Optimization Distance Learning Computer of Network with Hierarchical Token Bucket Per Connection Queue (PCQ) Queue Tree

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ABSTRACT

Implementation Distance Learning (DL) lecture at High School of Police Science namely Sekolah Tinggi Ilmu Kepolisian (STIK-PTIK) consisted of 32 Polisi Daerah (POLDA) in lecture Distance Learning (DL) throughout Indonesia. System bandwidth management using the method of simple queue, the simple queue is lacking both in bandwidth allocation. Optimization against computer networks in improving Quality of Service (QoS) using the method Per Connection Queue (PCQ) Queue Tree with four classes to model. Scale model of a priority bandwidth specifically as a model of optimization of computer networks with an average percentage of delay of 6.01%, packet loss decreased 0.26%, jitter of 13.56% and increased throughput became of 9.5%. The research is supported by the level of satisfaction by CSI towards PJJ / DL students, the methods of customer satisfaction index with the service quality (Servqual) questionnaire as against with levels of satisfaction the use of DL student participants with the result satisfaction levels of 74%.

Keywords: Hierarchical Token Bucket, Per Connection Queue, Queue Tree, QoS Parameters.

1. INTRODUCTION

High School of Science POLICE with has a role as the institution department academic and educational institution, have identify as Indonesia Police Colleges aims to develop the science Police in Indonesia. To realize this, always do the maximum efforts to improve the quality of the teaching learning process (academic) and the institutional quality of High school of Science "PTIK". Distance learning having component and characteristics of them educational institutions based formal in an interactive communication system connected learners, resources and structures or teacher separated by location and time [1]. WebEx online meeting is a web application developed by Cisco that offers a very flexible approach to those users who collaborate through the media such as pictures, video, and voice from any are more easily [2]. The data communication to raise and development at information technology care is needed and capacity traffic network that can run optimally by services and speed of data are reliable in support network access [3].

PTIK in the implemented bandwidth management current use by using the method simple queue. Simple queue is a queue that limitation data rate in the ip address or subnet certain [4]. Simple queue has several advantages, in arrangement

IP address in specific with determined the speed of traffic upload and download maximum reached, the bandwidth who used in according allocation used. Simple queue also has weaknesses, if the more than IP address is the rules address on set the queue rules is created into one by one based on the address of the client IP address, the bandwidth allocated for the client IP address and VLAN are not used be unused or idle. rules and application on in PTIK bandwidth management in the only based on segmentation VLAN who has weaknesses include subdivision of bandwidth based on both traffic upload, download and a specific ip address. When the traffic network VLAN in an idle or unused, then the bandwidth allocation cannot be used by another VLAN, so the impact on the interconnection network of lectures distance learning. The problems have an impact on quality of video (pictures) and presentation materials that seem less clear, the sound quality was less well received by the student, so acceptance of students has not been measurable properly against lecture distance learning resulting in the comfort of students in materials presented by the lecturer.

Based on background problems by PTIK, authors do the optimization models in the sharing bandwidth model a specific with the scales of priorities for the use of computer network access. By giving a result output parameter measurement of network including delay, packet loss, jitter and throughput of network bandwidth by used the methods of hierarchical token bucket i.e Per-Connection Queue (PCQ) and queue tree. By providing the optimal results of the use of computer network in PTIK. The survey level of satisfaction the lecture distance learning is student participants DL, in a customer satification index and servqual to vote for improve the service of distance learning and as a proponent of the research.

Problems of service education institutions by using the method servqual or service quality which consisting of several components, that is by using the model of service quality gap analysis by using five parameters of quality of services to educational institutions [5]. The Quality of Service by using Queuing Algorithm (QA) technic on packet loss and jitter video to evaluate against the speed of video streaming. [6]. Optimization on e-learning solutions with several stages including scale, perception, symmetry, interactivity, control student, integration capacity, costs, time and flexibility by using a system of agents. [7]. The e-learning of performance is function by using multiple stages of experimentation and testing i.e. smoke test, unit test, calibration test. [8]. Application of QoS method with hierarchical token bucket with the technique of the end-to-end bandwidth prioritization of bandwidth allocate [9].

2. RESEARCH METHOD

2.1 DATA

This research was conducted in a high school Science (PTIK) data center information technology Police Jakarta.

2.2 FRAMEWORK, PROBLEM IDENTIFICATION, REVIEW OF RELATED, FIELD OBSERVATION, ANALYSIS DATA

Identification of the problems found on objects in question in search of alternative solutions related to with problems of distance learning (DL). But in several ways problems identification and analyze the current use in terms of configuration and bandwidth management applied. Bandwidth management applied by PTIK is with a simple queue model, the model use the segment VLAN based on with bandwidth the specific needs. But problems in the model had weakness in VLAN was so bandwidth idle that could not used by VLAN other and can't specifically distinguish data packet of network traffic on demand as DL and lecture in classifying data packet based on file extension, port list, upload and download traffic, youtube or live streaming.

The Methods used an author in the research by in a customer satisfaction index and servqual as a questionnaire on the satisfaction students. Optimizing methods used technique Hierarchical Token Buckets (HTB) Per Connection Queue (PCQ) and queue tree. Hierarchical Token Buckets (HTB) technique is package scheduling by establishing a structure hierarchical queue, so has the parents of the queue other parent first developed. PCQ is kind of queue based on certain connection designed to distribute traffic evenly across subnet [10]. Data collection with created make a list of items written questions (the questionnaire) as data required needed.
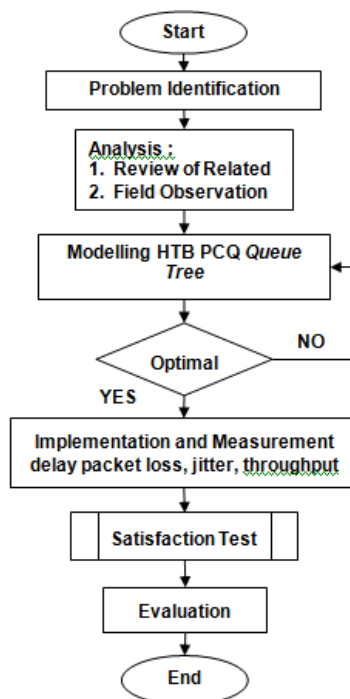

FIGURE 1. Framework optimization of computer networks for distance learning

2.3 MODELING OF HTB PCQ QUEUE TREE

Model of this research is to create a scale of priorities by dividing the four classes of network model bandwidth management of lectures of distance learning PTIK as in a picture 2. Stages in making a model HTB PCQ queue tree namely by dividing the total bandwidth in have PTIK of 20 mbps with four class the model divided each per class as much as 5 mbps, consisting of parent namely Downstream and Upstream to distinguish a traffic due include traffic that in or out traffic and child as tree of parent namely four classes model. On the model of HTB PCQ queue tree having parent and child as a hierarchy tree on management bandwidth with a total bandwidth of 20 mb on a parent has a child is consist of four classes model.
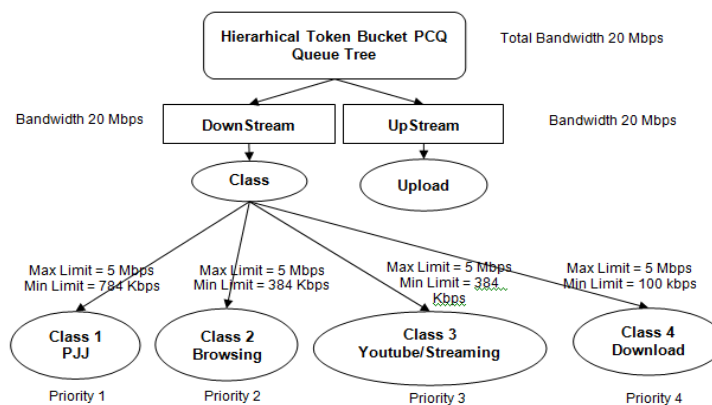

FIGURE 2. Schema model with HTB PCQ queue tree

The first class is a class of distance learning with a maximum limit of the parameters set is 5 Mbps and the minimum limit of 784 Kbps, on the second class is the class browsing with a maximum limit of the parameter set is 5 Mbps limit and minimum of 384 Kbps, at the third class was a class of youtube/streaming with maximum limit parameter on the set is 5 Mbps limit and minimum of 384 Kbps the fourth is on the class, the class with maximum download limit parameter set is 5 Mbps and the minimum limit of 100 Kbps.

Modeling phases in each class have a number of rules among other rules chain functioned as the first is chain rules which the serve consists of the prerouting and postrouting rules. Chain prerouting for marking process from a package incoming traffic that come in to the router, as downloads traffic and chose an interface namely out interfaces. Postrouting chain rules used to mark outgoing traffic through the router as upload the traffic upload and choose an interface namely is In Interfaces. Connection mark used to mark one connection good request and response, while packet mark serves as marking used to mark every package that passes through router. For the rule passthrough serve to continue a flow rule number rules next if passthrough set yes, if passthrough set no so the policy is not continued and will continue next rules as in Figure 3.
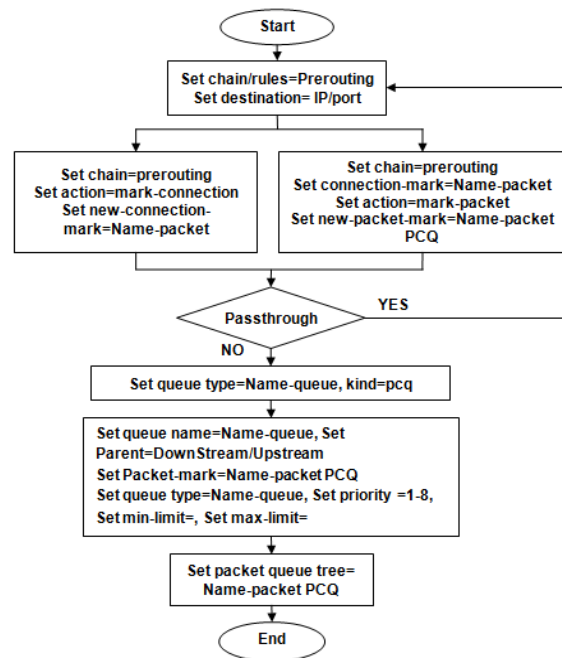
FIGURE 3. Stages of model class rules

3. RESULTS AND ANALYSIS

3.1 IMPLEMENTATION AND MEASUREMENT DELAY, PACKET LOSS, JITTER AND THROUGHPUT

Implemented bandwidth management PTIK using simple queue and optimization model with use Hierarchical Token Bucket (HTB) Per Connection Queue (PCQ) queue tree. On making process network data packet is captured using wireshark. Results of the extraction process network data packet is using two experimental comparison, in the first experiment using implemented simple queue method applied PTIK and in the second experiment using HTB PCQ queue. Capturing data packet on network traffic during the lecture distance learning is divided into two, the first week namely (M1) and the second week (M2) was conducted on Tuesday and Thursday with a time interval measurement and test divided four sessions of lectures distance learning. The first session starts between the hours of 08:00 - 09:00, the second session at 09:00 - 10:00, the third session at 10:00 - 11:00 and the fourth session at 13:00 -14:00. From the results of each session took lectures distance learning the data filtering based on source and destination IP address server webex distance learning, protocol used Distance learning is UDP protocol. Data packet filtering is performed to obtain the value delay, packet loss, jitter and throughput. The mechanism is repeated for a second experiment conducted by researchers with the implementation with divide four model class bandwidth management priorities, with each of the first class is class PJJ/DL, second class is browsing, third class is streaming / youtube and fourth class is download.

The first experiment using the method simple queue applied PTIK on first week (M1) and the second week (M2) Tuesday and Thursday, for the second experiment using the method HTB PCQ queue tree by comparing the measurement of quality of

service parameters value delay, packet loss, jitter and throughput. The first measurement of the parameters is the delay which is the grace period is needed. The results of the analysis data from data packet network distance learning during the process of Wireshark with count the number of packages that are being drawn. The large number of bit produced per unit time with the average yield delay in simple queue of 16,77 ms and PCQ queue tree of 15,82 ms smaller than simple queue of 0.95 ms. The second measurement parameter is the packet loss which is a total package that was sent, calculated rate data of loss rate observed based on the total number of packets sent and packets received. Results of packet loss is the number of packets sent is reduced with the package received divided with packets that are sent with the results the average packet loss. On the method of simple queue of 3.85% and at the PCQ queue tree of 3.84% with different of 0.01% as shown in Figure 4.
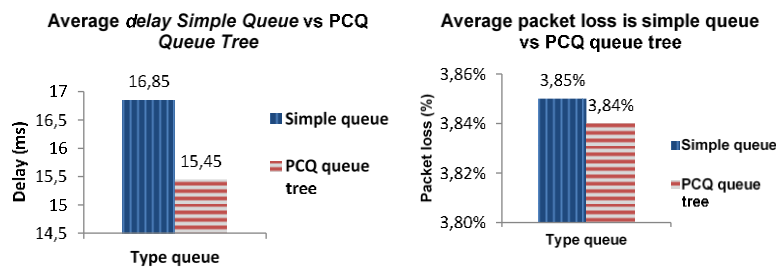

FIGURE 4. The results of the comparison of the average delay and packet loss between the simple queue with the PCQ queue tree

The third measurement parameter is the jitter which is a variation of the time of arrival of a package, calculated delay between packets received is reduced with the package that is sent. The result Jitter average obtained from delay variation divided by the number of package capture, thus the average jitter results on a simple queue of ms 30.44 and PCQ queue tree of 26.56 ms difference in jitter of 3.62 differences ms. The fourth measurement parameters is the throughput is the amount of data sent that come in to a node/network point to a network node to another. Throughput can be obtained with calculated total bytes package that received in a package data of traffic data with time needed from a package first and last, so that the obtained result the average throughput bandwidth usage DL lectures on the method simple queue of 2258 kbps and PCQ queue tree of 2501,63 kbps with distinction throughput difference of 243,63 kbps as in the Figure of 5.
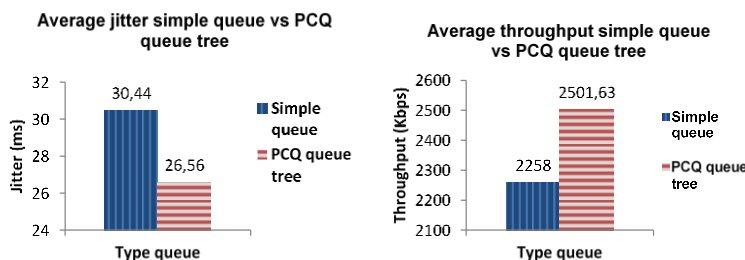

FIGURE 5. The results of the comparison of the average jitter and throughput between simple queue with the PCQ queue tree

It is evident that the fourth average results of the measurements on four parameters quality of service network i.e delay, packet loss, jitter have experienced decline between the method of Simple queue with PCQ queue tree. On the parameters throughput who have increased against, so that it can increasing the performance of quality of computer network DL/PJJ lectures in PTIK Jakarta.

3.2 SATISFACTION TEST

Satisfaction test conducted to measure the satisfaction level of the lecture process Distance Learning (DL) is a student. Methods of test measurement of satisfaction using the Customer Satisfaction Index (CSI) as an index measuring student satisfaction towards the course distance learning using Internet access and service quality or namely is Servqual as a measure of the performance of the services provided by the High Scool Science of POLICE PTIK to lecture DL both infrastructure and services to disturbance during the lecture DL. Framework groove to test satisfaction DL lecture illustrated in Figure 6.
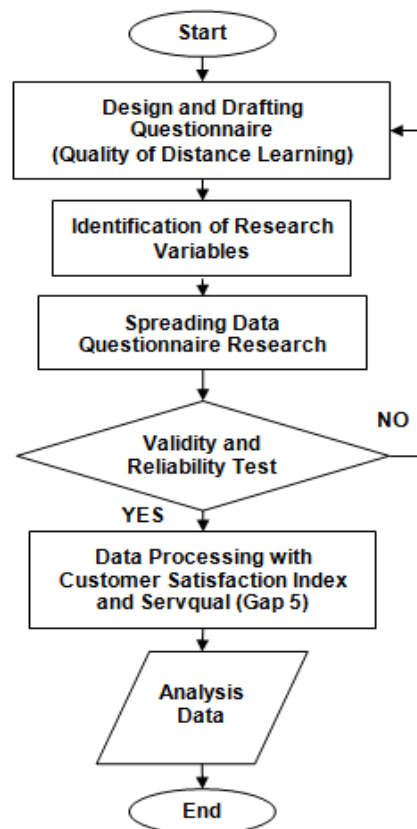

FIGURE 6. Framework satisfaction test for distance learning

3.3 DESIGN AND PREPARATION OF THE QUESTIONNAIRE, THE IDENTIFICATION AND DISSEMINATION OF RESEARCH DATA VARIABLES THE QUESTIONNAIRE

Design and formulation of the question at the questionnaire containing five dimensions of quality of services such as tangible, responsiveness, reliability, assurance and empathy. The purpose of use the Servqual dimensions is a measurement of the gap is to do a program for the improvement in the process of DL lecture and offer quality of services against network interconnection to give optimal results and convenience against users namely students .A method of the sample collection that used is purposive of sampling, purposive of sampling technique is the technique of sample takers by taking into account considerations based on a few certain criteria [11]. In the spread of data the questionnaire, the author took some of the respondents i.e college students to give statements on the quality of services lecture DL PTIK activities. The target respondents in this to research is the student participants DL, with the number of student participants of DL is 405 students. With probability the level of errors in samples population of 10 percent [12].

3.4 VALIDITY AND RELIABILITY TEST

Test validity used as an instrument assessment to test dimensions variable as a whole (infrastructure, support facilities direct and indirect support facilities). An instrument research is said to be valid if the coefficient correlation product moment exceeds 0.3. Reliability test is to understand the extent to which measurement results remain consistent, if the measurement adopted is twice or more. Reliability of measurement to research this using a technique alpha Cronbach, used to measure an attitude or behavior. Criteria an instrument research said reliability if the value of coefficient reliability > 0.6 [12].

3.5 METHODS OF DATA PROCESSING AND CUSTOMER SATISFACTION INDEX WITH SERVQUAL

Questionnaire data processing in measurement of the extent to which the gap between expectations and perceptions of customers top quality Distance Learning lectures in PTIK in service using customer satisfaction index with service quality (Servqual). Servqual was used to measure the difference between the expectations of the customers for the services provided and felt by students over the service of Distance Learning. The variables measured in this research this is to know the infrastructure quality of network in Distance Learning lectures with activities based on five dimensions of service quality of them reliability is the ability to provide the promised services accurately and reliable in academic fields. Assurance is the service quality of the given subject matter. Tangibles describe the physical facilities i.e. internet network interconnection and equipment support services activities in academic lectures. Empathy is caring as well as individual attention to the students. Responsiveness willingness to assist students and provide prompt service. The calculation of the value of the servqual gap consists of five dimensions as a result of the difference between the average value of the perceptions of students with average value results expectations of the students. A positive value indicates the service quality as a value sufficiently defended by the parties PTIK in providing

performance the performance of network DL. A negative value indicates the service quality as a value that needs to be on the increase, as it has not been able to provide the quality of service on the service performance of network DL in PTIK. The results of the calculation of the servqual gap by using the formula of Equation 1 [13].

$$Q = P - E \qquad (1)$$

where, Q is quality of service, P is the user's perceptions of service, E is expectation (hopes) service users

The object of this research is as a support of the research in terms of our satisfaction of students in improve the quality of service of Distance Learning lectures PTIK. To know the level of satisfaction students as a whole of attribute service to measured use Customer Satisfaction Index (CSI) and see the importance of student participants of Distance Learning. To know the CSI with using formula of Equation 2 [13].

$$CSI = \frac{\sum_{i=1}^{p} WSk}{HS} \qquad (2)$$

where, WSk is Weight Score for each variable, p is attributes importance to-p, HS is (Highest Scale) The maximum scale is used.

In table 1 is the value criteria of CSI index as on the level of value expectations and perception of services provided by PTIK to students. The value of CSI is obtained from shared between the total value of weight score (WSK) of each side variables with a maximum scale used in this research was 10.

TABLE 1.
Criteria Value Customer Satisfaction Index (CSI)

Value Criteria	Criteria CSI
0.81 - 1.00	Very Satisfied
0.66 - 0.80	Satisfied
0.51 - 0.65	Quite Satisfied
0.35 - 0.50	Less Satisfied
0.00 - 0.34	Not Satisfied

3.6 ANALYSIS DATA SERVQUAL AND CUSTOMER SATISFACTION INDEX (CSI)

In the determination of sampling collection in knowing a number of population is known with certainty the number of samples involved in them. The number of student participants DL/PJJ is of 405 student participants DL PTIK. The

measurement of the level of satisfaction in lecture PJJ as a support in this research, calculation customer satisfaction index (CSI) using an average score of level expectations and the level perception of each attribute. Based on the results of the calculation has been performed, the obtained value of the CSI of 73%. This CSI value retrieved from shared between total Weight value Score (WS) with maximum scale used in this study i.e. 10 and multiply by 100%, satisfaction index on table 1 criteria value customer satisfaction be range of 0.66 – 0.80 which means overall students PTIK were satisfied with the quality of service lectures DL/PJJ as in table 2.

TABLE 2.

The result of expected value and perception weight scores

Attributes	Average Perception	Average Expectation	Weight Score
X1.1	7.485	7.625	0.31
X1.2	5.966	7.131	0.23
X1.3	5.821	7.2	0.23
X1.4	8.165	7.55	0.33
X1.5	7.203	7.225	0.28
X1.6	6.098	7.169	0.24
X2.1	6.507	7.125	0.25
X2.2	5.553	7.075	0.21
X2.3	5.688	7.062	0.22
X2.4	6.433	7.062	0.25
X2.5	5.601	7.025	0.21
X2.6	6.483	7.175	0.25
X2.7	6.286	7.162	0.24
X2.8	6.232	7.175	0.24
X3.1	7.677	7.762	0.32
X3.2	7.956	7.75	0.33
X3.3	7.986	7.787	0.34
X3.4	7.32	7.575	0.3
X3.5	7.765	7.662	0.32
X4.1	6.242	7.125	0.24
X4.2	5.68	7.137	0.22
X4.3	8.035	7.837	0.34
X4.4	6.618	7.55	0.27
X4.5	5.816	7.175	0.23
X5.1	8.161	7.9	0.35
X5.2	8.095	7.862	0.34
X5.3	8.154	7.862	0.35
Total	185.026	199.745	7.44
CSI = (Weight Score Total / Scale Maximum) x 100 %			74%

3.7 EVALUATION

Evaluation the comparison of the performance measurement optimization computer of networks between the simple queue with pcq queue tree methods the

results to delay of 0,95 ms, packet loss of 0,01 % in Figure 4, jitter of 3,88 ms and throughput of 243,63 kbps in Figure 5.

Evaluation of measurement level of satisfaction at distance learning process very important to know how much hope that can improve carried by PTIK. Calculation customer satisfaction index (CSI) use score average expectations and perception each attributes. Based on the table 2 the results of being done, CSI obtained value of 74 %. The CSI obtained through from divide between the total value of weight score (WS) largest scale used in research is 10 and square on 100 %. Satisfaction index in Table 1 criteria the customer satisfaction be range of 0,66 - 0,80 which means overall PTIK students feel satisfied with respect to quality of services lecture of distance learning.

4. CONCLUSION

A settlement has been successful by used the method HTB Per Connection Queue (PCQ) queue tree by making tissue traffic more specific in setting of bandwidth of the division evenly, so that bandwidth allocation take advantage and use based on priority access distance learning. The model optimization how to application of bandwidth management Distance Learning class between implementation simple queue with pcq queue tree obtained the results of a delay decrease by 6.01 %, 0.26 % result for packet loss, 13,56 % for jitter results and increase 9.5 % throughput to the results. Model PCQ queue tree an implemented can reduce delay and noise so can increase comfort and satisfaction with the students in receive material delivered by lecturers on the process of implemented distance learning. It is also be supported with the result of the questionnaire data capture on student participants pjj one used as a support of the research. The results of questionnaires performance on improvement to the satisfaction services of student participants distance learning of 74 %.

On the model of the priority class browsing there are discharging bandwidth through the http port (80 and 8080) as download. For the further observations can use some parameters include pcq rate. The value parameters quality of network with setting burst time limit, max-limit and min limit. The Class model pcq queue tree can adjust with the desired bandwidth needs.

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