyond Line Of Sight (BLOS) operating system will take over the communication. Satellite communication on the UAV can be used to increase the range of communication when LOS communication cannot reach it (Niephaus et al., 2016).

Satellite communication for popular mobility on L band Satellite. However, L band communication has a narrow bandwidth, in the published L band test at the Aviation Technology Center, it is stated that the transmission bandwidth reaches 68-78 Kbit (Rahayu et al., 2019). This is quite small if it will be used for a PUNA MALE class UAV. Options for getting large bandwidth are in C band, Ku band and Ka Band. However, the C band antenna is too large for PUNA MALE, so the C band is excluded from the choice of satellite communication types. The Ka Band has a very sensitive air attenuation character, this is also a serious consideration, so the Ku Band was chosen. As for Ku band satellite communication, there are no regulations for use for mobility. To get proof that Ku Band communication can work for mobility, both static and mobility tests are carried out. The results of this test become material in the quality of communication, we know Quality of Service in communication. So that it can be used as a Ku Band recommendation for PUNA MALE.

Tests in internet protocol (IP) based communication are carried out in order to maintain the quality of the communication. This needs to be done randomly or periodically. In practice, this test is usually carried out using the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) protocols. This test is carried out by tapping communications from both sides of the point to be tested. The main parameters of service quality include (Campbell et al., 1998):

1. Lost Package
2. Delay
3.Jitter

There is a lot of data from this test in just a few minutes, so the data can be obtained. So the processing will be very time consuming. Therefore it was chosen by the author to create a web-based application to facilitate the processing of the data. So that it will be easy to make decisions regarding the Service Quality of the PUNA MALE communication system if it is necessary to do random testing to ensure the condition of the channel data or use it in the context of initial research on the PUNA MALE communication development (Niephaus et al., 2016).

II.   RESEARCH METHODOLOGY

In research for software development, the Software development life cycle (SDLC) research method will be known. This method presents the process in software development from design to evaluation. SDLC is divided into 4 stages, namely (Campbell et al., 1998):

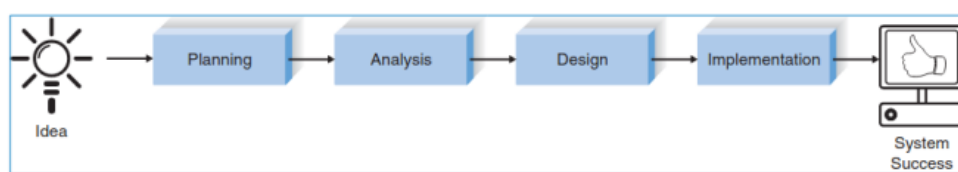1.   Planning
2.   Analysis
3.   Design
4.   Implementation

Figure 1. SDLC Flow

1. Quality of Service Communication

QoS is often a parameter of the quality of a communication. In his article, Campbell describes the parameters of QoS consisting of Packet Lost, delay and jitter (Campbell et al., 1998).

a. Lost Packet

The definition of Packet Lost is the percentage of packets lost during the data transmission process (Hasanul Fahmi, 2018). The Packet Lost formula can be described as below.

$$pl = ((p_t - p_r)/p_t) \, x100\%$$

pl = packets lost; pt = number of packets transmitted; pr = number of packets received

b. Delay

Delay can be interpreted as the time required for sending data from the sender to the recipient (Hasanul Fahmi, 2018). The delay calculation can be written in the formula as below.

$$d = t_r - t_t$$

d = delay; tt = time transmit; tr = time received

c. Jitter

Jitter is the variation between 2 delays in the data transmission process (Hasanul Fahmi, 2018). Jitter calculation is by subtracting the delay from one another. For example, the second delivery delay minus the first delivery delay is the first jitter.

$$j = d_n - d_{n-1}$$

J = jitter ; dn = delay to n;

2. IEEE Testing Standards for software anomalies

Institute of Electrical and Electronics Engineers(IEEE) is an international organization consisting of technology experts with the aim of advancing technology in the world. IEEE has many branches of technology expertise, one of which is the IEEE Computer Society which is engaged in information processing and computers. Through the IEEE Computer Society, issued various regulations for the manufacture of computer software and applications. Among them is the IEEE standard 1044-2009 on the classification standard for errors in software. This standard enhances the IEEE standard 1044 -1993. In the 1993 version there are some things that are still considered imperfect (IEEE, 2010). In the IEEE standard 1044-2009 the risk categorization is divided into three as shown in the table below.

Table 1.Risk Category

No	Category	Error
1	Tall	> 70%
2	Currently	40% - 70%

| 3 | Low | < 40 % |

3. Black Box Test

According to Pressman, black box testing is a testing process that prioritizes the existing functions of a system. So that the test ignores things that are in the system (Pressman, 2001). The purpose of this test is to find:

1. Function error
2. Display error
3. Error in database
4. Work process error
5. Initialization and termination errors.

The objectives of this test are:

1. Validate the function
2. View the behavior and performance of the tested system
3. What inputs make a good system
4. System sensitivity to input values
5. Limitation of data that can be processed
6. System speed in processing data
7. Effect of data combination on the system

As a whole, this black box will test the application input that is entered into the expected output without looking at the algorithm in the process. This is considered sufficient to test the process in an application so that it is considered to work properly.

4. Research Instruments

This research instrument in the form of hardware and software. Software in the form of:

a. Dbeaver

Is software for designing and managing databases. This software is open source.

b. Atom

Is a software interface to perform various programming languages. In this research, it is used to code PHP, HTML and CSS. This software is open source.

c. Httpd server

Isa software used for PHP servers.

d. Postgresql server

Is a server for the database of applications that are built.

e. Centos 7

Used for the operating system of the application server.

f. SmartMeter.io

Is a software that can be used in automatic black box testing. This software is free for trial and paid if you want to have more facilities. The smartmeter that researchers use is a free one.

Meanwhilen for the hardware used in the form of a server has the following specifications:

1.   Processor   : Intel Xeon E-2134 3.50GHz
2.   Memory   : 16 Gb DDR4 2666 MHz
3.   Hard disk   : Samsung SSD 850 1Tb and SanDisk SSD PLUS 120Gb
        ForThe client hardware specifications used in the form of a laptop are as follows:

1.   Processor   : AMD Ryzen 5 3500U with Radeon Vega Mobile Gfx
2.   Memory   : 16 Gb DDR4 2666 MHz
3.   Hard disk   : Samsung SSD 860 1Tb and WDC PC SA530 SSD M2 256 Gb

III.   RESULT AND DISCUSSION

In order to validate this application, two black box tests were carried out, namely functionally and in accuracy of application calculations. Functionally, researchers use smartmeter software that can perform tests automatically after we make a test plan. As for the accuracy of the calculations, it is done by comparing manual calculations with the results of calculations by the application.

1.   Functional Testing

Smartmeter is a software that can perform black box testing automatically according to a previously recorded procedure. This software is paid butthere isthe free version.

Figure 2.Smartmeter start

Figure 3. Black box data retrieval process with a smartmeter

This test is carried out to see the function of the application without seeing the process in it so that in detail this test is carried out for each function as below.

1.   Function save test data
2.   Function to process data delay
3.   Function to process packet lost
4.   The function of exporting the results of data processing and processing data jitter
5.   Function of clearing test data

The test results with the smartmeter will show the error and success numbers of the process carried out according to the prepared plan. The test results are as in the table below.

Table 2. Black Box Test Results

Test	Min (ms)	Max(ms)	Error (%)

Front page	93	1182	0.00
Save data	41	298	1.35
Process delay	243	1445	0.92
Packet lost process	95	416	0.00
Export data and jitter process	14	1165	0.46
Clear data	64	676	0.93
Average			0.61

2. Accuracy Test

Withthe formula that has been submitted, the data will be compared when manual calculations are carried out with application calculations as validation of the application. In this case, a sample of 30 data was taken sequentially in the existing test data and carried out 3 times with different samples as for the comparison as shown in the table below.

Table 3. Manual Calculation

	delay			Jitter		
Average	294	299	297		6	5
Minimum	290	290	291		0	0
Maximum	297	336	348		3	5
				8	2	
Datalost	6.67		23.33%		30%	

Table 4. Application Calculation

	delay			Jitter		
Average	294	299	297	3	6	5
Minimum	290	290	291	0	0	0
Maximum	297	335	348	6	3	5
				8	2	
Datalost	6.67%		23.33%		30%	

IV.   CONCLUSION

Validation of this application is done by comparing with manual calculations and black box testing. From the comparison of the results of the application with manual calculations obtained the same results. Meanwhile, with a black box using a smartmeter, the error is below 2%, so the error in the application process is very small. So it can be concluded that manual validation and black box shows that the application is valid. This will be very suitable when it has to be used in processing data on MALE satellite communication which requires good accuracy.

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