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An Efficient VLAN Implementation to decrease Traffic Load in a Network

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ABSTRACT

To share the information between communication devices, each machine should be connected to the web.This means that a network plays a major role in sharing the information. This paper discusses about designing an efficient VLAN to decrease traffic load in a network. Inorder to decrease the traffic load, a concept called VLAN is implemented. A VLAN is a virtual local area network that enables multiple networks to function functionally as one LAN. The primary goal of VLAN implementation is to boost network performance by reducing the number of transmitted domains. Domain transmission is a functional division of a computer networking network, in which every node is accessible by broadcasting. In the context of computer networks, the communication is a way to transmit information concurrently to all recipients. Through creating several broadcast domains, VLANs can help manage broadcast traffic. Dividing a wide network into smaller, isolated components limits the frequency of radio transmission in each network unit and section of the network. The VLAN specification needs to be safe and reliable enough. This research shows the benefits of improving the performance of a network by decreasing the traffic load, first, adds additional security to the network by restricting the users from sharing the information, second.

Key words : Network, VLAN, traffic load, broadcast domain.

1.INTRODUCTION

No matter how large the enterprise or technology, every organization needs a variety of network security strategies to defend it against ever-growing cyber threats today in the countryside. The present network infrastructure is dynamic and faces a constantly changing threat landscape and attackers that actively try to exploit and find vulnerabilities. In many places, including hardware, files, applications and users, such vulnerabilities may occur. Therefore many resources and softwares are in use today to manage specific risks and vulnerabilities as well as administrative failures to comply. Effective network management allows businesses reduce the possibility of data manipulation and intrusion being victims. Network protection helps shield workstations from malicious spyware, and can also render shared data secure. A network is an assembly of computers and other components connected through communication channels which enables information and resource sharing. The network essentially contains hardware components like servers, hubs, switches, routers, wireless access points, and other network infrastructure equipment. These are machines with various technical advices such as radio waves and wires that have a crucial role to play in data transfer from one location to another, allowing network-connected devices to interact between themselves and with other networks, including the internet. In terms of security, performance, management and productivity the great advantage of networking can be clearly observed, because this facilitates communication among the users of a wide spectrum.

Networks are of a broad variety of networking and Local Area Network (LAN) and Wide Area Network (WAN) are the most popular networks. A LAN network contains two or more computers, usually at home, workplaces or college, that are linked together over a short distance. WAN is a network which covers cities, countries and the world rather than LAN in general. We first need to understand the definition of LANs before considering VLANs. A LAN for example, comprises all consumer computers, servers, switches, routers, sensors, cables and wireless access points from one point of view. However, a more technical definition of LANs can help in understanding the concept of a Virtual LAN. All computers in one Broadcast area are part of a LAN. A broadcast domain contains the collection of all LAN-based devices, so that all other computers are supplied with a copy of the frame when any of the devices sends broadcast frames. A VLAN is a collection of machines that can be programmed to link on one or more LANs in the same manner as if it were wired to the same network, but these are situated at a range of different LAN segments. VLANs are extremely flexible because they are focused on logical and not on physical connections.

2.RELATED WORK

Yuya SASAKI, Tetsuya YOKOTANI, Hiroaki MUKAI [1] has summarized the problem of applying MQTT communication within a wide-area IoT network. They has proposed a system to provide efficient MQTT communication using legacy and MQTT communication coexisting in a wide-area network.

Aranda Equsquiza S, Rojas-Moreno A [2] has implemented the creation of logical subnet using the VLAN–ID method, which permits the identification of each subnet without modifying the IP addresses of the equipment.

Sierszen A, Przylucki S [3] has to do More work on improving the network algorithm for switching between single root bridge switches has been demonstrated. This is important.

Haiyan Y [4] has summarized that the core switches enable different VLAN data to arrive by different links so as to realize the gateway redundancy backup and achieve the aim of load balancing and link backup.

Chu Hung-Mao, Wang Pi-Chung [5] has introduced the Ethernet root selection method to prevent overlapping root switches when several root arbors of several VLANs share a limited number of root switches.

Lehocine M.B, Batouche [6] have analyzed the requirements and mandatory knowledge needed to develop ANM solutions designed for traditional networks, in comparison with flexibly and customizable applications in SDN networks. This research was materialized by studying the use case of VLAN filtering and segmentation, where lot of requirements have been vanished with SDN.

Koerner M, Kao O [7] has introduced prototype which is a full functional proof of concept work, which demonstrates the variety of SDN applications. It was developed and evaluated within the scope of SDN application for campus and enterprise networks.

Hu Kai-Cheng, Shih-Wei Wang [8] has summarized that the purpose of the future approach is to apply it to various problems of optimisation and simplify search process diversity controls so that it relies more on identified search areas than on predetermined criteria, to increase search outcome efficiency.

Zhang Z, Huang X, Keune B, Cao Y, Li Y [9] has proposed that the standard data flow has been quantitatively analyzed and the output is assessed for a sub-station based on VLAN in real-time. It can be inferred that laying down proper VLAN schemes will significantly reduce the data flow by reducing the cyclic SAVs within the bay and thereby minimize the use of the network connections and the SCN Ethernet latency.

Zhai G, Long Z, Zhong j, Cui Y [10] has proposed to break the room constraint of conventional research with simulated demonstration. It not only demonstrates the cycle of experimenting with reality, the nature of existence and perception but also provides experimenters with a kind of simulated learning environment. The question of modern research in practice sessions is effectively solved.

Schoofs A, Ruzzelli A.G, O'Hare G.M.P [11] has shown that the measurement of the energy waste after hours can be carried out at central locations without using company machinery program agents or without involving the analysis in situ of the power state of the machinery

Caro Luis F, Papadimitirou D, Marzo Jose L [12] studied the space-value sparsity of the ELS tags.The strategies for aggregating and marking fusion were updated and assessed to optimize the use of label volume. The granularity of the bandwidth for the labels was analyzed as a measure of the sparsity of the labels and the introduction and validation of three conventional routing algorithms.

Bahri A, Chamberland S [13] have studied the problem of designing WLAN and proposed an optimization model for selecting the location of the as well as the power and the channel of each APs. They have presented a mathematical formulation of this design problem. A heuristic for generating initial solutions and a tabu search algorithm for improving this initial solution have been proposed.

3.PROPOSED SYSTEM

We once realized the Local Area Network (LAN) was taking a particular path. But for some of us it may still be a little difficult to grasp what VLANs are and how they function. Inorder to further clarify it up, I describe the VLAN definition not just in terms but also by utilizing diagrams by contrasting the VLAN with our normal flat switched network. Let us begin by evaluating a usually configured network easily, pointing to its key features and then going on to VLANs.

3.1 The Traditional Switched Network

Nearly every network today has a switch that links all network nodes such that nodes can interact easily and efficiently. Switches in our network today are what hubs have been a long time back, so definitely there are no doubts. While switches can match most networking styles, they do not fit mid to large sized networks, where it is not simple to link a switch into the outlet and hang a few PCs away! We all know well in general that switches are layer 2 machines that build a flat network. Figure 1 shows the basic architecture of a network.

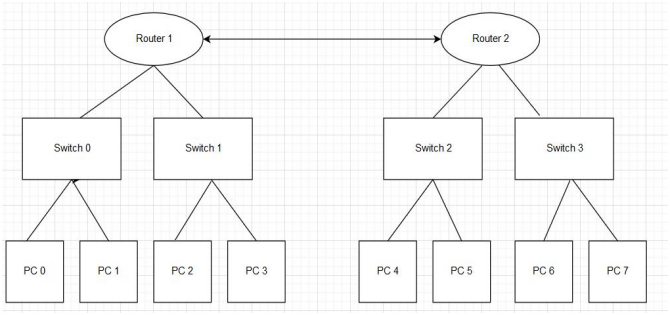

Figure1: Basic architecture of a network.

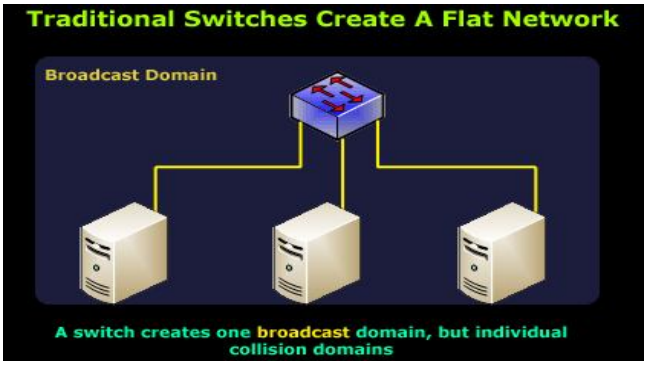

Figure 2: Traditional switches create a flat network.

Figure 2 shows the traditional switches create a flat network.A connection with three workstations attached are shown in the above network scheme. The workstations are able to connect and are a part of the same transmission network, which ensures that the remainder can obtain a transmittal if one workstation sends the transmission. Several broadcastings in a limited network might not be really troublesome, but as the network increases in scale, broadcasts can overwhelm the network as waste (most times!) and drain a precious bandwidth to the degree that they tend to become a major concern! See the following illustration for visual interpretation of the issue and also the concept of a wide flat network. Figure 3 shows the flat network.

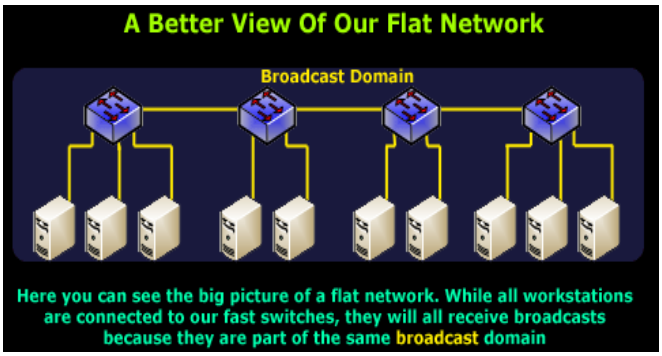

Figure 3: Flat Network

As we fill the network with more switches and operating stations, the issue is getting apparent here. Because most workstations are typically fitted with the Windows operating system, it can often contribute to unwanted transmissions on the network's cable, which we are sure to prevent. Another major concern is security. In the above network, all users are able to see all devices. This will mean that everybody should be given network access and of course they would be more vulnerable to an intrusion in a much wider network with a sensitive file servers, databases and other classified material. To shield these devices from your network efficiently, you will need to limit the network access by segmentation of the current network or simply put a firewall around each system. Nonetheless, most administrators would only worry about that only in terms of expenses and challenges. Fortunately, there is always a solution.

4.METHODOLOGY

The methodology applied for this project is Virtual Local Area Network. Here we are implementing Static VLAN which is based on port numbers. The formation of VLANs will overlook all the problems and many more atleast to some extent. As most of us are aware, we need a layer 2 switch which supports VLANs to build (and function with) them. Since VLANs have millions of mathematical computations, they involve special hardware that is included with the switch, so at the point of purchasing the switch will accept VLANs, or we won't be able to set up VLANs on it. A separate network is created for any VLAN on a switch. This implies that for any current VLAN, a separate broadcast domain is established.

4.1 CISCO Packet Tracer

Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks.
The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface.

4.2 VLAN Creation

a. COMMANDS

switch(config)#vlan<number>
switch(config-vlan)#name<name>
switch(config-vlan)#exit

To verify the status, we use the command show vlan.

4.3 Assigning Ports in a VLAN

a. COMMANDS

switch(config)#interface<interface type><interface number>
switch(config-if)#switchport mode access
switch(config-if)#switchport access vlan<number>

To shift multiple ports at a time, we use the command
switch(config)#interface range<interface type><interface number>

Network transmission is segregated by design from all ports of a system not belonging to the same VLAN and this is why VLANs are commonly used in the big network today as they tend to separate the network segments. To help create the visual picture on how VLANs differentiate from switches, consider the following diagram:

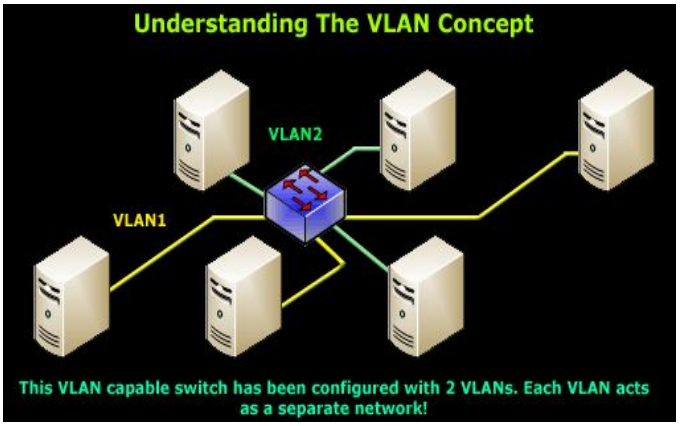

Figure 4: Understanding the VLAN concept.

Here is a tiny network of 6 workstations connected to a VLAN switch. This function is configured by 2 VLANs, by VLAN1 and by VLAN2 and has been allocated to three workstations per VLAN.

VLANs = Separate Broadcast Domains

We have now established 2 broadcast domains with the development of our VLANs. This implies that, when a workstation in either VLAN sends a transmission, the port belonging to the same VLAN as that created by the broadcast shall spread to the workstation.

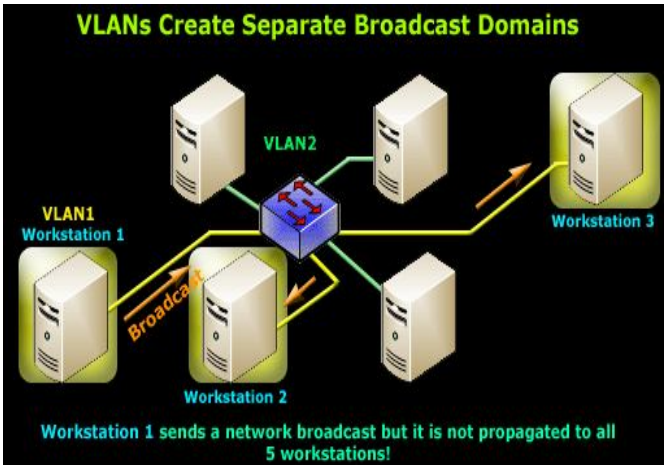

Figure 5: VLANs create separate broadcast domains.

The map above demonstrates explicitly that the Workstation 1, that isVLAN1, transmits network transmissions (FF: FF: FF: FF: FF: FF: FF: FF: FF: FF: FF: FF). This switch collects and passes the broadcast to Workstations 2 and 3 as if those three workstations were attached to a regular switch, although VLAN2 workstations are entirely ignorant of the broadcast transmitted by VLAN1, since they do not receive any packets streaming throughout the network. To help clear any questions or doubts on how the above setup works, the diagram below shows the logical equivalent setup of our example network:

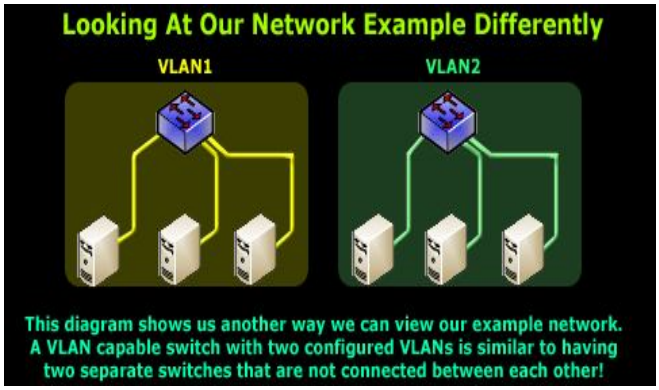

Figure 6: Network example

At this point, we will continue to see the obvious benefits of utilizing VLANs on your network. As the network absorbs more hosts and the amount of VLANs is increased, reliability, expense, and network traffic are decreased.

4.4 VLANs help reduce the cost

Let us take an illustration and quickly hit the financial side of things and see just how we save money with VLANs. Imagine that you are the network manager of a big organization and that the entire network system needs to be split into 12 different networks, but without the capacity to connect with these new networks. Provided that the cable system has already been mounted, we only need to link the ports for each network to one switch and a total of 12 switch switches are expected for each network. The latter function of VLANs may be accomplished with a single or more VLAN compatible switches covering the amount of hosts to which we will link, and the expense is definitely much smaller than that of 12 switches.

5. RESULTS AND SCREENSHOTS

Here are the results of the work performed in the simulation tool named Cisco Packet Tracer (CPT). The figure below represents the implementation of a normal network with network devices like routers, switches, and communicating devices.

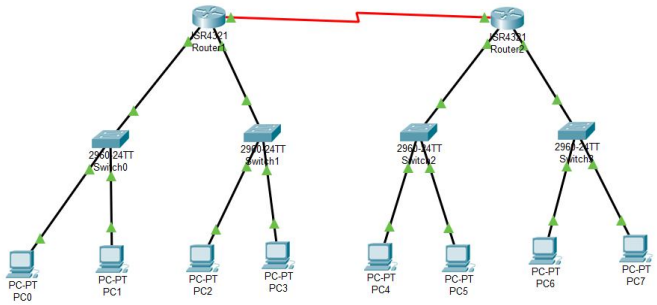

Figure 7: Network Implementation

5.1 System Communication Visuals

These are the ping commands executed in command prompt which shows whether the devices that are connected are able to communicate properly or not.

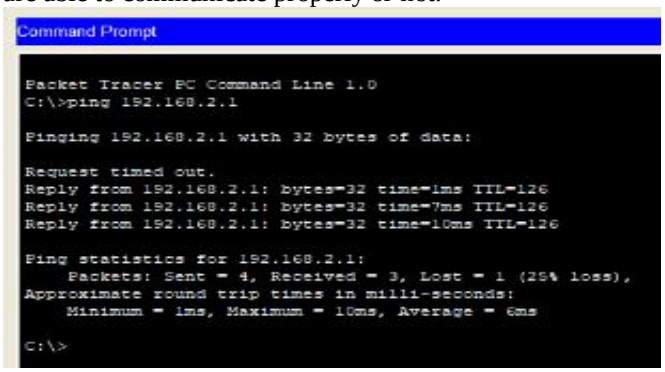

Figure 8: System Communication Visual-1.

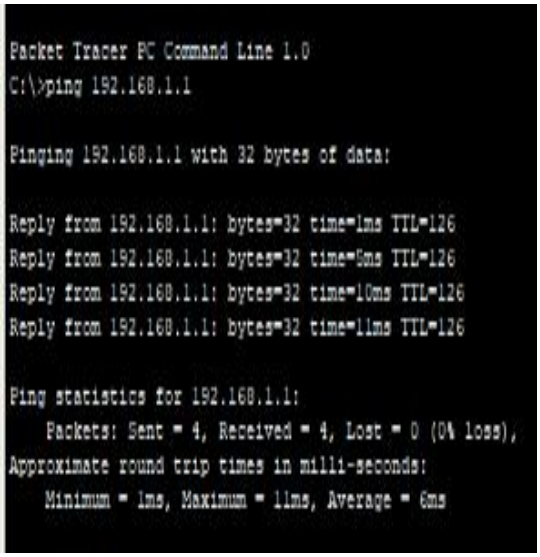

Figure 9: System Communication Visual-2.

5.2 Packet sharing between communicating devices in a normal Network

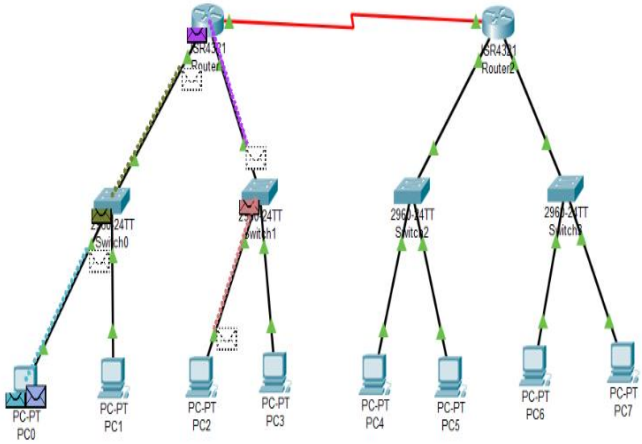

Figure 10: Packet sharing in a normal network-1

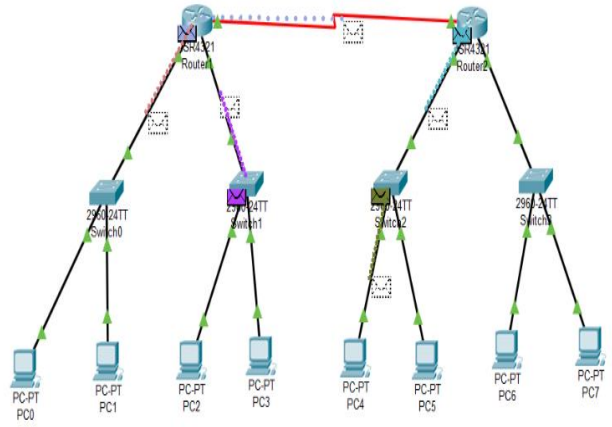

Figure 11: Packet sharing in a normal network-2

Here in the above figure, we can observe that the data packets are sent through the whole network since Switch 0 broadcasts the packets. So there is no guarantee for the data. In order to overcome this issue, we implement VLAN in the switch.
In the above figure, we shifted the ports of a switch as per our requirement by using Static VLAN method.

5.3 Shifting ports in a Switch

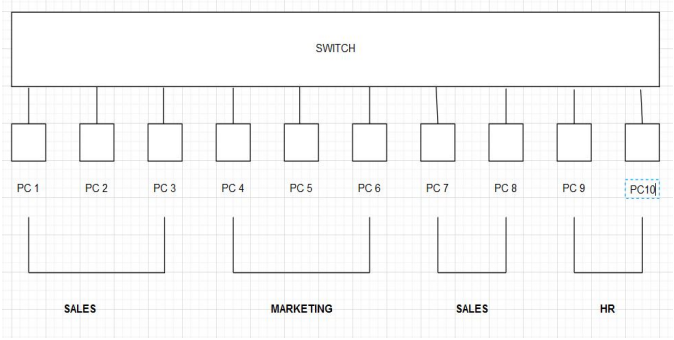

Figure 12: Shifting ports in a switch.

We created three departments like Sales, Marketing, HR for VLAN 10, VLAN 20, VLAN 30 respectively. The ports assigned to the VLANs are:

- VLAN 10 - 1,2,3,7,8
- VLAN 20 - 4,5,6
- VLAN 30 - 9,10

Now these three departments acts like three separate networks although they are present only in a single switch. This is the major purpose of using a VLAN. So if there is any broadcast in the switch, the data packets will be send only to the devices of intended departments. Thus the VLANs provide additional security to the networks.

5.4 VLAN creation

We can create VLANs in a switch in the command line interface of the Cisco Packet Tracer.

```
Gig0/2
10   sales                              active
20   marketing                          active
30   hr                                 active
1002 fddi-default                       active
1003 token-ring-default                 active
1004 fddinet-default                    active
1005 trnet-default                      active
```

Figure 13: VLAN Creation

PORTS ASSIGNED TO VLANs

```
10   sales                              active    Fa0/1, Fa0/2,
Fa0/3, Fa0/7
                                                  Fa0/8
20   marketing                          active    Fa0/4, Fa0/5,
Fa0/6
30   hr                                 active    Fa0/9, Fa0/10
1002 fddi-default                       active
1003 token-ring-default                 active
1004 fddinet-default                    active
1005 trnet-default                      active
```

Figure 14: Ports assigned to VLANs.

The above figure shows that the ports 1,2,3,7,8 are assigned to VLAN 10 which is named as Sales. The ports 4,5,6 are assigned to VLAN 20 named Marketing and the ports 9,10 are assigned to VLAN 30 which is named as HR.

5.5 Packet transfer in Network with VLAN

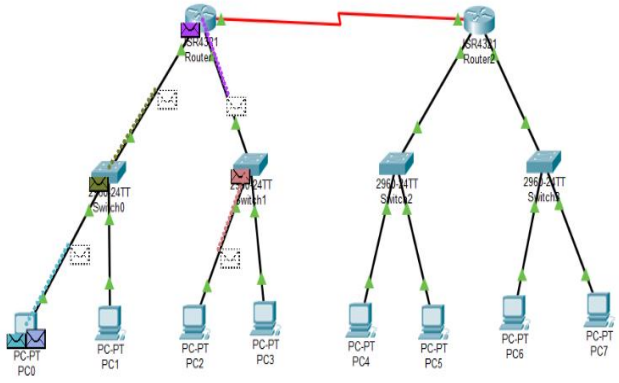

Figure 15: Packet Transfer with VLAN

The above figure shows that the data packets are transmitting only to some devices which are intended to receive the data but not to the entire network. This is only because we have created VLANs to the switches present in the network.

6.CONCLUSION

We can observe that the data packets are transferred only the intended devices because we created VLAN in the switches. Thus we reduced the traffic load in the network because data will not be shared through the entire network. Since data is not shared through the whole network, we are providing additional security to the data in the network.

7.LIMITATIONS AND FUTURE SCOPE

Static routing is implemented in this project which means that the administrator has to configure the network manually and the path between two routers cannot be updated automatically. This might become a burden to the network admin when the size of the network increases.
I feel that the future direction can be the implementation of Dynamic routing in which the routing paths between the routers are updated automatically.

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