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ANALYSIS AND IMPLEMENTATION OF VIRTUAL LOCAL AREA NETWORK (VLAN) DESIGN USING POX CONTROLLER

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Abstract

The limitations of LAN gave birth to a VLAN technology that allows the configuration of a virtual computer network (virtualization), VLAN is a network model that is not limited to physical locations such as LANs, this results in a network being configured virtually without having to obey the physical location of the equipment, By utilizing various techniques, especially subnetting techniques and the use of better hardware (including switches), the concept of a Virtual Local Area Network (VLAN) emerged which can be maximized compared to a Local Area Network (LAN). In this study, a VLAN network simulation using a Pox controller was carried out so that it could find out the results of the VLAN network evaluation using a Pox controller. The use of VLANs will make network arrangements very flexible where segments can be created depending on the organization or department, regardless of the workstation location, VLANs are also functioned as a method for creating networks that are logically arranged individually, in addition to VLAN techniques. superior to LAN where the average LAN data transmission time is 4 ms longer than VLAN. With this VLAN can create very many LAN segments in an interface. This allows a network to be configured virtually without having to obey the physical location of the equipment.

Keywords: Design, Virtual Local Area Network, Pox Controller

1. Introduction

Currently, the use of computer network technology as a data communication medium is increasing. Along with the increasing level of need and the number of network uses that are used by humans, it is possible to configure a computer network that can provide maximum results both in terms of efficiency, high speed, as well as from increasing network security itself. Almost all information management and storage is carried out with computer equipment and this is easier to do if a computer device is connected to a network, or in general what is often used is a LAN (Local Area Network) network. Technological developments cannot be separated from the development of network technology and hardware, computer networks can be grouped into three types, namely LAN (Local Area Network), MAN (Metropolitan Area Network) and WAN (Wide Area Network) (Muhajir, 2019).

An agency, organization and other places in carrying out their activities need a network, so they can communicate, share information and so on. In this case, it requires an interaction between computer users using a network. One type of application of a computer network is a Local Area Network (LAN). Local Area Network or LAN is a network that is limited in distance / local area (local), where hardware and software equipment are combined to be able to communicate with each other in a limited area. This network is usually built for offices or educational institutions, or for the scope of departments within the company (Syarif, et al., 2019; Haryoyudhanto et al., 2019; Poluakan et al., 2019).

Along with the development of technology, especially in computer software (in the form of operating systems and applications), it is possible to configure a virtual computer network (virtualization) VLANs are used to separate physical networks into several logical networks, in other words VLANs are logical groupings from ports that have independent locations and allow multiple subnets on the same network device, to communicate and each must have a consistent IP address and subnet mask (Ilyas, 2019). Utilization of Virtual Local Area Network (VLAN) technology is used to minimize various performance degradations and to recognize interfaces by spreading user broadcasts in a LAN, so with the support of the VLAN system, it is expected to provide better results in making network settings and can broadcast. in certain groups without depending on the location of the workstation (Haris, 2019).

VLAN is a network model that is not limited to physical locations such as LANs, this results in a network that can be configured virtually without having to obey the physical location of the equipment. The use of VLANs will make network arrangements very flexible where segments can be created depending on the organization or department, without depending on the location of the workstation, VLANs are also functioned as a method for creating networks that are logically arranged independently. VLAN itself is in a Local Area Network (LAN), so that in a network (LAN) there can be one or more VLANs. Thus it is concluded that in a network, one or more networks can be created (networks within a network). The VLAN configuration itself is done through software, so that even if the computer moves, it remains on the same VLAN network. (Sutanto, 2018).

There are several advantages of implementing VLANs in a network, compared to other computer networks and the following is an explanation, (1) Data security from each division can be made separately, because the segments can be separated logically. Segment-limited data traffic (2) Saving on existing bandwidth usage and saving on the cost of upgrading network expansion which can be expensive (3) Division of the network into smaller broadcast domain groups, will reduce packet traffic not needed in the network (4) VLANs facilitate network management because users need various resources in the same segment (5) VLANs combine network users and network equipment to support the company and deal with geographical conditions (6) A network is full of broadcast traffic. VLAN can reduce broadcast delivery to destinations that are not needed so that network performance becomes more effective and efficient.

2. Method

The research method used is the PPDIOO method (Prepare, Plan, Design, Implement, Operate and Optimize), the analysis method to the development of computer network installations which continuously defines the service life cycle needed for Networking development (Solikin, 2017). In the early stages of preparing where at this stage there are several things to do, namely making a flow that explains the stages on the device. Researchers also want to examine a phenomenon that discusses virtual local area network simulation using a pox controller.

Prepare Includes preparation at the organizational level, such as determining network strategy, determining the appropriate business model for the network to be built. Plan Planning network requirements, conducting analysis, and planning project execution time. Design Create a detailed network design. From the data obtained previously, this Design stage will create a design drawing of the interconnection network topology that will be built. Usually the results of the design are: Topology drawings, Creating simulations using Cisco Packet Tracer, and Detailed drawings of estimated requirements. Implement Carry out implementation based on plans and designs that have been made. This stage will take longer than the previous stage. In the implementation of network practitioners will implement everything that has been planned and designed previously. Implementation is a very decisive stage of the success or failure of the project to be built. Operate Network operations and monitor network conditions. This stage is part of the implementation stage, after implementation it is necessary to supervise and monitor its operation and optimize and overcome existing weaknesses.

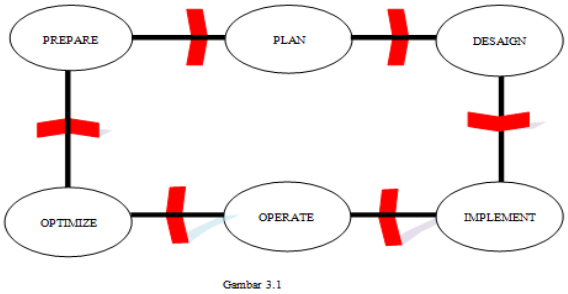

Figure 1. The following are the stages in the PPDIOO method which is the basis of the research

3. Results and Discussion

3.1 Problem Formulation

In Virtual Local Area Network (VLAN) networks using traditional switches, network administrators must configure each network hardware connected to the network. Configuration must follow the configuration of each of the hardware. Each network hardware has a different way of configuration according to the hardware vendor. This is a problem in terms of creating a network using traditional switches which results in network administrators having to know how to configure each connected hardware (Sinuraya & Sembiring, 2014).

From these problems it can be concluded that a solution is needed that can help network administrators in terms of configuration. The solution that can be applied to overcome these problems is to implement a Software Defined Network (SDN). SDN is open and separates the control plane from the data plane so that the SDN network makes it easier for administrators to innovate the network and make the existing infrastructure a logical entity.

In scenario 2 the simulation is carried out for the Conceptual model in this study is to create a simulation concept by creating a topology 2 VLAN network scenario model using a Virtual Network Description (VND) simulation through the website http://www.ramonfontes.com/vnd, then run using mininet and pox controllers. The provisions of the scenario, namely, the number of switches used are 2

switches and 3 switches, then in each scenario there are 6 PCs and 1 pox controller. The input used is the VLAN configuration. On the 2 switches there are 3 PCs which are 3 different VLANs, namely VLAN 10, VLAN 20 and VLAN 30. The following are the inputs for each connected PC (Martias et al., 2019) .

Table.1 PC Input Data

PC	IP ADDRESS	SUBNET MASK	VLAN
PC 0	10.0.0.1	225.255.255.0	10
PC 1	10.0.0.2	255.255.255.0	20
PC 2	10.0.0.3	255.255.255.0	30
PC 3	10.0.0.4	255.255.255.0	10
PC 4	10.0.0.5	255.255.255.0	20
PC 5	10.0.0.6	255.255.255.0	30

The variable used to get the output in this simulation, namely, Jitter Output shows the time it takes for a data packet to be sent from the sending node to the destination node, then the second is Packet Loss output to measure the percentage of the amount of data sent and data received. At the modeling stage, the author makes an illustration of a VLAN network model based on the previous stages. There are 2 VLAN network models that the author made with the following explanation, scenario one uses 2 Switches:

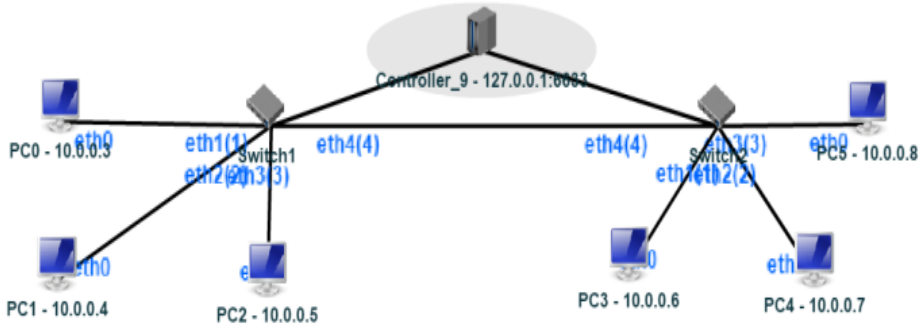

Figure 2. scenario 1 using 2 switches

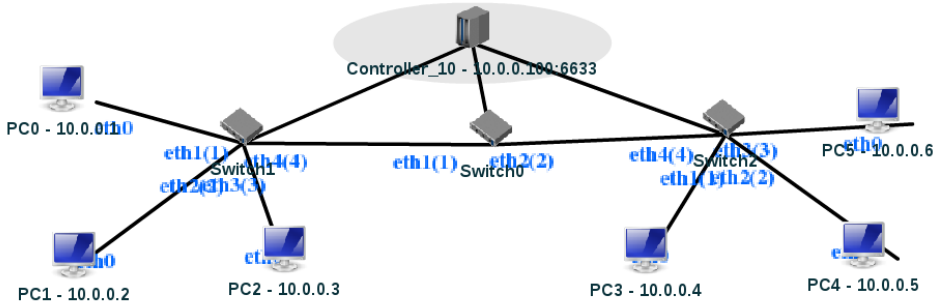

Figure 3. Scenario 2 using 3 switches

3.2 VLAN Test Simulation

To test the connection between VLANs can use the PING or TRACERT commands. for example Tracert from PC4-VLAN11 with IP address 192.168.11.2/24 to PC21-VLAN12 with IP address 192.168.12.9/24 as shown in the Figure below.

```
PC>tracert 192.168.12.9

Tracing route to 192.168.12.9 over a maximum of 30 hops:

  1    1 ms       0 ms       0 ms       192.168.11.1
  2    *          0 ms       0 ms       192.168.12.9

Trace complete.

PC>
```

Figure 4 Tracert PC4-VLAN11 to PC21-VLAN12

```
PC>tracert 192.168.10.2

Tracing route to 192.168.10.2 over a maximum of 30 hops:

  1    0 ms       0 ms       1 ms       192.168.11.1
  2    12 ms      0 ms       0 ms       192.168.10.2

Trace complete.

PC>
```

Figure 5. trace rt PC4-VLAN11 to PC7-VLAN10

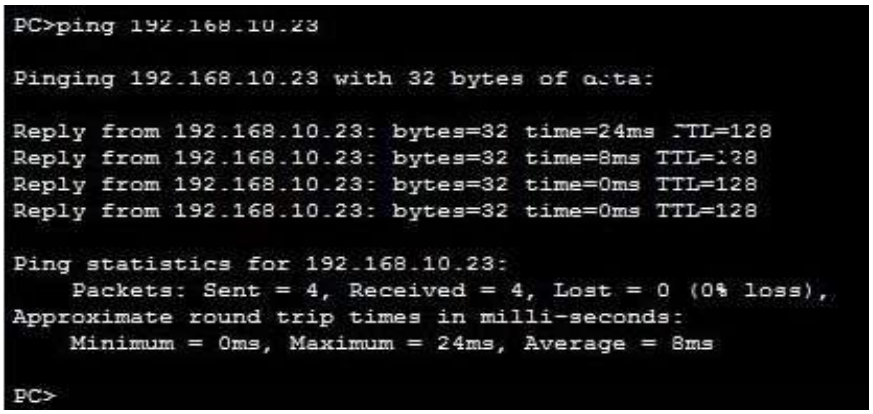

Figure 6 PING from PC4-VLAN 11 to PC 21-VLAN 12 By LAN

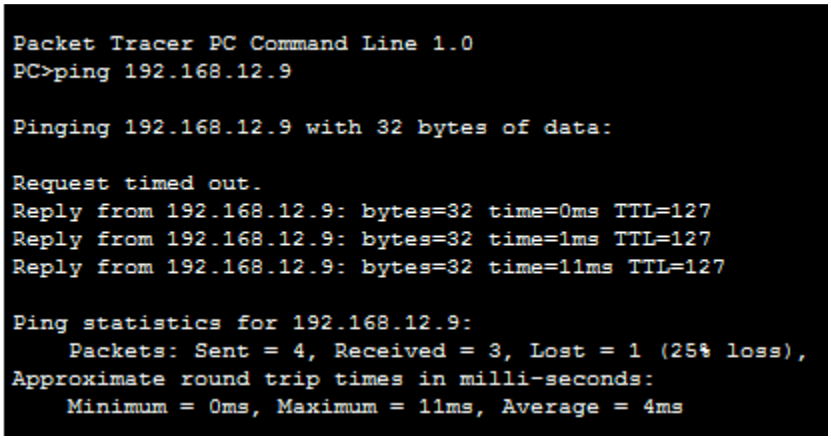

Figure 7 PING from PC4-VLAN 11 to PC 21-VLAN 12 with VLAN

From some of the above tests, the VLAN technique is superior to LAN, where the average LAN data transmission time is 4 ms longer than VLAN. This is because when sending data from PC4-VLAN11 to PC21-VLAN12 using the LAN technique, the Switch will match the destination address for sending data with possible 22 host addresses. Unlike the case when sending data from PC4-VLAN11 to PC21-VLAN12 using the VLAN technique, the Switch will match the destination address for data transmission with the possibility of 8 host addresses on VLAN 12 (Irawan & Fatoni, 2019).

3.3 Verification and Validation

Data verification and validation is carried out by checking whether the network created is appropriate or not. Each scenario will be experimented with at this stage to determine whether the network simulation that has been designed in the previous stage is in accordance with the provisions set out in the

previous stage. If an error occurs in the experiment carried out at this stage, corrections or improvements will be made at the simulation stage (ARIEF & Ade, 2020). If no error occurs, it will proceed to the next stage, namely experimental and output analysis. The scenario carried out at this stage involves testing the network connectivity that has been created on the mininet and sending UDP packets. The time used was 20, 40 and 60 seconds with each time three experiments were carried out. The values that came out at the end of the experiment were Jitter and Packet Loss (Tenie & Irwansyah, 2019). In this phase or stage the author tests the inter-VLAN connection. This test is carried out after running the controller that was created earlier. The test that the author does is to use the pingall command. Pinall is executed after the controller is run. Here's an Figure when pingall after the controller is run:

```
mininet> pingall
*** Ping: testing ping reachability
pc0 -> X X pc3 X X
pc1 -> X X X pc4 X
pc2 -> X X X X pc5
pc3 -> pc0 X X X X
pc4 -> X pc1 X X X
pc5 -> X X pc2 X X
*** Results: 80% dropped (6/30 received)
```

Figure 8. Pinall after the controller is run

The Figure above illustrates the testing of connectivity between PCs. The connectivity check in Figure 3 is carried out after the controller is run and takes 1 minute 20 seconds. The check takes a long time because it checks all connected PCs. The test results show that each pc is only connected to 1 other pc. PC0 is connected to pc3, pc1 is connected to pc4, pc2 is connected to pc5 and vice versa pc3 is connected to pc0, pc4 is connected to pc1 and pc5 is connected to pc2. Pinall also shows that 30 packages can only be sent 6. This is shown in the 6/30 received section (Nursadi & Maria, 2019).

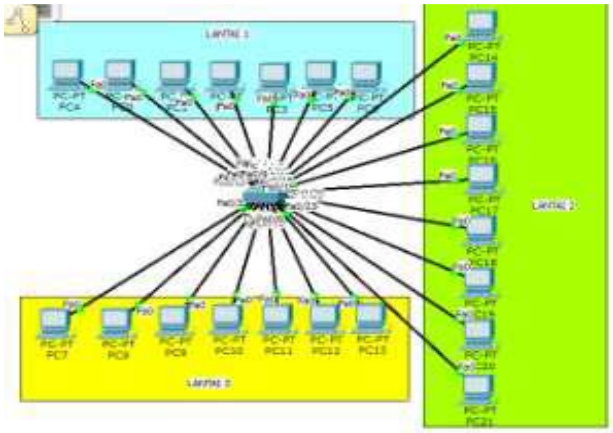

Figure 9 VLAN Network Topology

The picture above shows that all VLAN networks can connect to each other with the help of the dot1Q protocol, but based on the importance and security aspects of each VLAN membership, connections between VLANs are limited by protocol Access Control Lists (ACLs).

3.4 **Network Performance Testing With UDP Packages**

3.4 1 Scenario 1

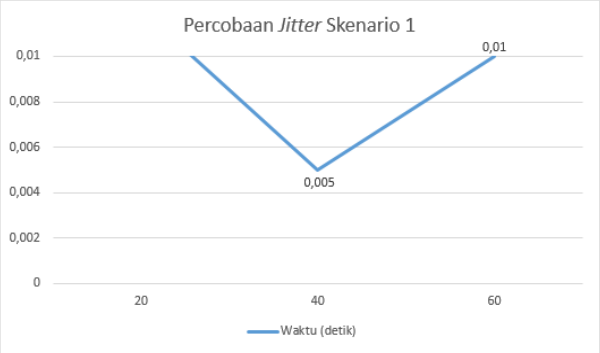

Figure 10. Jitter graph of scenario 1

The Figure above shows the change in the average value of jitter in each experiment. The largest jitter value was shown in the first and third experiments with an experimental time of 20 and 60 seconds. While the smallest jitter value is shown in the second experiment with an experimental time of 40 seconds.

3.5 Output Analysis

The results of the exposure of the experimental results that the authors get in each simulation scenario, then the average value of the jitter and packet loss parameters is taken. The average value of the two parameters from each scenario is compared with each other to get which scenario has the best value for each parameter. The overall results of the simulation are displayed in graphical form.

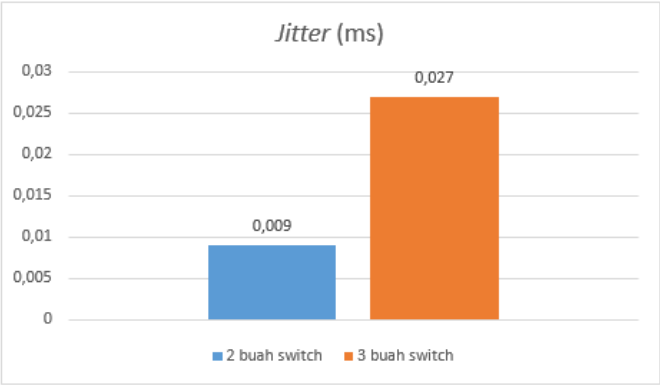

Figure 11. Jitter graph

The Figure above shows a comparison of the average jitter values for each scenario. A network can be said to be good if it has a small jitter value. The smaller the jitter value, the smoother the data transmission process. The results of the simulation that the author did show that the more switches used, the more the jitter value will be.

4. Conclusions

The development of information and communication technology has progressed very rapidly. This is due to the era of globalization, where computers and the internet with their dynamic nature dominate various life activities, so that educational, office and industrial activities absolutely require the availability of these facilities. VLAN is a method for creating networks that are logically arranged independently. VLAN itself is in a Local Area Network (LAN), so that in a network (LAN) there can be one or more VLANs. Thus it is concluded that in a network, one or more networks can be created (networks within a network). The VLAN configuration itself is done through software, so that even if the computer moves, it remains on the same VLAN network. VLANs have advantages compared to conventional LANs, including being able to improve network performance, besides that VLANs can reduce broadcast delivery to destinations that are not needed so that network performance becomes more effective and efficient.

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