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Internet Network Analysis with Hierarchy Token Bucket Method at Dhyana Pura University

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ABSTRACT

Bandwidth management is indispensable in computer networks. Not only to manage the needs of each individual, but also to keep the data traffic running smoothly. Dhyana Pura University is a private university that utilizes information technology in achieving optimal performance. Observation results with throughput, delay, packet loss and jitter parameters show that bandwidth management has not been done properly. Implementation of bandwidth management is done on Mikrotik Cloud Core Router and PC Router based on Ubuntu server version 16.04. One way to reduce performance degradation is to manage bandwidth. Good bandwidth management is expected to provide the right Quality of Service (QoS) for each internet service. The Hierarchy Token Bucket (HTB) method as a queuing method that regulates bandwidth usage to be given to each internet user shows more optimal results and is easier to use according to the desired needs. This is because the bandwidth is divided evenly and prevents one user from spending excessive bandwidth, so that it can increase employee satisfaction in using internet services. The results of the analysis of measuring the level of employee satisfaction with the Customer Satisfaction Index (CSI) method show that the HTB method has a total satisfaction index of 66.154% in the very satisfied category, while for troughput variables of 65.32%, delay of 67.14%, packet loss of 66.50% and jitter of 65.40%. Thus the implementation on the internet network at Dhyana Pura University using the Hierarchy Token Bucket (HTB) method is feasible to implement with a satisfied predicate.

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INTRODUCTION

The need in education for internet access is very high, because many educational activities are carried out online, from information, new student admissions, payments, teaching and learning student activities, final exam systems, and other academic activities. With the educational activities carried out, adequate bandwidth is needed, but the badwidth owned is limited so that it hampers the speed of developing the learning process for students, teaching staff, and improving the quality of educational administration services (Armanto & Daulay, 2020). Infrastructure development started since the establishment of Dhyana Pura University in 2011. With internet service initially amounted to 2 Mbps. Undhira has 5 (five) buildings namely building A, B, C, D, and building E, where the bandwidth allocation is only the main building, namely building B of 120 Mbps allocated to Mikrotik Local Area Network Employees for building BC 40 Mbps, building A,D,E Kampung Bali 30 Mbps, Server Sister unlimited, Mikrotik Hostpot 20 Mbps, Mikrotik

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Repostori unlimited with the number of internet users as many as 80 employees.

Based on the problems obtained from internet users in the process of sending and receiving data that often gets interrupted (slow), or what is usually referred to as bandwidth overload, especially when heavily used during working hours, this can result in several such as a decrease in connectivity speed due to delays, data corruption when sending / packet loss and causing high jitter values, surging due to lack of bandwidth restrictions (Zuqhra & Rosyid, 2021). User satisfaction will have an impact on the costs involved in building internet networks, the large number of users of internet services is a big challenge for bandwidth managers to optimize.

Quality of Service (QoS) analysis using the Hierarchy Token Bucket (HTB) method is a bandwidth management technique on a network that allows hierarchical regulation of data transfer rates (Kusbandono & Syafitri, 2019). The HTB method has advantages including: allowing bandwidth allocation to be divided in more detail and flexibly, ensuring service quality by setting an upper limit (maximum bandwidth) and a lower limit (minimum bandwidth) on each class of service (Iqbal Ichwan dkk., 2019). The implementation of the HTB method uses Mikrotik Routerboard in bandwidth sharing, with the hope of being able to provide effective and efficient service quality so that it can support and improve services to students and service satisfaction for employees at Dhyana Pura University. This research aims to contribute to improving the quality of internet services at Dhyana Pura University through the application of the Hierarchy Token Bucket (HTB) method, which overcomes the problem of adequate but limited bandwidth restrictions (Toresa & Renadi, 2020). The results of the analysis showed that the measurement of employee satisfaction level reached a total satisfaction index of 66,154%, falling into the satisfied category. In addition, the throughput variable reached 70,21 bps, delay was 30,2 ms, packet loss was 1%, and jitter was 2,22 ms. Based on these results, it can be concluded that the implementation of the HTB method on the internet network at Dhyana Pura University is worth implementing with a satisfied predicate.

RESEARCH METHOD

Research is a way to get a certain goal. Figure 1 is the research stage for the preparation of Internet Network Research using the HTB method at Dhyana Pura University.

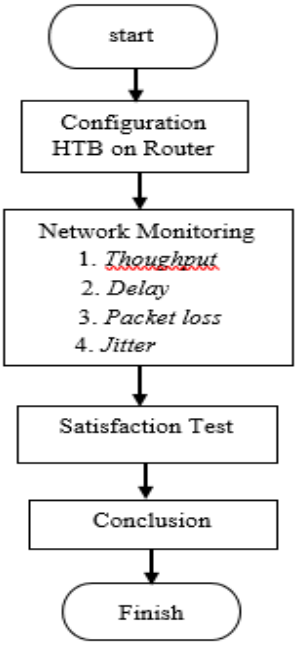

Figure 1. Internet Network Research Stage Using HTB Method

The steps of the research stages are explained as follows:

1. Configuration HTB method
   The configuration and implementation process using the HTB method at Dhyana Pura University uses Mikrotik Cloud Core Router and PC Router based on Ubuntu server version 16.04 with a total bandwidth of 40 Mbps divided into each employee room connected to the LAN internet network of Dhyana Pura University (Kusbandono & Syafitri, 2019).
2. Network Monitoring
   Measurements are made on the Hierarchy token Bucket method to determine the work of the network through QoS measures, namely throughput, delay, packet loss and jitter (Kusbandono & Syafitri, 2019).
   a. Throughput is the effective data transfer rate through a network, system, or process in a given period of time. In the context of computer networks, throughput refers to the amount of data successfully sent or received over a network in a unit of time, usually measured in bits per second (bps).
   b. Delay is the length of time it takes for data or information to reach its destination. Delay on a network will determine what steps will be taken when managing a network. When the delay is large, it can be known that the network is busy or another possibility is that the network capacity is small so that preventive action can be taken to avoid overload.
   c. Packet Loss is the number of packets that fail to reach the destination where they were sent. When packet loss is large, it can be seen that

the network is busy or overloaded. Packet loss affects network performance directly, when the packet loss value of a network is large, it can be said that the network performance is poor. network is large, it can be said that the network performance is poor.

d. Jitter is the variation of delay between packets that occurs in IP-based networks. The magnitude of the jitter value will be greatly influenced by variations in traffic load and the size of the stack between packets in the network.

3. Satisfaction test
   Satisfaction test steps have been carried out to get the results of the satisfaction stage of the users and expectations of the quality of internet services of Dhyana Pura University (Willyanto Arif & Novia Rizki, 2021). The satisfaction test assessment method uses the Customer Satisfaction Index (CSI) method with total sampling if the percentage index of employee satisfaction measurement as an effort to improve internet services at Dhyana Pura University.
4. results and conclusions
   From the results of observations made simply from the research of the Hierarchy Token Bucket (HTB) method at Dhyana Pura University, it is expected to provide input to network management and bandwidth management.
5. Validity
   Performed content validity and reliability using Microsoft Excel.
6. Analysis
   Analyze the results of the analysis of the fourth and fifth stages, by measuring the satisfaction index in Table I.

Table I.
Customer Satisfaction Index (CSI) Criteria

Index Value (%)	Criteria Customer Satisfaction Index
81,00 - 100,00	Very Satisfied
66,00 – 80,99	Satisfied
51,00 – 65,99	Moderately Satisfied
35,00 – 50,99	Less Satisfied
0,00 – 34,99	Not Satisfied

(Source: Widodo, 2018)

7. Quality of Service
   Quality of Service (QoS) is a terminology concept used to define the characteristics of a system service to ascertain how good the quality of that service is (Hidayah, 2020). QoS is designed to support servers to work creatively after ensuring that users benefit from the applications used for the network. Each technology has different characteristics that must be considered when implementing QoS to avoid congestion. Congestion management techniques are used to manage and prioritize traffic on the network, which requires more bandwidth than the network can provide.
8. Hierarchy Token Bucket (HTB)
   Hierarchy Token Bucket (HTB) is a form of bandwidth capacity control management. A service provider must have efficient and high-performance bandwidth management, in order to receive the results required by the system and HTB is a principle that provides maximum bandwidth improvement. HTB is useful in controlling the implementation of bandwidth on links that are shared with consumers (Ady Saputro, 2022). HTB requires the physical implementation of a single link view to display multiple links and send different types of traffic to unequal views. That is, HTB is useful for limiting the connection rate of upload and download clients, so that clients cannot arbitrarily use the entire bandwidth.

   The way HTB works is not much different from its predecessor, but the HTB General Scheduler uses the Deficit Round Robin (DRR) technique and in the return target division, the HTB estimator does not use Exponential Weig

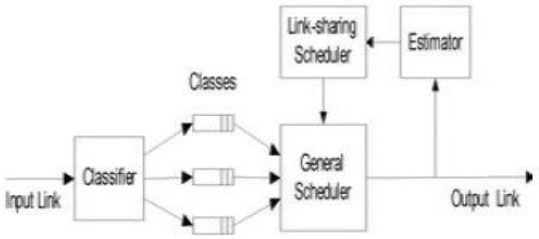

Figure 2. Deficit Round Robin

In HTB which has a ceil parameter for the level of course bandwidth gain effort the base link value and the ceil link score. The indicator can be considered to be a second approximation, causing each measure to be able to take bandwidth as long as the total bandwidth found is less than the ceil value (Sidqi dkk., 2021). This is easily implemented by only allowing the bandwidth borrowing process when the class passes this link. As a side note, if the base link value is feasible through the ceil value, it needs to have the same relative role as a bound size, where the class is not allowed to borrow bandwidth. Meanwhile, if the ceil score is set to invinity or an incremental value, that to get an obligation equal to the level is unlimited.

RESULTS AND DISCUSSION

a. Configuration Hierarchy Token Bucket (HTB) Method
   The system design that will be built is a bandwidth management design using the Hierarchy Token Bucket (HTB) method made on the Mikrotik Routerboard Cloud Core Router. This design will be made using a simple queue. Simple Queue is a way to limit bandwidth, namely through dividing bandwidth from small to medium size. Simple Queue is used in order to sort bandwidth in uploading and downloading on each client. So the

admin can limit some target users using IP. In addition to IP addresses, network interface addresses are set in bandwidth using Simple Queue.

1. Throughput Value Measurement Analysis

The results of throughput measurements with the HTB methods can be seen in Figure 3 below.

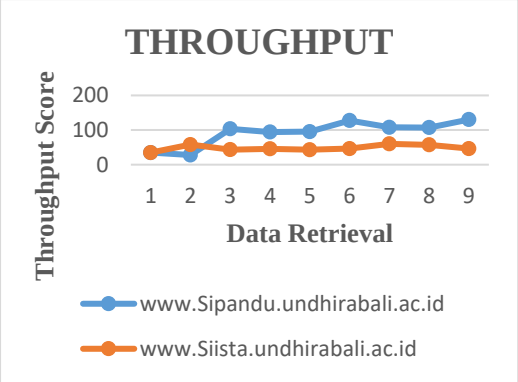

Figure 3. Graph of Throughput Measurement on HTB

According to the TIPHON version of the standard, throughput is said to be very good if it is worth 100 bps, good if it is worth 75 bps, medium if it is worth 50 bps and bad if it is worth less than 25 bps. From the graph in Figure 3, throughput measurements were carried out 3 times a day, namely at 08.00-12.00, 13.00-16.00 and 16.00-20.00 for 3 days where the throughput at www.sipandu.undhirabali.ac.id increased by 130.31 bps. while www.siista.undhirabali.ac.id by 60.08 bps. So using the HTB method succeeded in increasing the average throughput from 34.74 bps to 92.10 bps in the Good category.

2. Delay Value Measurement Analysis

The results of delay measurements with the HTB methods can be seen in Figure 4 below.

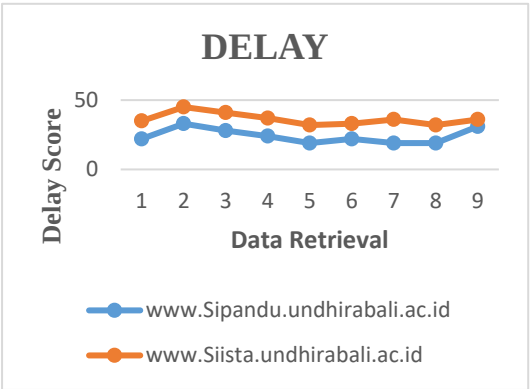

Figure 4. Graph of Delay Measurement on HTB

Figure 4 shows that delay measurement with the HTB method is able to reduce delay from peak hour conditions. According to the TIPHON version of the standard, a delay of less than 150 ms is considered excellent, good with a value of 150 to 300 ms, medium 300 to 450 ms, and poor value of more than 450 ms. From the graph in Figure 4, the delay measurement is carried out 3 times a day from 08.00-12.00, 13.00-16.00 and 16.00-20.00 for 3 days where the delay on www.sipandu.undhirabali.ac.id has decreased significantly by 32 ms. while on www.siista.undhirabali.ac.id by 46 ms. Thus, the application of the HTB method succeeded in reducing the average delay from 48.7 ms to 36.3 ms in the Very Good category.

3. Packet Loss Value Measurement Analysis

The results of Packet Loss measurements with the HTB methods can be seen in Figure 5 below.

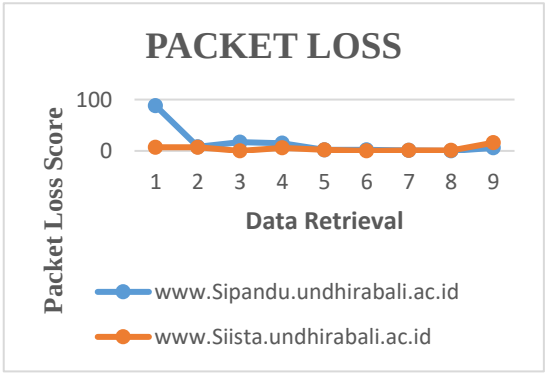

Figure 5. Graph of Packet Loss Measurement on HTB

Figure 5 shows the results of the packet loss measurement in the HTB method. According to the standard version of TIPHON Packet loss is categorized as very good if it is 0%, good if it is 3%, if it is 15% it is called medium, and if it is above 25% it is bad. The graph in Figure 5 Packet loss measurements were made 3 times a day from 08.00-12.00, 13.00-16.00 and 16.00-20.00 for 3 days where packet loss on www.sipandu.undhiabali.ac.id increased by 88%. While at www.siista.undhirabali.ac.id by 3%. Thus, the HTB method succeeded in reducing the average packet loss from 88% to 1%, which is in the Very Good category.

4. Jitter Value Measurement Analysis

The results of Jitter measurements with the HTB methods can be seen in Figure 6 below.

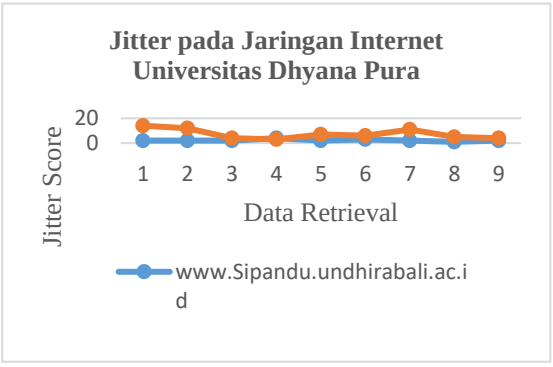

Figure 6. Graph of Jitter Measurement on HTB

According According to the TIPHON version of the standard, jitter is said to be very good if it is 0, good value 0 to 75 ms, value 75 to 125 ms is medium, and 125 - 225 ms is categorized as bad. From the graph in Figure 6, jitter measurements were made 3 times a

day, namely from 08.00-12.00, 13.00-16.00 and 16.00-20.00 for 3 days where jitter at www.sipandu.undhiabali.ac.id decreased by 4%. While at www.siista.undhirabali.ac.id by 13.9%. Thus, the results of jitter testing on the application of the HTB method with an average jitter from 14.7 ms to 3 ms with a Very Good category.

b. Custumer Sattisfaction Index HTB

Satisfaction analysis in measuring the performance of the internet network which is described in the customer satisfaction index is carried out using the CSI analysis technique. CSI is an index used to determine overall customer satisfaction through an approach that reviews the level of expectations on each indicator of measured results or contributions.

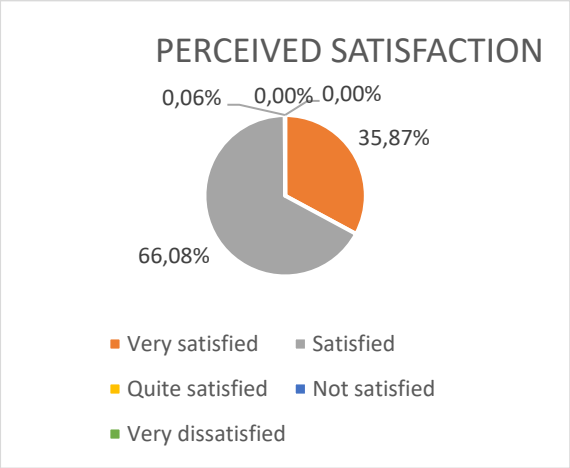

Figure 7. Perceived Satisfaction

Figure 7 states the results of measuring the perception of satisfaction of LAN internet network users at Dhyana Pura University using the HTB method show a significant increase of 66.08% of respondents answered in the satisfied category and 35.87 respondents answered very satisfied. Thus, the application of the HTB method is in accordance with the desired expectations.

CONCLUSION

The results of the implementation and testing of internet network performance using the HTB method on Quality of Service (QoS) parameters including throughput, delay, packet loss and jitter that have been tested on the LAN internet network of Dhyana Pura University. Measurement of Quality of Services (QoS) parameters from the results of the application of the HTB method with the comparison of the TIPHON version of the QoS standard obtained values, namely; for the measurement results on Throughput of 70.21 bps, Delay of 30.2 ms Packet loss of 1%, while Jitter of 2.22 ms so that the HTB method. Implementation of bandwidth management used by users in busy and not busy internet network conditions measured on the use of SiPandu and Siista using Axence Nettools tools Network performance with the HTB method is well used in busy internet network conditions. With the HTB method, the satisfaction index obtained is 66.154% with the satisfied category. Thus the implementation of the LAN internet network at Dhyana Pura University using the HTB method is feasible to implement with a satisfied predicate.

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