The Network Planning Concept for Increase Quality of Service using Packet Tracer

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Abstract— **Monitoring of data communications in office or company is usually the responsibility of the network administrator and is known as the NOC (network operations center). Network monitoring will be very difficult and complicated when the network administrator does not understand network performance correctly, which can cause long downtime that interferes with work productivity. Determining the shape of the network becomes very important in improving the quality of services as well as to anticipate unwanted events and in the end can find network damage quickly, easily and cheaply. This paper will explain how the packet tracer can be used as a medium for analyzing and designing applications simultaneously function as network monitoring system in the network simulation because it can reflect the real computer network architecture. Using a packet tracer application, simulation of data communication can be used to become information about the state of the computer connection in the network and can be used to retrieve solutions in handling problems that occur accurately. The program results from network design using packet tracer can be used by converting QoS licensing network design program files to Cisco routers.**

Keywords— *network, planning, quality of service, packet tracer.*

I. INTRODUCTION

The development and information requerments of computer networks is very fast and important, especially for network administrators need application network monitoring system computer networks so that connected computer networks can communicate data with other computer networks without being limited by distance and time [1], and along with these developments, the user needs to be quality of the network increasing both the LAN or WAN [2]. The quality of network in question is a computer network that is free from problems such as slow data transmission, unstable connections, etc. so that it can indirectly reduce work productivity [3]. The connection of Computer network is a fundamental thing in a network, because if the connection is problematic then all types of applications run through computer networks cannot be used [4]. Network monitoring is usually done by administrator or NOC (Network Operation Center) [5], it will be a difficult and complicated thing if the administrator does not know the location of the computer or network that works well and which

does not work properly, so that it can cause considerable downtime and disrupt work productivity [6]. Considering the need for computer network information is so important especially to find network damage quickly, easily, and cheaply, to overcome the above problems a network administrator needs a Network Monitoring System application for simulations that can reflect the architecture of computer networks on the network system used [7], as seen in Fig. 1. The network model is a representation of a common structure or protocol for resolving communication between systems and other systems. The form and model of the network should be able to provide a framework for network communication.
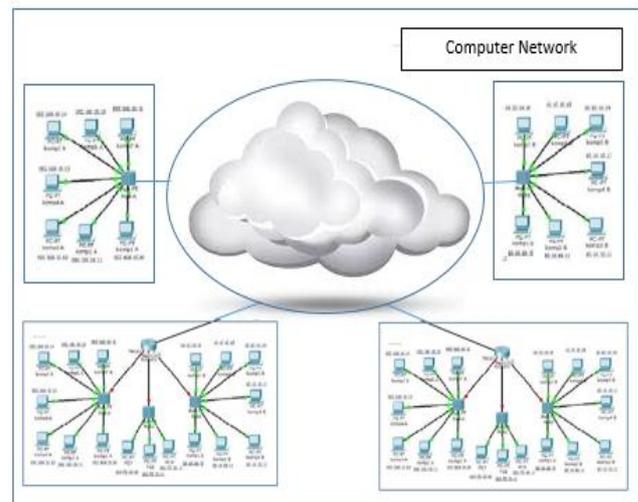

Fig. 1. Computer Network Illustration

By using the Cisco packet tracer applications, simulation data on a computer network can be utilized as information about the state of the computer on a network connection if there are problems in the interconnection network, The QoS program for networks that have been designed in a packet tracer can be used directly by copying files and then installing into the device via a Cisco router [8]. In the mechanism of computer networks, the concept of controlling the traffic of data in the network must really be considered. Control flow is used to regulate the flow of data from two points [9]. Control flow is also used for indirect relationships, such as two points in a packet switching network where both end points are virtual

circuits [10]. Fundamentally it can be said that the function of control flow is to provide an opportunity for the receiver to be able to control the rate of data reception, so that it is not inundated by overflow of data [11].

II. MATERIAL AND METHOD

Before designing, analyzing and monitoring computer networks, it is appropriate for a network administrator to understand of knowledge about the use of static and dynamic networks [12], so that managing a computer network can be stable and reliable.

A. Material tools

In the development of this research, researchers will use hardware and software equipment, for hardware including: Cisco routers, HUB / switches, UTP cables, connector RJ45, wifi, computers for server and clients and mobile smartphone. The software used is based on Microsoft Windows operating system and the packet tracer installer from Cisco products. This research was conducted at STEKOM University Semarang, Indonesia, involving three computer laboratories and in each computer laboratory room consisted of more than 30 computers. The first projects is to design and conceptualize a computer network using packet tracer software. After all goes according to the agreed rules, the application program can be applied to the Cisco Router. The stages of this research can be seen in Fig. 2. Actually to increase the accuracy and level of network security can add fuzzy logic rules [13], then to access data can be divided based on user interests through ranking the need for a computer network [14]. the use of rules and ranking of interests has not been implemented in this paper but will be discussed on another occasion

B. Method of Research

Research in computer networks as a means of deciding the route of information packets must be sent and also the priority of connections used as well as rules for controlling routines and special cases of network traffic. There needs to be a strategic step like the Fig. 2, which adopts the research and development method [15] to minimize the interests of certain parties so that the results of this research are independent and can be satisfying.
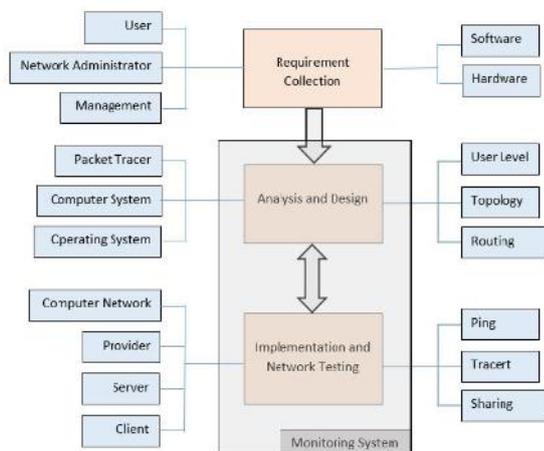
Fig. 2. Stages of Research

At the data collection stage for research needs, researchers involve all stackholders to provide information to be used, including the possible needs for hardware and software. After going through a sufficient analysis process, the design process can be done by planning a model or computer network topology, routing system and users level. Monitoring can be done after the implementation of the network design that has been made before, if there is an error or additional network researcher can repeat the analysis and design stages.

C. Computer Network

Two or more computers can be said to be connected to each other if the computer can exchange information through various transmission media. The computer network is basically a combination of two technologies, namely computer technology with communication technology and the merger produces a data communication technology that can be applied in computers [16]. The network model represents a common structure or protocol to complete of communication between systems. Determining the network topology must be in accordance with the network form needed, in this design using a tree topology, like the design in Fig. 3, to choose a connection in the network can use a cable or use wireless can even use a combination of wireless and cable usage. Maping the computer addresses based on each class in a network system [17].
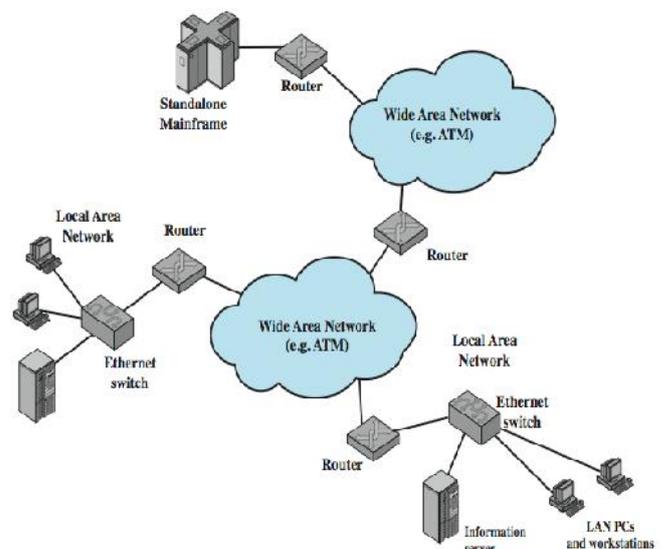
Fig. 3. Design of Computer Network

D. Concentrator Tools

Concentrator is a hardware device that has many ports that will connect several points in a computer network and is usually referred to as HUB or Switch [18]. Before the switch technology was discovered, a network can be divided into several segments with a device called bridge. Bridge has two portethernet. If there is traffic to the network, the bridge will automatically observe the devices involved from both sides (see based on the MAC address). Bridge will then be able to make a decision to forward or not forward each data packet to the destination device [15], [19]. The switch functions to

combine several computers into one network group, as shown in Fig 4. In terms of transmission technology the switch will broadcast all packets that will be sent to one of the destination addresses [20].
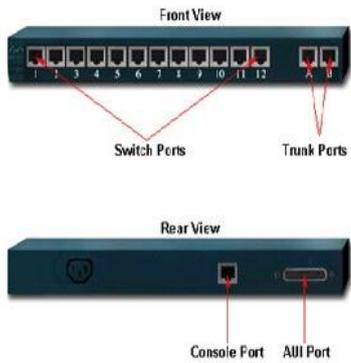

Fig. 4. Switch Connector

E. Router Systems

The working system of this tool is sending data packets through a network or the internet to the destination through a process known as routing. The routing process occurs in layer three of the open system interconnection. The router functions as a liaison between two or more networks to forward data from one network to another. A router is different from a switch. Switch is a link between several tools to form a local area network [18], [21]. Routers can be used to connect many small networks to a larger network, called internetwork, or to divide a large network into several subnetworks to improve performance and also simplify the management system, as seen in Fig. 5. it can also be used to connect LANs to the telecommunications service such as telecommunications leased lines or Digital Subscriber Line (DSL) [22].
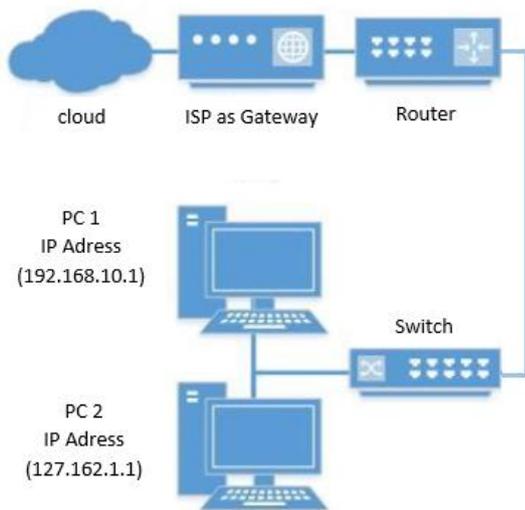

Fig. 5. Router Function

The function of router is to receive packets from the sending station to be forwarded to the destination station. For this purpose, a path in the network must be chosen, so that more than one possible route will appear for sending data. The

function of routing must be realized and must refer to values without errors, simple, sturdy, stable, fair and optimal in addition to remembering the calculation of efficiency factors, so to form routing it must understand routing elements in the form of performance criteria, time decision, place decision , network information sources, routing strategy and adaptive routing updates [3-7].

III. RESULT AND ANALYSIS

Collision will occur when more than one device tries to transmit data at the same time, this is indicated by the process of slowing network traffic caused only one device can transmit data to a segment at a certain time. After the collision occurs, each device must send the data back (retransmit). If the quantity of segments in the network increases, the possibility of a collision will automatically increase [23]. Correct and reliable network design and analysis that suits your needs will be very helpful in dealing with this problem, of course, must be accompanied by continuous monitoring [24]. All of this can be done using the Packet Tracer application.

A. Network Protocol

The form of network protocol that provides a framework for network communication is TCP/IP, it is a combination of two terms, namely TCP stands for Transmission Control Protocol and IP stands for Internet Protocol, TCP/IP are two different types of protocols and not what most people think [9], [11]. The use of the term TCP/IP is often interpreted as a communication protocol for sending data in the data transport [25], and this communication is shown by Fig. 6, so TCP/IP is a collection of protocols that are built so that all computers of various sizes, from various different computer vendors and run with different operating systems to be able to communicate with each other [26].
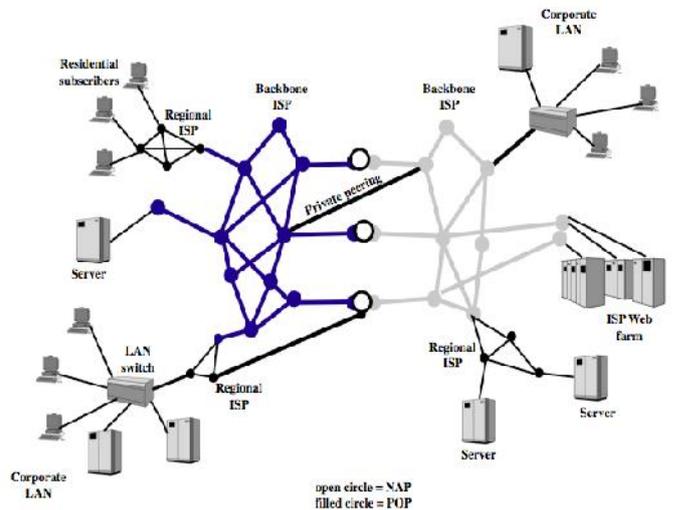

Fig. 6. Communication Protocol

To make a topology model of the computer network to be used can be done by utilizing the work area of the Cisco packet tracer, then selecting the end device to determine the device that want to connect, then use the concentrator as needed, then connect each end device to the concentrator using connection

facility. IP address is the identity of a device in the computer network, the IP address can be created by double clicking on the device that wants to be given an IP address, then selecting the desktop, then select IP configuration, then enter the IP number based on the class specified. As seen in Fig. 7.

Fig. 7. IP Address Configuration

B. Subnetting Technique

In the network simulation images for subnetting setting shown by Fig. 8, there are three separate networks, and each network forms its own computer network, so that between one network and another can be interconnected, then the network must be connected. If the use of the IP address class of each network uses the same class, then in connecting this network can only use equipment in the form of switches, but if each network that will be connected using a different class of IP addresses, then in connecting this network requires a more tools where this tool can control the trafc to be traversed.
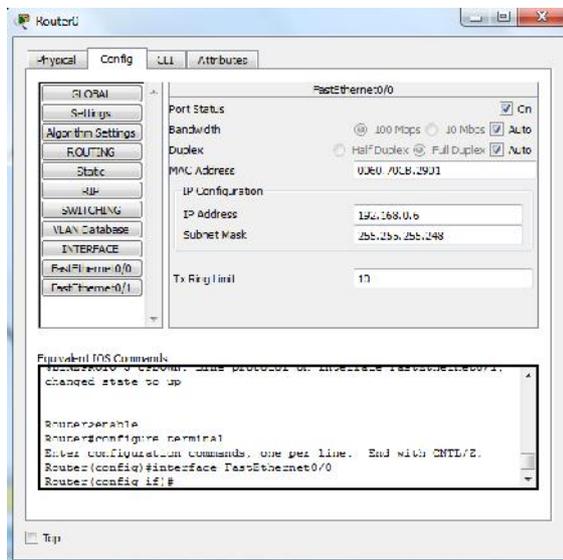

Fig. 8. Subnetting Setting

Subnetmask is an information technology term that refers to 32-bit binary numbers on IPv4 which are used to distinguish network ID from host ID and indicate the location of a host whether on a local network or on an outside network [11], [27].

The use of a subnet mask is also called an address mask as a 32-bit value that is used to distinguish a network identifier from a host identifier in an IP address [9], [28]. A subnet mask is usually expressed in dotted decimal notation, as is the case with an IP address. After all bits are set as part of the network identifier and host identifier, the 32-bit value will be converted to dotted decimal notation. Note that even though it is represented as a dotted decimal notation, the subnet mask is not an IP address. The default subnet mask is based on IP address classes and is used on TCP / IP networks that are not divided into several subnets [9], [11].

C. Management Routing

The computer network in fact consists of several computers that are connected, while a computer network will be connected to another computer network in a network both local and global network [29]. The importance of network management systems as shown in Fig. 9, proves that wise use of internet bandwidth is one solution to overcome expensive bandwidth prices, because the bandwidth must be able to serve hundreds of users who want to use the internet simultaneously. There is a high probability that traffic and bandwidth will be full when used by only a few users, so to anticipate this a continuous system of traffic and bandwidth is needed to monitor Internet usage activities [30].
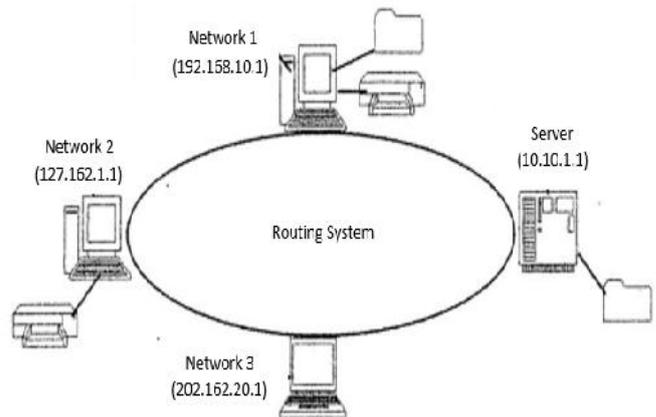

Fig. 9. Management Routing

Limitations of non switched Ethernet, that is, only one device can transmit data to a segment at a certain time. If more than one device tries to transmit data at the same time there will be a collision. After the collision occurs, each device must send the data back. If the number of segments in the network increases, the possibility of collisions will automatically increase, and because of this collision, all devices will retransmit, so network traffic will automatically be relatively slower [31]. The main function of a packet-switched network is to receive packets from the sending station to be forwarded to the receiving station. For this purpose, a route or route in the network must be chosen, so that more than one possible route will appear for flowing data. For that the function of routing must be realized. The routing function itself must refer to value values, among others: without error, simple, sturdy, stable, fair and optimal in addition to remembering the calculation of efficiency factors [32].

D. Monitoring System

Internet activity monitoring is a function of management that is useful for analyzing whether the Internet network is still quite feasible to use or needs additional capacity [33]. The monitoring results can also be used to help if the administrator wants to redesign the existing internet network [34], as seen in Fig. 10. Many things in the network can be monitored, one of which is load internet network traffic that passes on a router or computer interface. Monitoring can be done with the SNMP standard, in addition to internet network load traffic, network conditions must also be monitored, for example the status of up or down of a network equipment. This can be done with the ping utility [35]. Especially in terms of security must also be maintained both in network security and in the room to put down the server [36],[37].
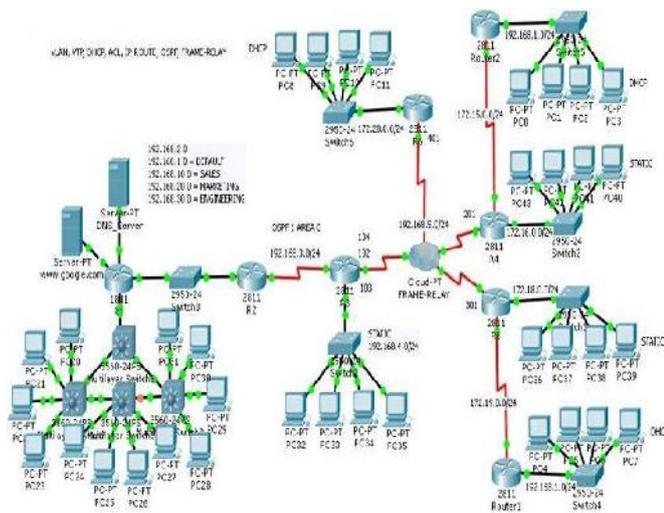

Fig. 10. Network System

The controlling of data traffic must be considered. Control flow is used to regulate the flow of data from two points in order to control the rate of data reception, so that the network is not burdened by data overflow [9], [11], [38]. Control congestion is used to handle congestion. Every packet switched network is a queue network. At each node there is a queue of packets that will be sent to a particular channel. If the speed at which a packet arrives in a queue is greater than the speed of packet transfer, will appear a bottleneck effect [39]. If the queue is getting longer and the nodes that use the channel are also increasing, then the possibility of congestion is very large [40]. The problem caused by the congestion effect is deadlock, which is a condition where a group of nodes cannot continue sending packets because there are no buffers available [41]. Deadlock avoidance techniques used to design the network so that deadlock does not occur [42].

CONCLUSION

The network model represents the structure to complete communication between systems. The routing process occurs in layer three of the open system interconnection. The router functions as a liaison between two or more networks to forward data from one network to another. To use a router in a network, the router must be set so that each network connected to the router in forming a larger scale network can be achieved. The software application of cisco packet tracer can be used to design and analyze the simulation data and the traffic in computer networks and can be utilized as an information about the state of the computer connection in the network so that it can be used to detect damage to the computer network in a fast, easy, and inexpensive.

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