

**VIRTUAL LAN IMPLEMENTATION FOR
CONSUMER PROTECTION POLICE DIVISION**

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Thematic Paper
entitled
**VIRTUAL LAN IMPLEMENTATION FOR
CONSUMER PROTECTION POLICE DIVISION**

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ABSTRACT

This research illustrates the logical network technology which is called Virtual LAN or VLAN to develop the Consumer Protection Police Division. The research also provides the advantage of VLAN over the traditional LAN system and demonstrates the VLAN configuration of the organization. Moreover, the comparison of performance and security between the VLAN and the LAN system after the implementation is also provided.

This research analyzes the old network system of the Consumer Protection Police Division organization and shows how the VLAN system develops its network system. VLAN can support the organization in network security improvement, cost reduction and network performance increasing which make the organization's network better than ever.

KEY WORDS: VLAN IMPLEMENTATION / CPPD / VTP

50 pages

การประยุกต์ใช้ VLAN กับกองบังคับการปราบปรามการกระทำความผิดเกี่ยวกับการคุ้มครอง
ผู้บริโภค

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บทคัดย่อ

งานวิจัยนี้แสดงให้เห็นถึงการนำเทคโนโลยีเครือข่ายเสมือน หรือที่เรียกว่า VLAN มา
ประยุกต์ใช้กับกองบังคับการปราบปรามการกระทำความผิดเกี่ยวกับการคุ้มครองผู้บริโภค ซึ่ง
กล่าวถึงประโยชน์ที่ได้รับจากการนำ VLAN มาใช้แทนระบบ LAN เดิม รวมถึงแสดงการตั้งค่า
VLAN ในองค์กร นอกจากนี้ยังได้สรุปผลของการประยุกต์ใช้ และประโยชน์ด้านความปลอดภัย
ระหว่าง VLAN และระบบ LAN เดิมหลังจากที่ได้ทดลองใช้งาน

การวิจัยนี้วิเคราะห์ระบบเครือข่ายเก่าของกองบังคับการปราบปรามการกระทำ
ความผิดเกี่ยวกับการคุ้มครองผู้บริโภค และแสดงให้เห็นว่าจะพัฒนาเป็นระบบ VLAN ได้อย่างไร
ระบบ VLAN สามารถตอบสนององค์กรในด้านการปรับปรุงความปลอดภัยของเครือข่าย การลด
ต้นทุน และเพิ่มประสิทธิภาพของเครือข่าย ซึ่งทำให้ระบบเครือข่ายขององค์กรดีขึ้นกว่าเดิม

50 หน้า

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CHAPTER I

INTRODUCTION

1.1 History and Importance of the Problem

In general, computer networking is very essential in running business as it allows people to share information between two devices or more such as computer desktop, laptop, and cell phone via transmission devices through the Internetworking. So nobody is able to give a reason why an organization can work efficiently without the Internetworking. A Local Area Network or LAN is a group of computers or other devices that are physically connected together and these computers communicate to each other via network devices such as hubs and switches and transmissions medium such as twisted pair cables, coaxial cables, fiber-optic cables, and wireless access points. The LAN is usually connected in a building area for sharing resources purposes and is defined as a broadcast domain. Mostly, LANs are connected to Wide Area Networks or WANs using routers.

To learn more about computer networking, the network is categorized into 3 types which are Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN). Some organizations in all countries have been applying LAN to their network system. However, LAN is not optimal for a large organization. Therefore, a new technology had been developed which is Virtual Local Area Network (VLAN). VLAN is better than the tradition LAN technology for many reasons. VLANs are designed to divide the physical LANs into logical groups mostly in case of workgroups in the large organization which will be discussed in more detail in chapter 3. The switch that can support VLAN configuration is more expensive than traditional LAN switch whereas, it can divide workgroup into many groups. Therefore, it is worth to apply VLAN to large organization network such as the Consumer Protection Police Division (CPPD) which currently applies traditional LAN network. Currently, the Internet usage in CPPD organization faces some difficulties in network management, such as increasing of users, office layout arrangement due to the

physical LAN network. In addition, the commutation on the network is very slow because there are many users share data without creating department group.

1.2 The Purpose of the Research

The purpose of this research is to analyze the difficulty of business organizations such as Consumer Protection Police Division (CPPD) which do not apply the Virtual Local Area Network (VLAN) technology to their network systems and find the solution. This research also clarifies the VLAN concept including VTP (VLAN Trunk Protocol) which are mostly used in large business organizations and universities, and compare the advantages and disadvantages of new network system after applying VLAN technology in CPPD. Lastly, the network security of VLAN technology is also analyzed.

1.3 The Scope of the Operations

1.3.1 To compare the traditional LAN to VLAN and explain the advantages of the large organizations, which apply VLAN to their network system.

1.3.2 To analyze the cost of LAN switch VLAN and traditional LAN switch and describe the reason of purchasing VLAN.

1.3.3 To illustrate how VLAN is implemented in the business organization via a network simulator, which is packet tracer.

1.3.4 To compare the advantages and disadvantages of VLAN comparing to LAN technology

1.4 The Expected Benefits

1.4.1 To learn more information about VLAN system including its advantage and disadvantage.

1.4.2 To recommend VLAN concept to solve a difficulty of the Consumer Protection Police Division (CPPD).

1.4.3 To learn how to configure LAN switch that support VLAN technology.

1.4.4 To know the security level of VLAN comparing to LAN technology.

CHAPTER II

LITERATURE REVIEW

The contents of this chapter are reviewed about the literatures and other application that related to work. To deeply understand how VLAN technology is perform in Consumer Protection Police Division (CPPD), these following contents are needed to review:

- 2.1 Local Area Network
- 2.2 Internet Protocol
- 2.3 VLAN concept
- 2.4 Central Investigation Bureau
- 2.5 Consumer Protection Police Division (CPPD)
- 2.6 Packet Tracer
- 2.7 Colasoft Capsa 7 (Network Traffic analyzer)
- 2.8 Related research

2.1 Local Area Network

Before discuss about VLAN technology, the understanding of traditional LAN is important. Local Area Network or LAN is a set of computers or other devices such as smart phones, and tablet that are physically linked to each other and those devices communicate to each other passing through network devices such as switches, and hubs and transmissions medium are twisted pair cables, coaxial cables, fiber-optic cables, and wireless. In general, LAN connection is applied in a building area and the objective of LAN is sharing resources. As shown in figure 2.1, the LAN is divided into 2 networks. It is defined as a broadcast domain. Regularly, LANs are connected to Wide Area Networks or WANs via routers.

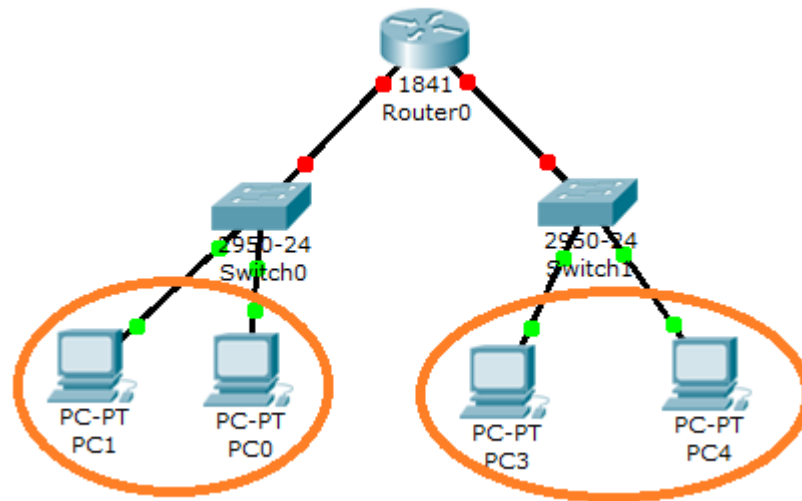


Figure 2.1: Architecture of 2 LAN connections

2.2 Internet Protocol

Internet Protocol address or IP address is an address of one or more computers or other devices on a network. "192.168.1.100" is an example of IP address using TCP/IP standard. The number is comparable to addresses of a house Data is delivered from origin to the desired destination on network.

IP address are divided into 5 classes which are Class A, Class B, Class C, Class D and Class E, whereas only class A, B, and C are generally used. Each class has their own a range of IP addresses as following table:

Table 2.1: Internet Protocol

Class	Address Range	Supports
A	1.0.0.1 to 126.255.255.254	Support 127 networks and 16 million hosts per network
B	128.1.0.1 to 191.255.255.254	Support 16,384 networks and 65,534 hosts per network
C	192.0.1.1 to 223.255.254.254	Support 2 million networks and 254 hosts per network
D	224.0.0.0 to 239.255.255.255	Reserved for multicast groups.
E	240.0.0.0 to 254.255.255.254	Reserved for future use, or Research and Development Purposes.

The address ranges from 127.0.0.0 to 127.255.255.255 are reserved for the local host. Usually, when we ping local host, it would be IP 127.0.0.1 which is called loopback address. The address range 255.255.255.255 broadcasts to all hosts on the local network.

In an office generally assigns automatic IPs from router which allow all network devices to communicate to each other over a network. The following IP are most common used in home and office network:

192.168.1.0 is the automatically assigned network address.

192.168.1.1-2 are used as the gateway.

192.168.1.3 – 254 are assigned to computers and devices on the network.

192.168.1.255 is automatically assigned on most networks as the broadcast address.

2.3 VLAN concept

Virtual LAN or VLAN is created to manage each network devices, which connected in LANs. VLANs are developed to divide the physical LAN network into logical groups of networks. Regularly, VLANs contain two or more group of broadcast domains. Each group of VLANs connects to one or more switches which are configure by network administrator. Generally, switches have more ports than hubs so that switches are mostly use in organization. Network administrator does not need to physically move the computer from a work group to another. They can logically configure the switch that can support VLAN. And the numbers of VLAN workgroups are equal to number of VLAN broadcast domains. The below figure illustrate the architecture of 3 VLAN connections.

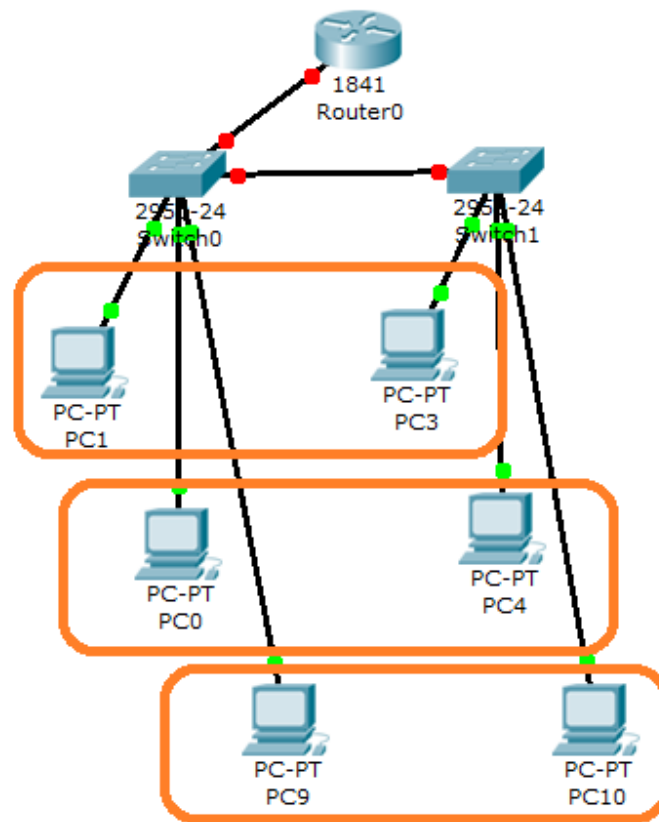


Figure 2.2: Architecture of 3 VLAN connections

The switch device operates at the data link layer of the OSI (Open Systems Interconnection) model. This layer operation is filtering, flooding, and forwarding frames which are found on the destination address of each frame.

Fundamentally, a switch that supports the VLAN technology is composed of more ports than a router. The switch specifies group of VLAN broadcast domain at each port of the switch. As a result, one switch can separate the VLAN into more than two broadcast domains. As above mentioned that the switches operate at the Data link layer, nevertheless, some switches are able to operate at the Network layer, which is similar to routers.

Devices in one broadcast domain are unable to communicate to other devices in different broadcast domains. The devices can only communicate to others in the same broadcast domain. Therefore, data cannot be sent to outside the broadcast domain.

VLAN is described as the operation and administration of its topologies within a bridged LAN infrastructure by the IEEE 802.1Q standard. IEEE 802.1Q is standard which provides devices in the same logical broadcast domain and in different physical broadcast device can communicate with each other. This concept is also called frame tagging.

A switch communicates to another switch in VLAN through 802.1Q protocol. Therefore, the switch that supports VLAN has to support the 802.1Q protocol.

In general, switches can be configured to communicate between each other on the VLAN by using VLAN Trunk Protocol (VTP) which will be described in more detail in chapter 4.

Advantages of VLAN

There are several advantages of the VLAN configuration over the LAN configuration which are:

Reduce cost and time consuming

As above description, VLANs can reduce the cost of network design. The switches that are configured as a VLAN do not need to be reconfigured when the devices in VLAN are added or removed which takes time and is costly .it is better than LAN which needs to be physically reconfigured. Computers that need to be changed from a VLAN to another can be configured by easily using VLAN switch configuration. Another advantage is that VLANs can also decrease number of using switches as it contains many ports. VLAN can support 5 VLANs by one switch configuration which reduces costs.

Enhance network performance and minimize in network traffic

VLAN is also created as a virtual group of network. A computer broadcasts data only in its work group without broadcasting the data to another work group. So, VLANs can reduce traffic on the network. VLANs also enhance performance of data sharing because they reduce the chance of the collision domains and the broadcast traffic. In other word, only devices on the same VLAN are able to

receive specific broadcasts traffic that they need on the domain and they are prevented unwanted data from other devices.

LAN and VLAN equipment comparison

Table 2.2: LAN and VLAN Equipment comparison

Network equipment	LAN	VLAN
Computer	19	19
LAN switch	3	2
LAN cable	21	21
Cross cable	1	1
Router	1	1

From the about table, we can see that the current network of CPPD organisation uses 3 LAN switched but VLAN network uses only 2 LAN switch. Therefore, it can save cost for the organisation.

Advantage and disadvantage of VLAN and LAN

Table 2.3: Advantage and disadvantage of VLAN and LAN

Network equipment	Advantages	Disadvantages
LAN	<ul style="list-style-type: none"> • Easy to configure 	<ul style="list-style-type: none"> • Need more network equipments • Data collision
VLAN	<ul style="list-style-type: none"> • Cost saving • Better performance • Better security • Easy to manage 	<ul style="list-style-type: none"> • Complicated to understand • Need router to communicate with other VLANs

2.4 Central Investigation Bureau

The Central Investigation Bureau (CIB) is a national coordinating headquarters under the structure of the Royal Thai Police. The Royal Thai Police divides various government branches under ministerial regulations of government agency divisions, police divisions, or other government offices under the Royal Thai Police.

The CIB has several government branches under its command under government allocated ministerial regulations such as various police divisions or government agencies. The 2009 Act divided 12 police divisions comprised of: (The Government Gazette Publication, Volume 66, Part 126, dated 7 September, 2009)

- 1) Administration Division
- 2) Crime Suppression Division
- 3) Highway Police Division
- 4) Railway Police Division
- 5) Tourist Police Division
- 6) Marine Police Division
- 7) Natural Resources and Environmental Crime Division
- 8) Anti-Human Trafficking Division
- 9) Economic Division
- 10) Anti Official Corruption Division
- 11) Consumer Protection Division
- 12) Cyber Crime Division

2.5 Consumer Protection Police Division (CPPD)

According to Thai national police regulation authority of the Government Office legislated in 2009, Consumer Protection Police are divided in to 5 divisions as shown in Figure 2.3



Figure 2.3: Structure of Consumer Protection Police Division

1. Administration is responsible for the following contents:

- General affairs and document
- Human resource management
- Legal, litigation and discipline
- Policy planning and strategic
- Finance and accounting
- Budget .Logistics
- Welfare
- Administration assistant and secretary
- Information Technology and Communications
- Public relations and information dissemination.
- Job training
- news reporting

- Monitor, control and reporting the status of Metropolitan Police Commissioner. Also check the troop information in the database of Royal Thai Police. And ensure that the status of army is in responsibility, accurate and up to date.

- Work with and support other related divisions or the divisions that are assigned

- Support other related work or works that are not in responsibility of other divisions

- Support other tasks that are assigned by commander

2. Sub division 1 and 2 are responsible for taking care for safety, peace, and suppression of crime relating to consumer protection and other responsibility which are committed.

3. Sub division 3 is responsible for taking care for safety, peace, and suppression of crime on standard of product from industry and investigation practices under the Code of Criminal Procedure. This sub division also accepts other responsibilities which are committed in its area.

4. Sub division 4 is responsible for taking care for safety, peace, and suppression of crime relating to food and drug under the Code of Criminal Procedure. This sub division also accepts other responsibilities which are committed in its area.

5. Investigation division has responsibility for following the Code of Criminal Procedure and investigating the crime relating to product from industry, and food and drug or criminal acts by other related laws. The responsibility is also including cooperating with or supporting the operations of other related agencies or other responsibilities which are committed.

Authority

The main responsibility of Consumer Protection Police Division is consumer protection which consists of 3 sections:

1. Product labeling, advertising, direct sales and direct marketing
2. Product from industry
3. Food and drug administration

Each sub division is divided by scope of their works that share the data in a local area network which are:

- The administration section is responsible for internal document and administration of each sub division
- The detective section is responsible for investigating the fact of assigned cases.
- The investigation section is responsible for interrogating and gathering evidence to summarize the comment to prosecutor.
- The suppression section is responsible for the offender inspection and suppression
- Other supporting work section.

2.6 Packet Tracer

To illustrate how VLAN work in the real situation, Cisco Packet Tracer is taken as network simulation software. It can provide network learner to experiment with network behavior Packet Tracer also present simulation, visualization, of network technology concepts. Therefore the learner can design and configured a network of nodes and links easily. The following figures basically describe the descriptions of Packet Tracer interface and how packet tracer simulates a scenario of network topology.

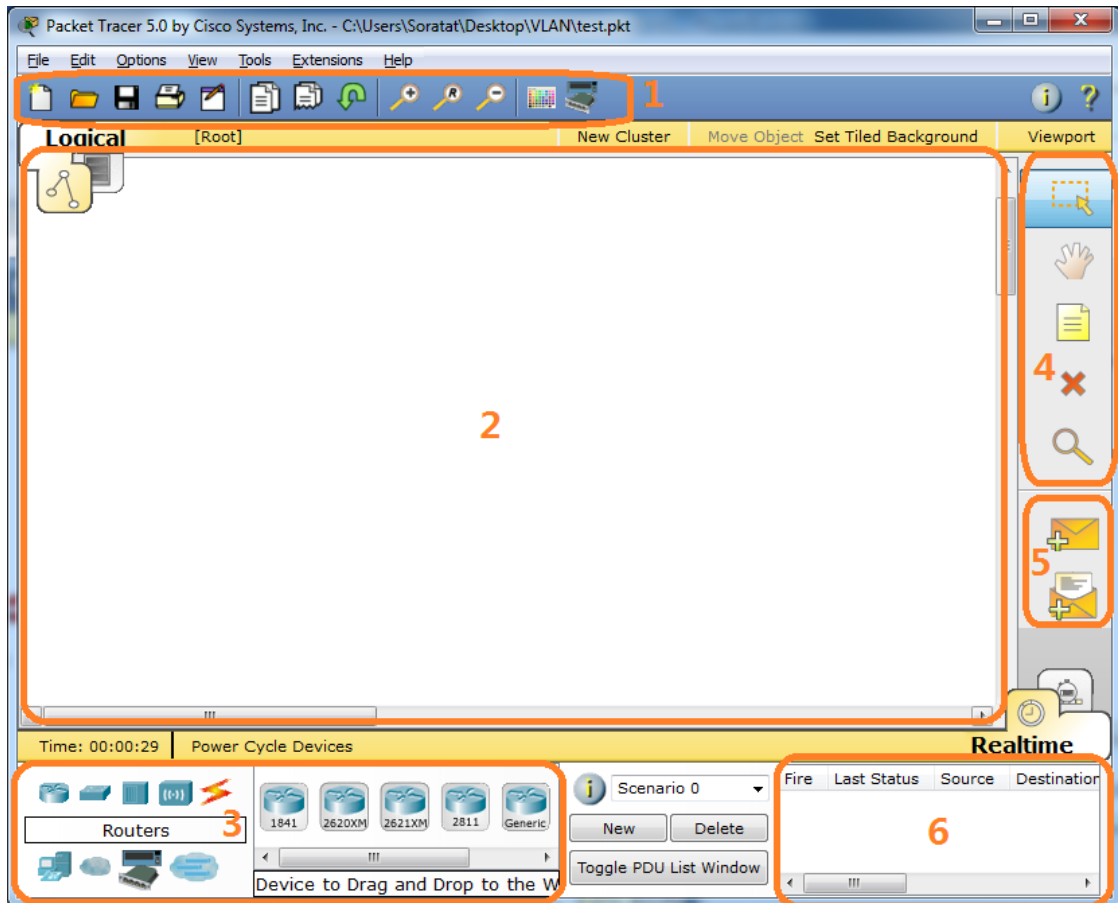


Figure 2.4: Packet Tracer interface

The figure 2.4 shows 6 section of interface of Packet Tracer which are as follows:

1. Main tools bar
2. Logical workspace
3. Network devices and connections
4. Layout editor
5. Protocol data unit (PDU)
6. Event list.

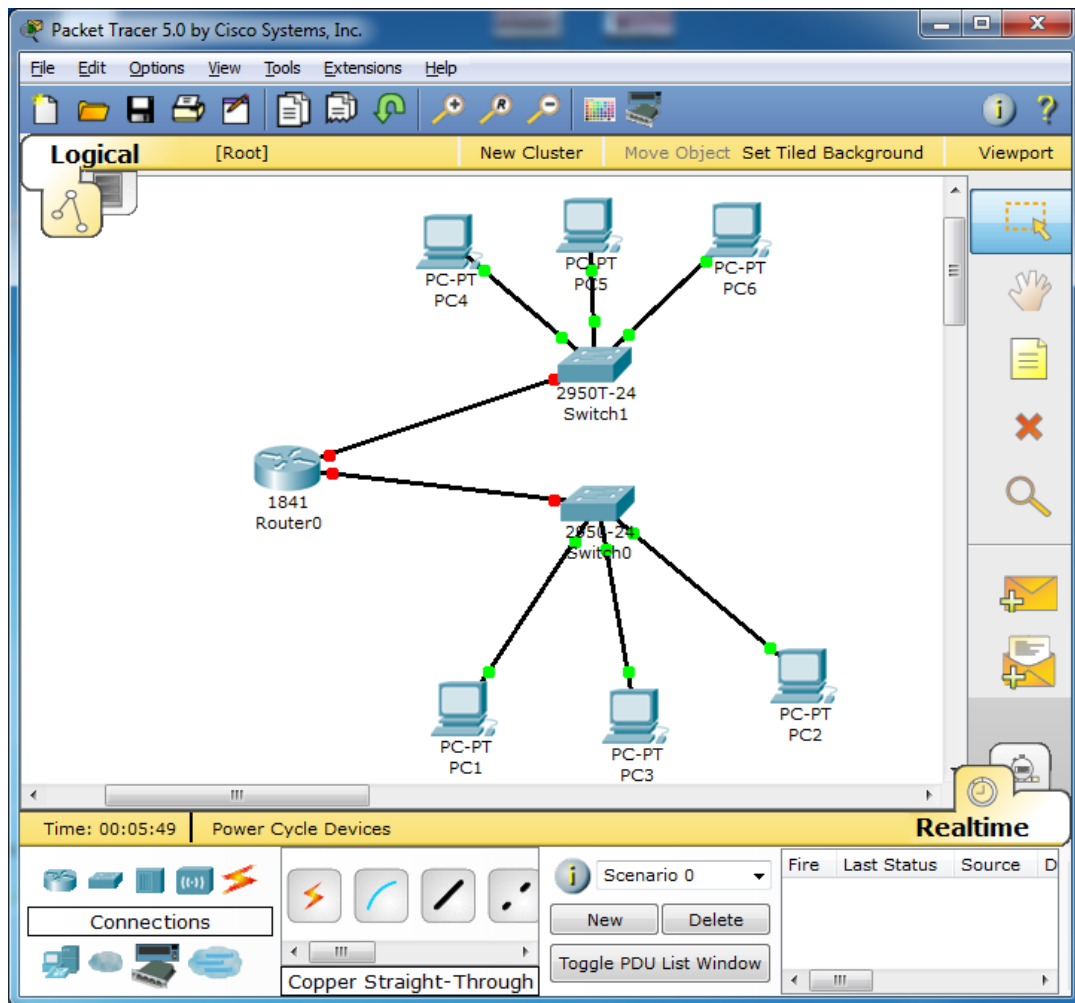


Figure 2.5: Simple topology designed by Packet Tracer

To design a simple network topology through Packet Tracer, each network devices and connections such as router, switch and computer desktop are dragged from the network devices and connections section to the logical workspace of Packet Tracer interface as Figure 2.5 shown.

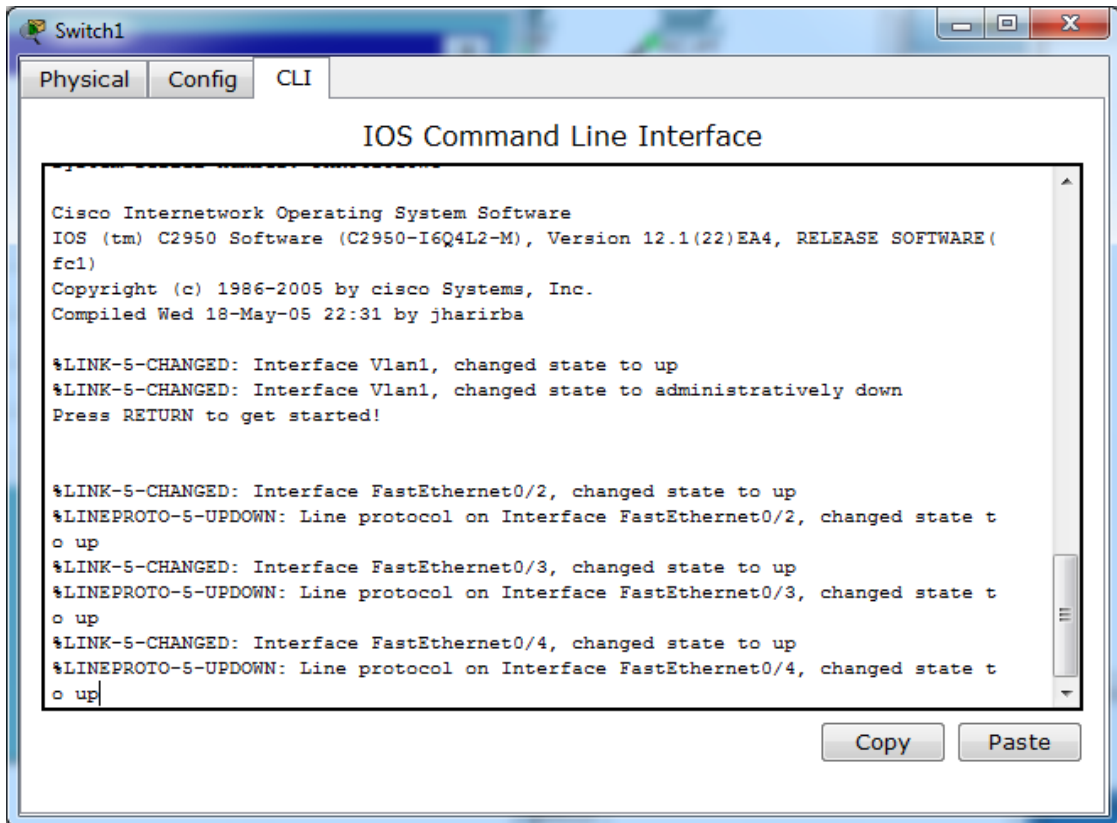


Figure 2.6: Command line interface in switch device configuration

For example, to configure a switch, the learner clicks on the desired switch and goes to CLI to display Command line interface which shows in figure 2.6. Besides, the computer desktop can be configured by clicking on the desired computer desktop and go to Desktop to configure its IP address as figure 2.7 shown.

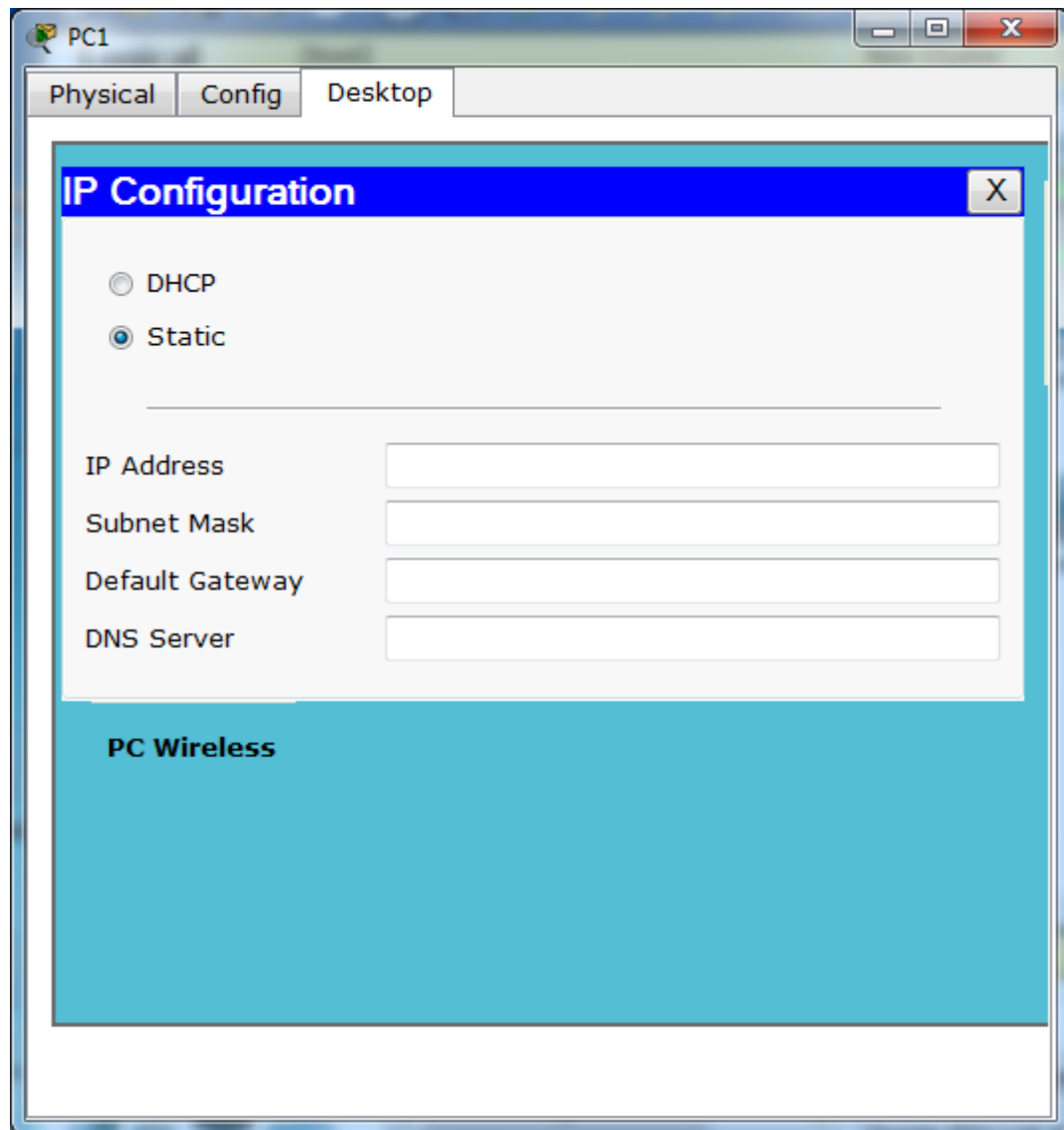


Figure 2.7: Command line in switch device configuration

2.7 Colasoft Capsa7 (Network Traffic analyzer)

The monitoring about data usage, packet, e-mail, network traffics, online chat, and the others can check by using application or software to monitor network system. Ashish Kulkarni, Nimish Kate, Rohit Ghadshi and Rusihkesh Date (2014) have presented an application or software with the ability to monitor the network system very well, one of them is Capsa7.

Capsa7 is the Freeware for Network analyzer (protocol analyzer and packet sniffer), that can detect and diagnose basic system quickly. The main function of this application is about, check and monitor the network and system analysis diagnostic for the cause. In version 7 also has added three special functions including Email Analysis Module, Web Analysis Module and Transaction Analysis Module. That all of them will show available in the Real-Time.

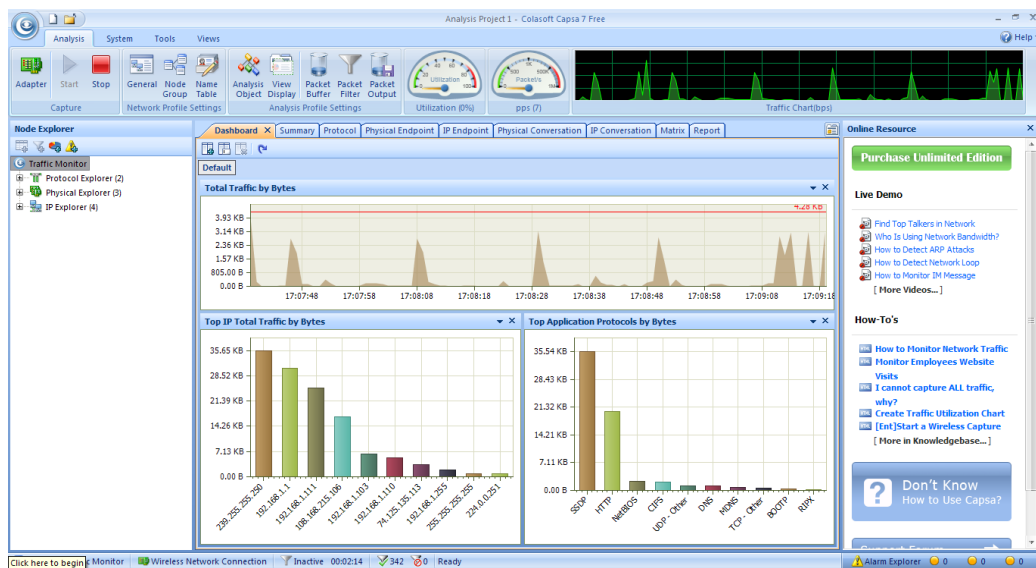


Figure 2.8: The User Interface of Capsa7 application

The important features of this application.

- **Traffic Statistics and Bandwidth Use**

Show the display of monitor traffic and bandwidth of the network that is used, in the form of graphs and statistics. The application can be used to monitor the network all of any times for 24 hours in 7 days.

- **Advanced Protocol Analysis**

Can analyze and identify the type of Network protocol in advanced mode. This application can be analyze more than 300 protocols.

- **In-depth Packet Decoding**

Show the summary of each packet with the details that already complete decoding.

- **Monitor Multiple Network Behaviors**

Monitoring and verifying in use the web site, the details of email, online chat, and more.

- **Map out Each Host in Network**

Show the list of any host on the network system, and also show the details of each host as IP address, MAC address and the others.

- **Automatic Expert Network Diagnosis**

Can be presents the analysis of problems on network system with instructions that shown how to fix it.

- **Visualize all Connections in Matrix**

Presents model of the devices connection in the network system. And show the volume of network traffics.

- **Conversation and Packet Stream**

Can observe and created the packets that occur during a conversation.

- **Useful and Valuable Built-in Tools**

The application has built-in tools that come with the program, which can generate packet and replay packet as needed. And include the scan function and ping function to check network system.

- **Quick and Intuitive Report**

The application can create reports about the interested connection quickly.

2.8 Related research

The purpose of this case study is to apply VLAN technology for CPPD which is able to solve problem and enhance network system. The related researches are as followed:

Cheng Yu, Maria Lei, and Yang Yulong (2011) explained that Virtual LAN (VLAN) technology is applied from LAN technology, VLAN technology is the concept of logical changing node. So it does not need to change the physical location of local network. It can divide the functions, departments, and applications in to the logic work group. VLAN technology provide efficiently avoid local network heavy traffic and strengthen security LAN. It describes VLAN theory, standard, benefits, and classification, configuration, authentication, and implementation methods in a university.

Prasad Yarlagadda and Yun-Hae Kim (2012) described VLAN technology is known as virtual local area network technology, which divide the net work into 2 or more logical sub-network from the physical LAN devices. So, to analyze the VLAN network technology, this article studies on the production, characteristics and communication of VLAN technology and its effective implementation and adjustment.

Stephen L. Van Seters, Ryan T. Ross, Leonard Schwartz, David C. Ready, John A. Flanders, Robert P. Ryan, and William D. Townsend (1999) described logic circuits are used in telecommunications equipment such as bridge and router to check the frame to verify VLAN that if the frame is connected with. The protocol type, accepted port identification, and accepted VLAN tags are used to authenticate the identification of sending port and tags. The table defined in advance points which ports that the bridge/router was connected with the VLAN. The frame is not transmitted to the ports that are not connected with node of the related VLAN.

Yatin Acharya (2005) explained that a way of communicating between phone networks includes the several devices such as shared phone line medium, and a remote network. The way consists of add a VLAN header to a data frame. The contents of the header point the destination of data frame that is transmitted over a VLAN pointed by a VLAN header pointer. The VLAN has a minimum part of the phone cable network and minimum part of the remote network. The data frame is sent over the VLAN the network and the distant network.

Ward Coburn, Harvir Singh, and Roger Wood explained that VLAN technology provides software, system, and method for getting content security using a serial from the LAN system. In use, an unsuccessful try to remotely access network security content at a second device is pointed by a first device, which the unsuccessful results is from a fault at the first device. Additional, the security content is accepted at the first device using a serial on a LAN connection start remotely from second device, founded on the signal.

CHAPTER III

RESEARCH METHODOLOGY

As has been researched in chapter 1 and 2, it found that VLAN technology has been widely applied in a large organization. In order to explain how the VLAN technology applies in CPPD organization, the following topics are prerequisites for VLAN implementation.

- 3.1 Requirements
- 3.2 Collect Data
- 3.3 Network Analysis
- 3.4 Network Development
- 3.5 Network Design

3.1 Requirements

The requirements for the network improvement have been evaluated from the current LAN networks of Consumer Protection Police Division which is divided in to 5 divisions. This research has been evaluated that VLAN should be implemented in the network system due to the size of CPPD organization. To develop a VLAN network for CPPD organization, these following materials are required:

Hardware

CPU: Intel Pentium III 500 MHz or equivalent

RAM: 256 MB Free

Storage: 250 MB of free disk space

Display resolution: 800 x 600

Software

OS: Microsoft Windows XP, Microsoft Windows Vista, Microsoft Windows 7, Fedora 11, or Ubuntu 8.04 LTS

Packet tracer 5.0

Adobe Flash Player

Colasoft Capsa 7

3.2 Collect data

In order to obtain the numbers of user, and amount of data transmission over the network, and transmission speed, CPPD’s data is collected via the Capsa 7 application in working days.

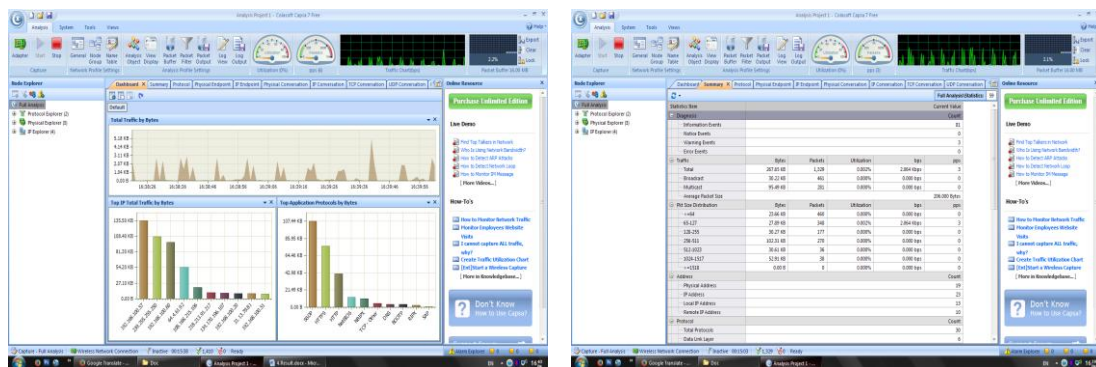


Figure 3.1: Collecting data.

3.3 Network Analysis

As the previous chapter explained, there are 5 divisions in CPPD organization. The network system is also divided into 5 workgroups of LAN which is shown as follows:

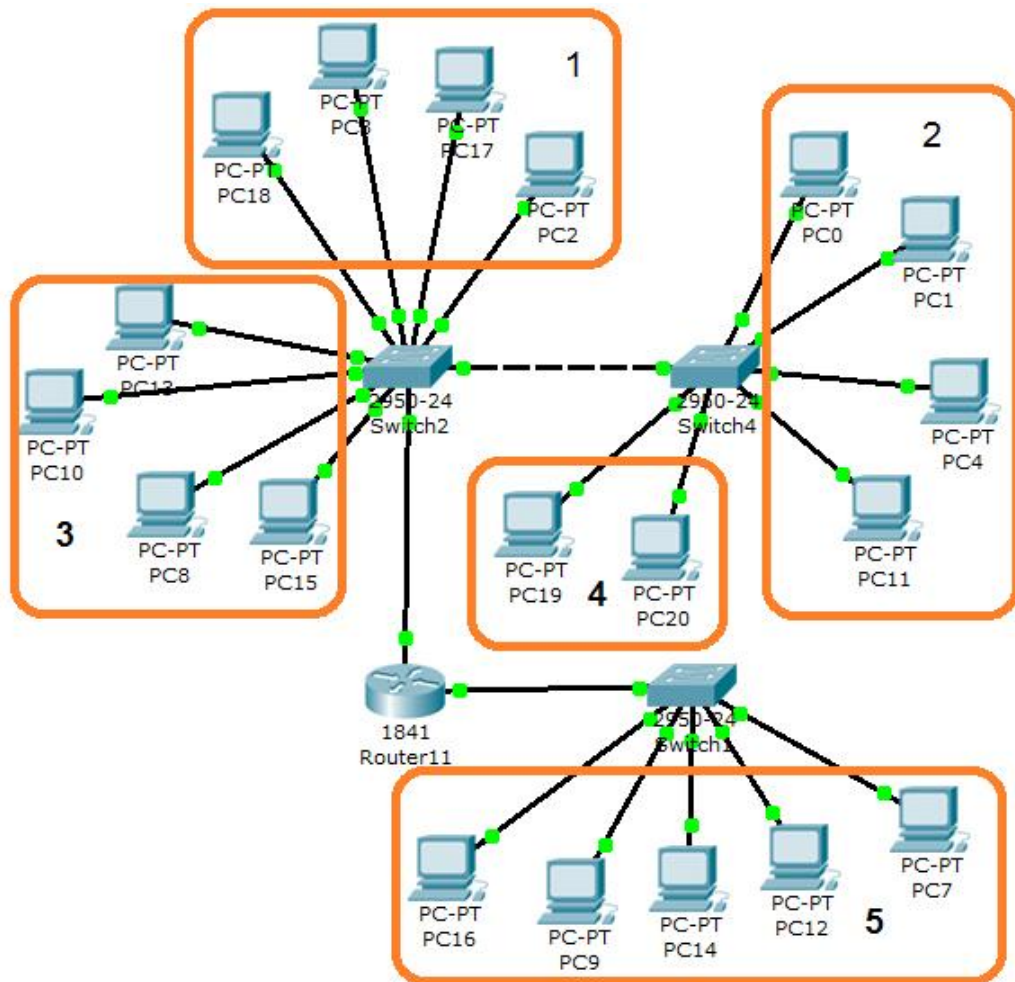


Figure 3.2: Current LAN system of CPPD which consist of 5 divisions(1)

As shown in figure 3.2, there are 5 Sub divisions. Sub divisions 1, 2 and 3 consist of 4 computers. Sub division 4 consists of 2 computers and administration division consists of 5 computers. These sub divisions are connected to each other on 3 LAN switch. The disadvantages of current LAN system and the advantages of new VLAN will be explained in next section.

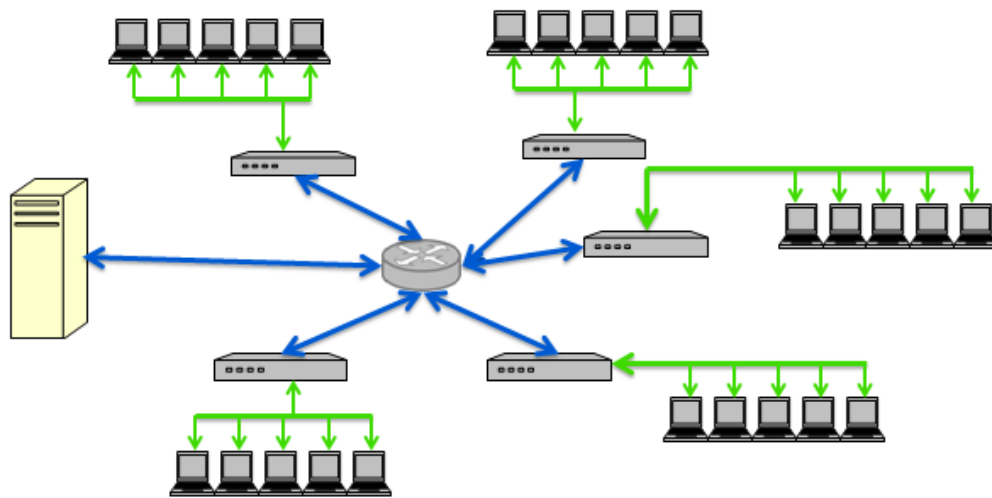


Figure 3.3: Current LAN system of CPPD which consist of 5 divisions(2)

In order to improve the LAN network which each division consists of 5 users which is divide into 5 scopes of work as described in chapterII, LAN network of CPPD is also demonstrated in figure 3.3.

3.4 Network Development

The main reason why VLAN should be applied in the CPPD network system is it creates as a virtual work group. Therefore, a computer can broadcast messages only in the same work group without broadcasting the messages to another work group. As a result, VLANs can reduce in network traffic on the network. VLANs also increase performance of shared media devices because they reduce the size of the collision domains and limit the broadcast traffic. In other words, only the computers on the same VLAN must receive specific broadcasts or multicast traffic that they need on the domain and they are prevented unnecessary traffic from other devices.

VLAN also provide a higher level of security than the current system. A computer can broadcast messages only in the same workgroup and computers in other workgroups cannot receive the messages which are broadcasted. So the data which is shared from one computer to another computer does not leak out of the workgroup.

The next section will illustrate how to VLAN divides the CPPD network system to 5 groups.

3.5 Network Design

As mentioned in the previous chapter, there are 5 Sub divisions in CPPD organisation. 3 forms of VLAN have been designed which are as follows:

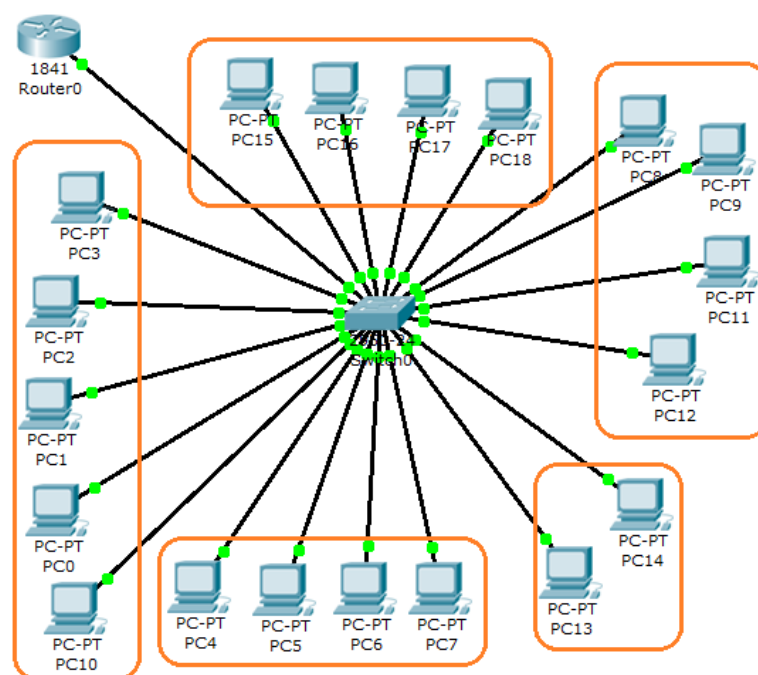


Figure 3.4: 5 groups of VLAN connecting to 1 switch

As the figure 3.4 shown, there are 5 groups of VLAN connecting to 1 LAN switch. LAN switch divides 1 physical LAN into 5 groups of VLAN. This form is inexpensive but it is not flexible for the office extension. The figure 3.5 shows another form of VLAN which is more costly comparing to the figure1. However, computers can be added around 50 units for the office extension.

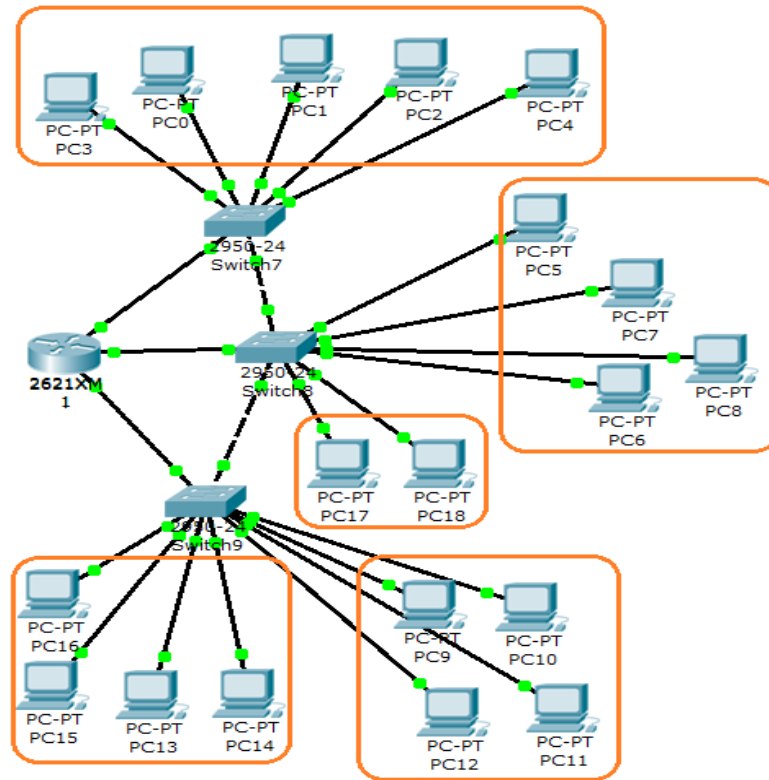


Figure 3.5: 5 groups of VLAN connecting to 3 switches

According to the size of CPPD organisation, form of VLAN that shows in figure 3.6 is the most suitable. It is flexible and not too expensive.

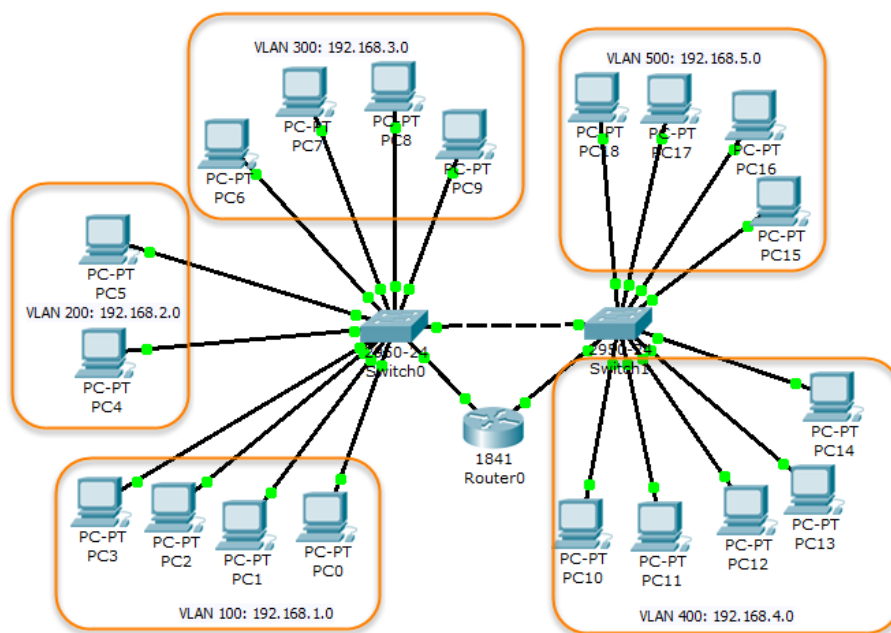


Figure 3.6: 5 groups of VLAN connecting to 2 switches

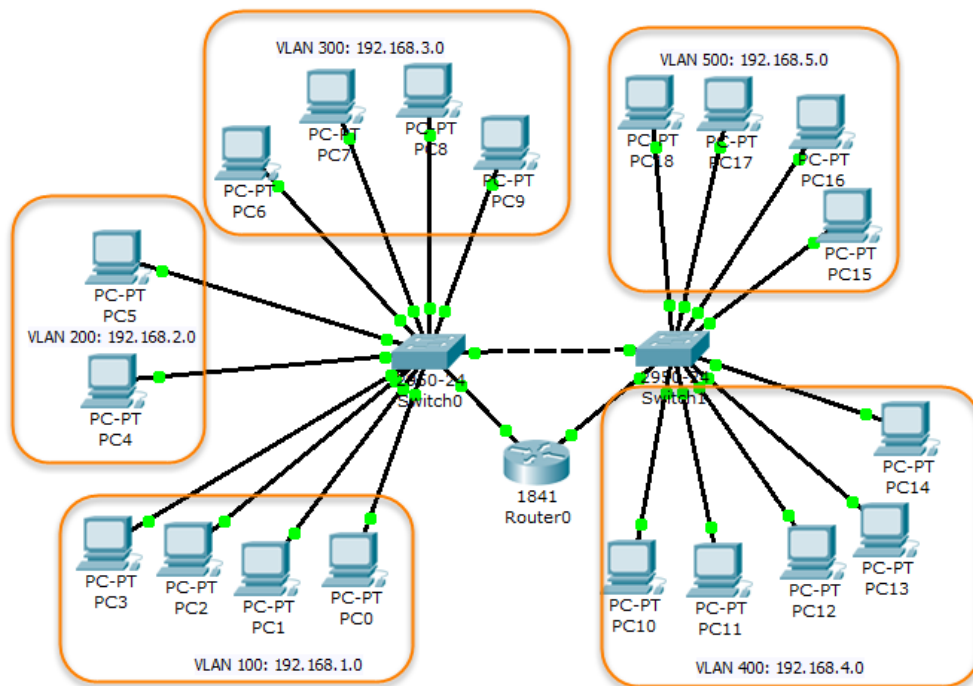


Figure 3.7: VLAN system developed for CPPD which consist of 5 divisions (1)

This part will illustrate VLAN system for CPPD organisation via Packet Tracer. In this case, there are 2 logical workgroups connected to 2 switches as in Figure 3.7. VLAN divide the network of the organisation into 5 scopes of working. The detective section, the suppression section, and the investigation section consist of 4 computers. The other supporting work section consists of 2 computers. And the administration section consists of 5 computers.

Computers in each sub workgroups of each section are set static IP address to 5 sub networks. Those computers can send package across VLAN through the router. However, the unwanted package will not be sent to another subnet work.

For example, one computer in administration section desires to share file to another in the same VLAN, the file would be shared without broadcasting package to other VLAN group which is unnecessary.

When switches connect together on the VLAN, the connection is called VLAN Trunk Protocol or VTP. Figure 3.7 is an example where there are 5 departments of CPPD organization, the detective section, the suppression section, the investigation section, the other supporting work section, and the administration section.

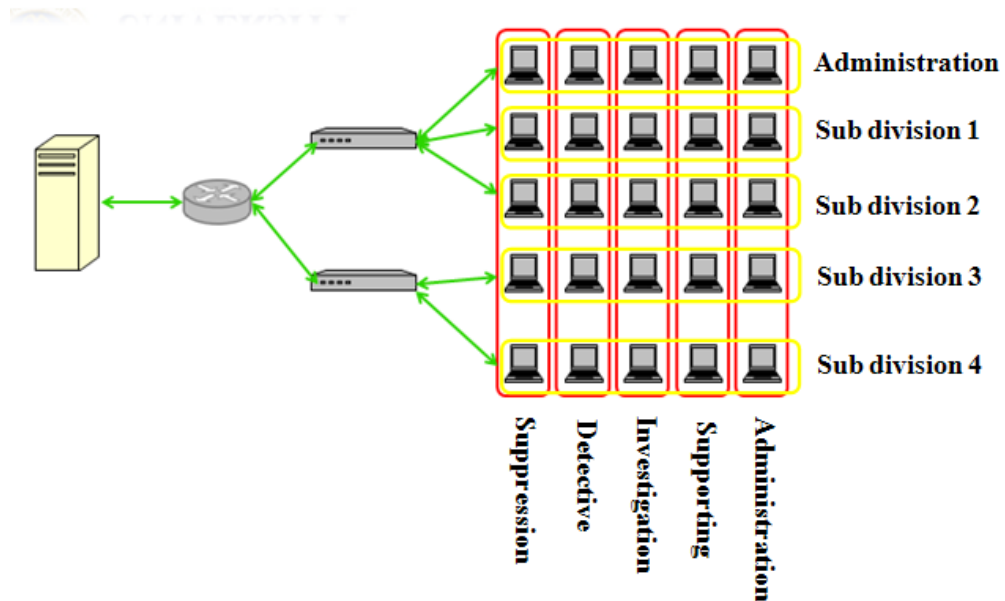


Figure 3.8: VLAN system developed for CPPD which consist of 5 divisions (2)

Or as shown the VLAN network system is developed as figure 3.8. Each division consists of at least 5 users. To manage the work of each group of work that sharing relative data, the network is divided that into 5 VLANs to avoid data collision over the network.

The implementation of VLAN system will be illustrated in the next chapter.

CHAPTER IV

RESULT

This chapter will illustrate step by step VLAN configuration for consumer protection police division via Packet Tracer, and compare the traffic data in the network system between LAN and VLAN implementation with Capsa7 application.

There are 5 logical workgroups connected to 2 switches as in figure 4.1. When switches connect together on the VLAN, the connection is called VLAN Trunk Protocol or VTP. In addition, a router is connected to the switches to direct the package that is delivered from source to destination across the VLAN group.

4.1 VLAN Implementation

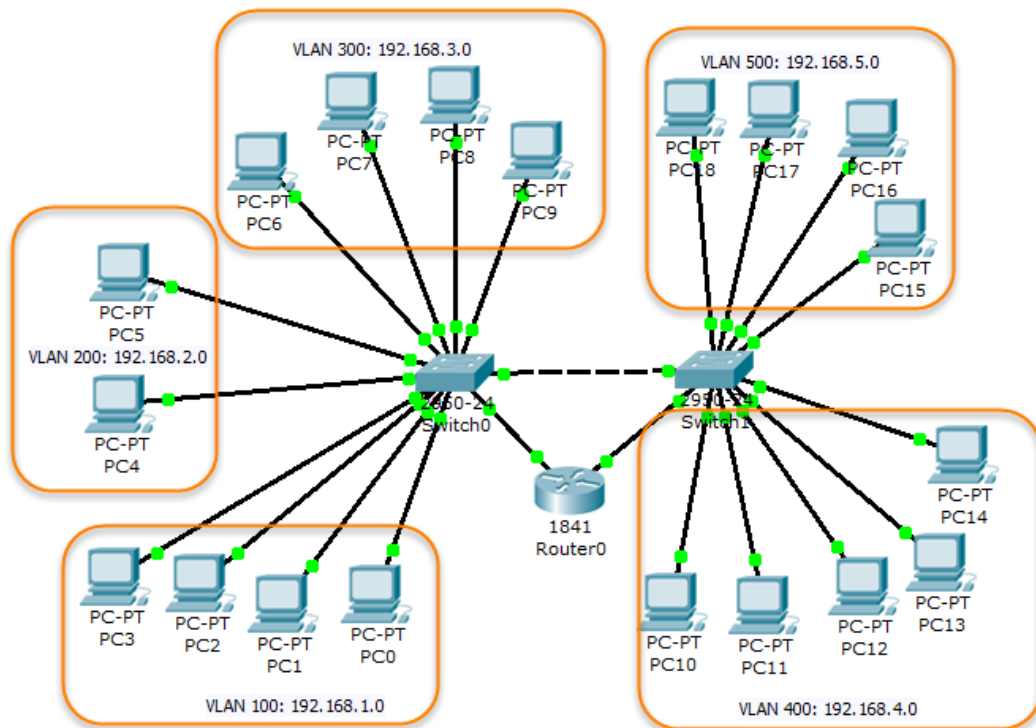


Figure 4.1: VLAN system developed for CPPD which consist of 5 divisions.

Firstly, to implement the VLAN configuration, 2 switches and 19 computers are wired up as figure 4.1 shows and in order to configure VLANs for each computer, click on the Switch0 as the figure 4.2 shows.

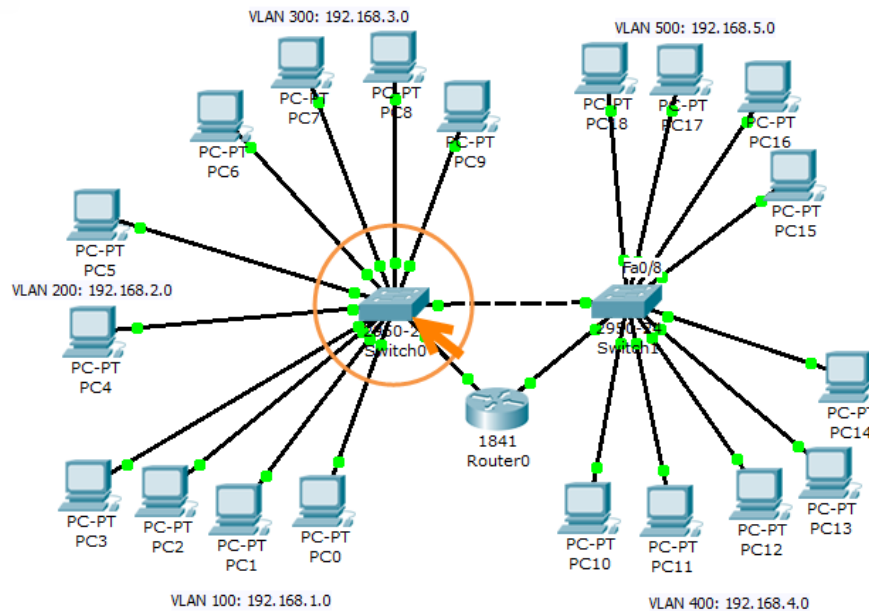


Figure 4.2: Switch0 configuration.

After clicking on the Switch0, figure 4.3 will be shown. Then, click on the CLI tab and input the following command:

“en” to get the privilege to configure the Switch0.

“conf t” to start the configuration.

“vlan” is followed by VLAN number. In switch0, there are 3 VLANs which are 100, 200, and 300.

“ex” buttons to quit from the configuration.

“Int range” is followed by range of numbers in a VLAN. Range of port fa0/1-7 is in VLAN 100. Range of port fa0/8-15 is in VLAN 200. Lastly, Range of port fa0/16-22 is in VLAN 300.

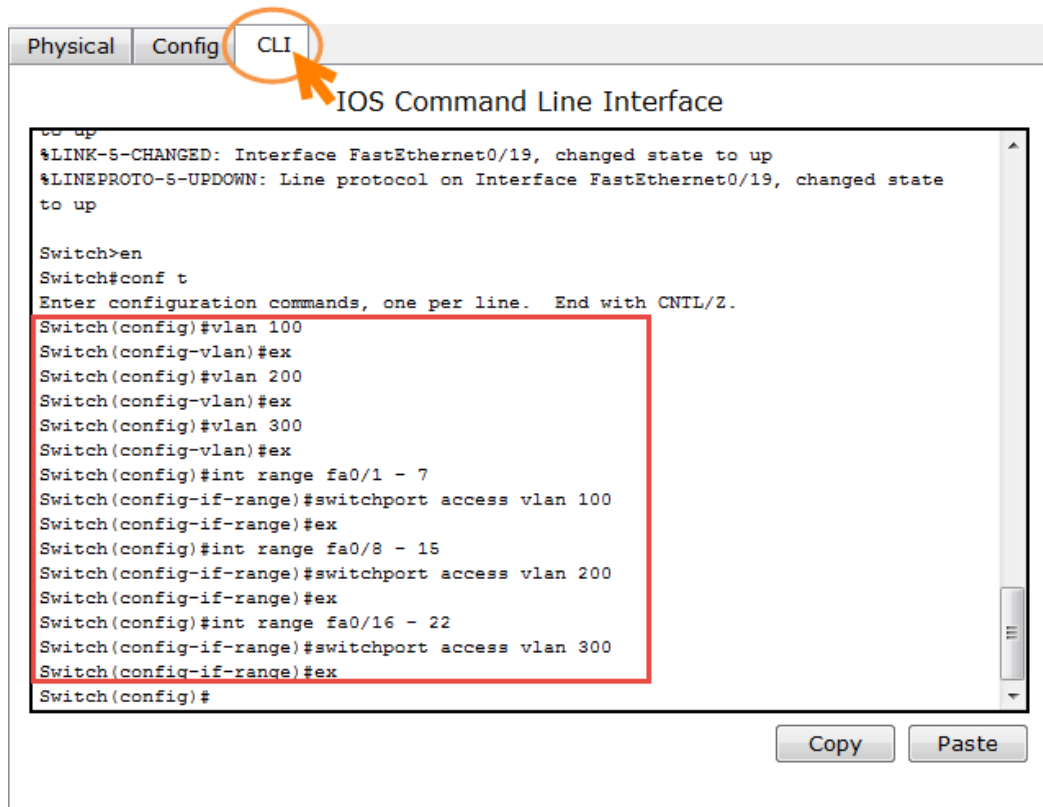


Figure 4.3: Switch0 configuration window.

In figure 4.4 “sh vlan” to show a number of VLAN that has been created. There are 3 VLANs which are VLAN100, VLAN200, and VLAN300 and their ranges as created in figure 4.3.

IOS Command Line Interface

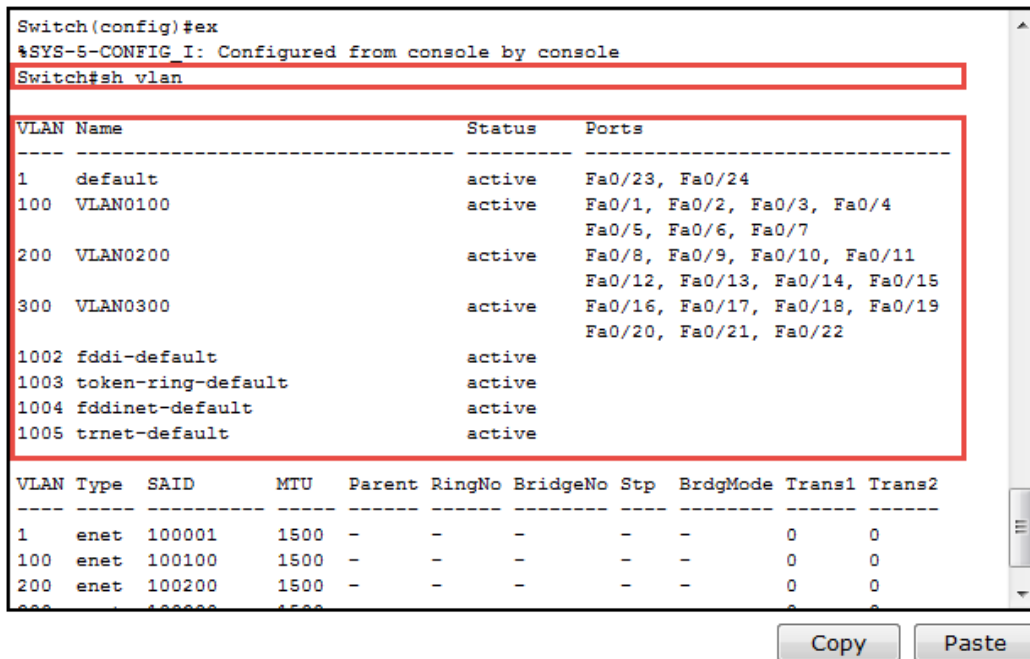


Figure 4.4: Switch0 configuration window.

To configure VLANs for each computer, click on the Switch1 as the figure 4.5 shows.

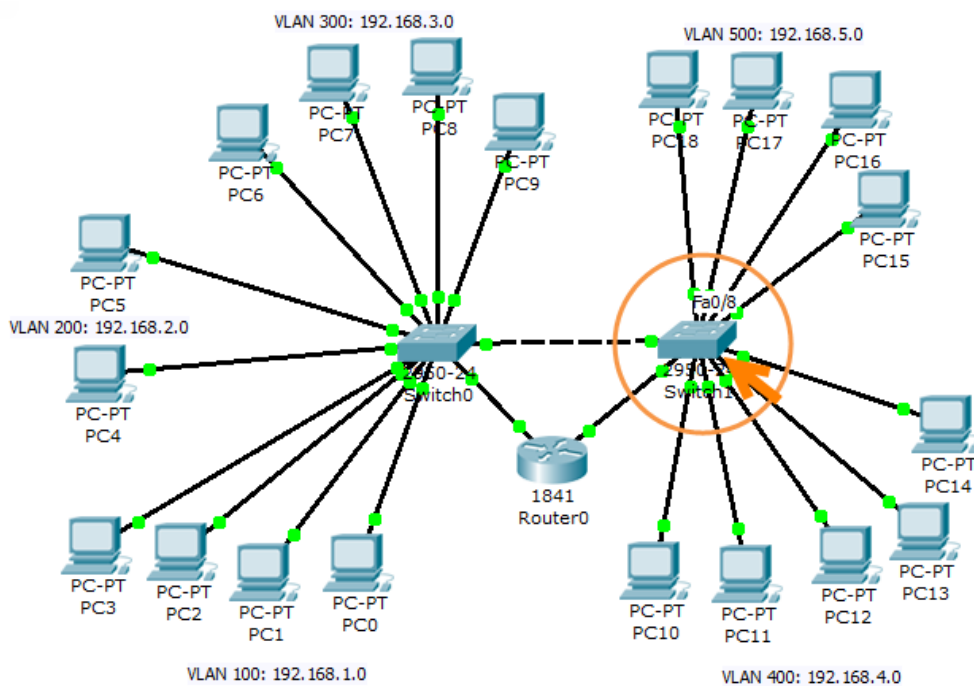


Figure 4.5: Switch1 configuration.

“en” to get the privilege to configure the Switch1

“conf t” to start the configuration.

“vlan” is followed by VLAN number. In switch1, there are 2 VLANs, which are 400, and 500

“ex” buttons to quit from the configuration

“Int range” is followed by range of numbers in a VLAN. Range of port fa0/1-7 is in VLAN 100 and range of port fa0/8-15 is in VLAN 500.

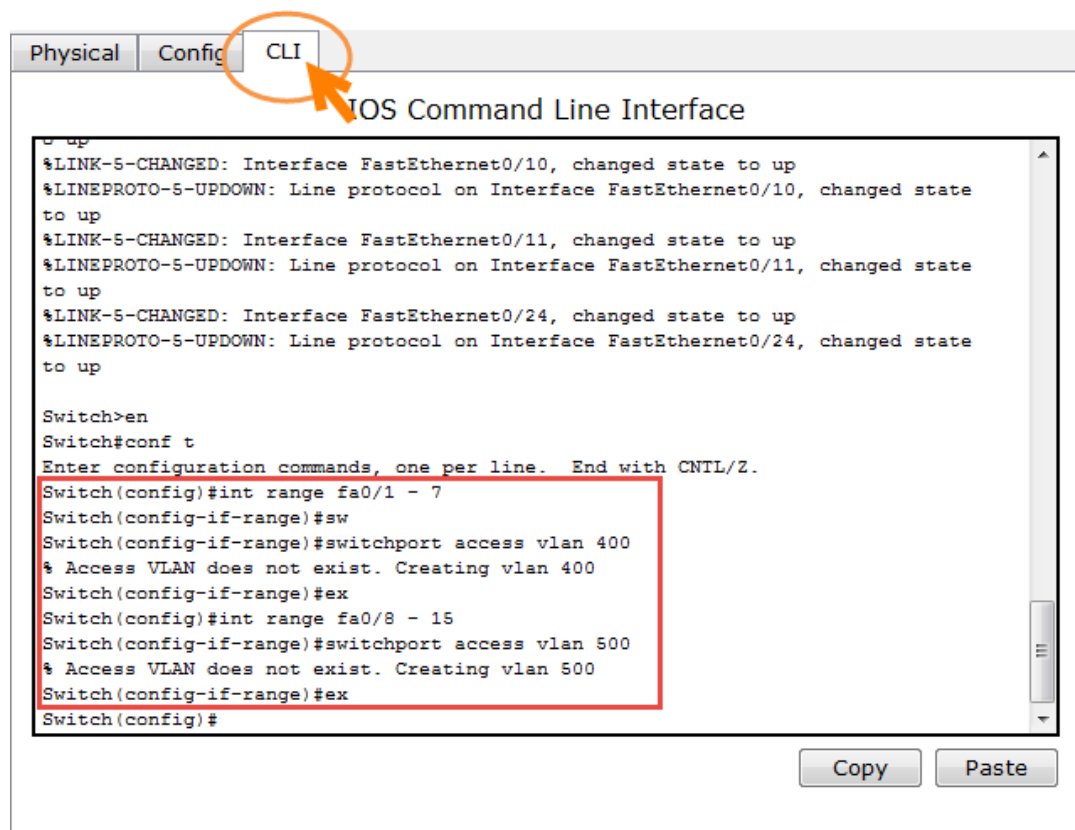


Figure 4.6: Switch1 configuration window.

In figure 4.7 “sh vlan” to show a number of VLAN, that has been created. There are 2 VLANs which are VLAN400, and VLAN500 and their ranges as created in figure 4.6.

```
%SYS-5-CONFIG I: Configured from console by console
Switch#sh vlan
```

VLAN Name	Status	Ports
1 default	active	Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22, Fa0/23 Fa0/24
400 VLAN0400	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7
500 VLAN0500	active	Fa0/8, Fa0/9, Fa0/10, Fa0/11 Fa0/12, Fa0/13, Fa0/14, Fa0/15
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
1005 trnet-default	active	

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1	enet	100001	1500	-	-	-	-	-	0	0
400	enet	100400	1500	-	-	-	-	-	0	0
500	enet	100500	1500	-	-	-	-	-	0	0
1002	enet	101002	1500	-	-	-	-	-	0	0
1003	enet	101003	1500	-	-	-	-	-	0	0

Figure 4.7: Switch1 configuration window.

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1	enet	100001	1500	-	-	-	-	-	0	0
400	enet	100400	1500	-	-	-	-	-	0	0
500	enet	100500	1500	-	-	-	-	-	0	0
1002	enet	101002	1500	-	-	-	-	-	0	0
1003	enet	101003	1500	-	-	-	-	-	0	0
1004	enet	101004	1500	-	-	-	-	-	0	0
1005	enet	101005	1500	-	-	-	-	-	0	0


```
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int fa0/23
Switch(config-if)#switchport mode trunk

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state
to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state
to up
Switch(config-if)#
```

Figure 4.8: Switch1 configuration window.

To allow 2 switches to communicate to each other, “int” is followed by port number. In this case, “fa0/23” is set as a switch port mode trunk.

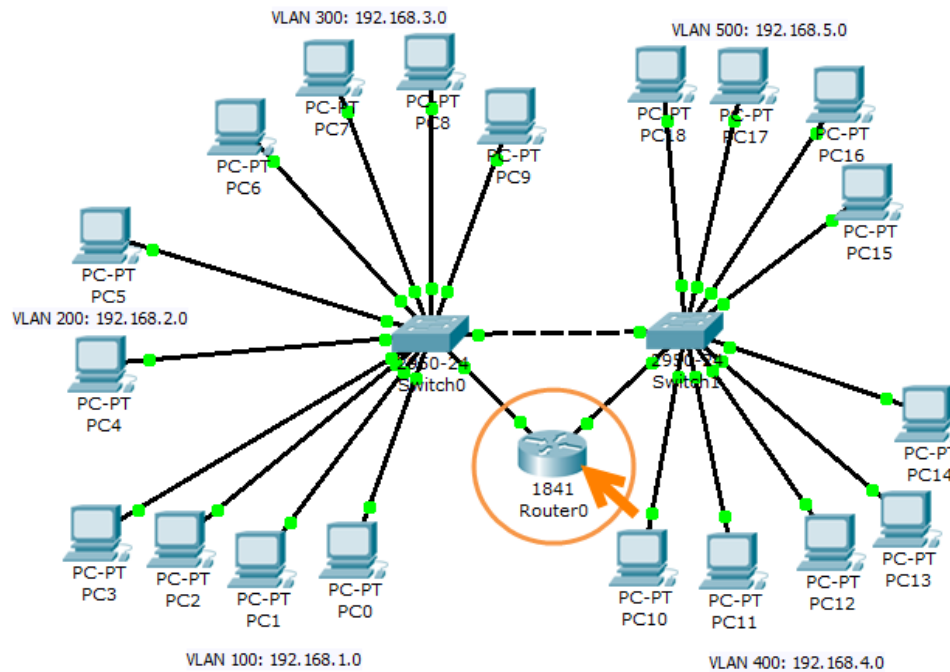


Figure 4.9: Router0 configuration.

Now, computers in each VLAN are able to communicate to each other but unable to communicate to other computers in other VLANs. To allow computers to communicate to other computers in other VLANs, click on the router0 as the figure 4.9 shows.

After clicking on the router0, figure 4.10 and 4.11 will be shown. Then, click on the CLI tab and input the following command:

“en” to get the privilege to configure the router0

“conf t” to start the configuration.

“int” is followed by port number in router that is connected to switch0, “.”, and VLAN number to configure the VLAN routing. Examples are int fa0/0.100, int fa0/0.200, int fa0/0.300 , int fa0/1.400 and, int fa0/1.500.

“encapsulation” is followed by protocol name that support router0 and VLAN number. Examples are encapsulation dot1Q 100, encapsulation dot1Q 200, encapsulation dot1Q 300, encapsulation dot1Q 400, and encapsulation dot1Q 500.

“ip address” is followed by default gateway of VLAN and subnet mask. For example, ip address 192.168.1.1 255.255.255.0, ip address 192.168.2.1 255.255.255.0, ip address 192.168.3.1 255.255.255.0, ip address 192.168.4.1 255.255.255.0, and ip address 192.168.5.1 255.255.255.0

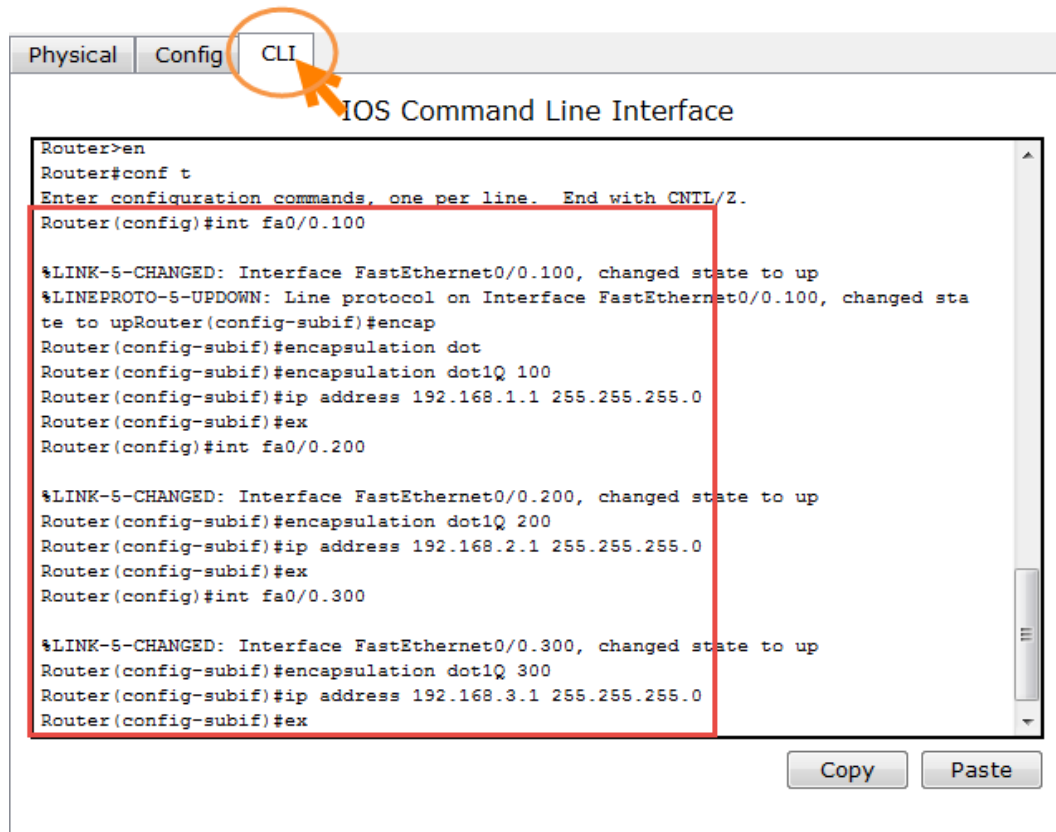


Figure 4.10: Router0 configuration window.

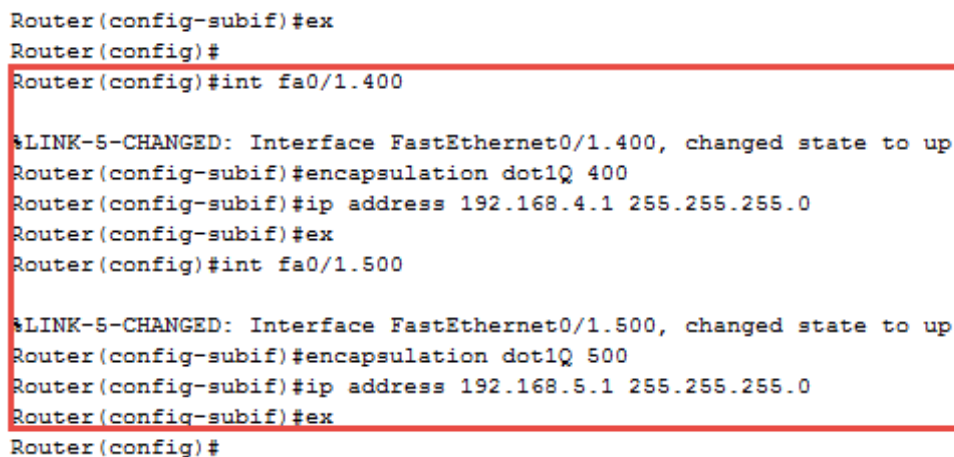


Figure 4.11: Router0 configuration window.

To allow switch0 to communicate to router0 as figure 4.12 shown, go to Switch0 and click on the CLI tab and input “int” following by port number. In this case, “fa0/24” in switch0 is set as a switch port mode trunk. To show VLAN

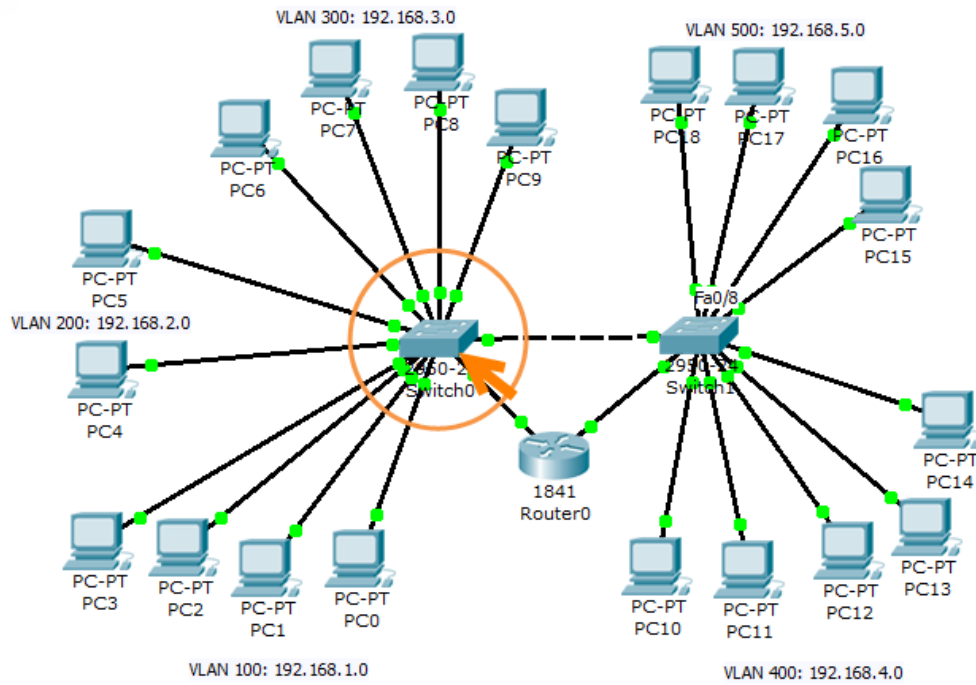


Figure 4.12: Switch0 configuration.

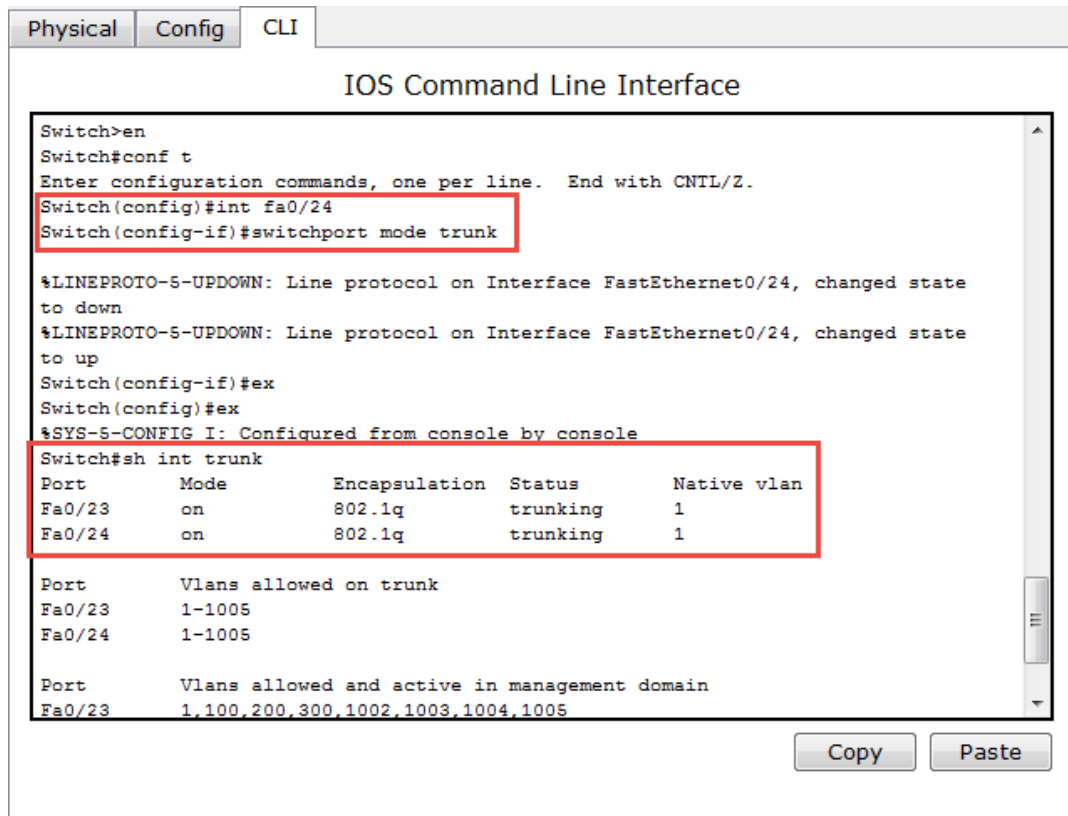


Figure 4.13: Switch0 configuration window.

In the same way, to allow switch1 to communicate to router0 as figure 4.14 shown, go to Switch1 and click on the CLI tab and input “int” following by port number. In this case, “fa0/24” in switch0 is set as a switch port mode trunk. To show trunk port in VLAN

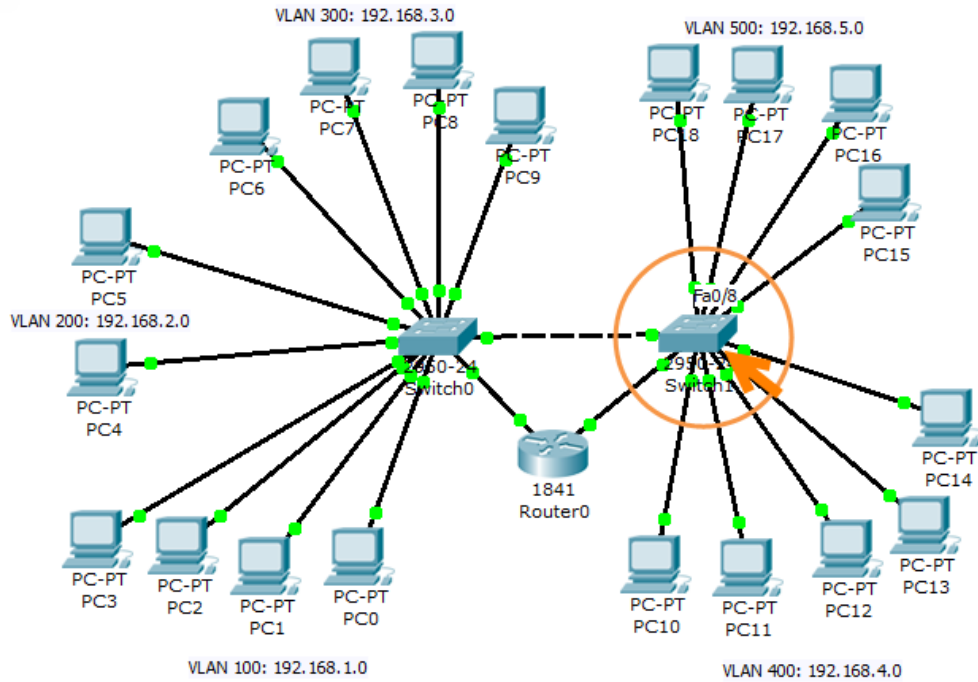


Figure 4.14: Switch1 configuration.

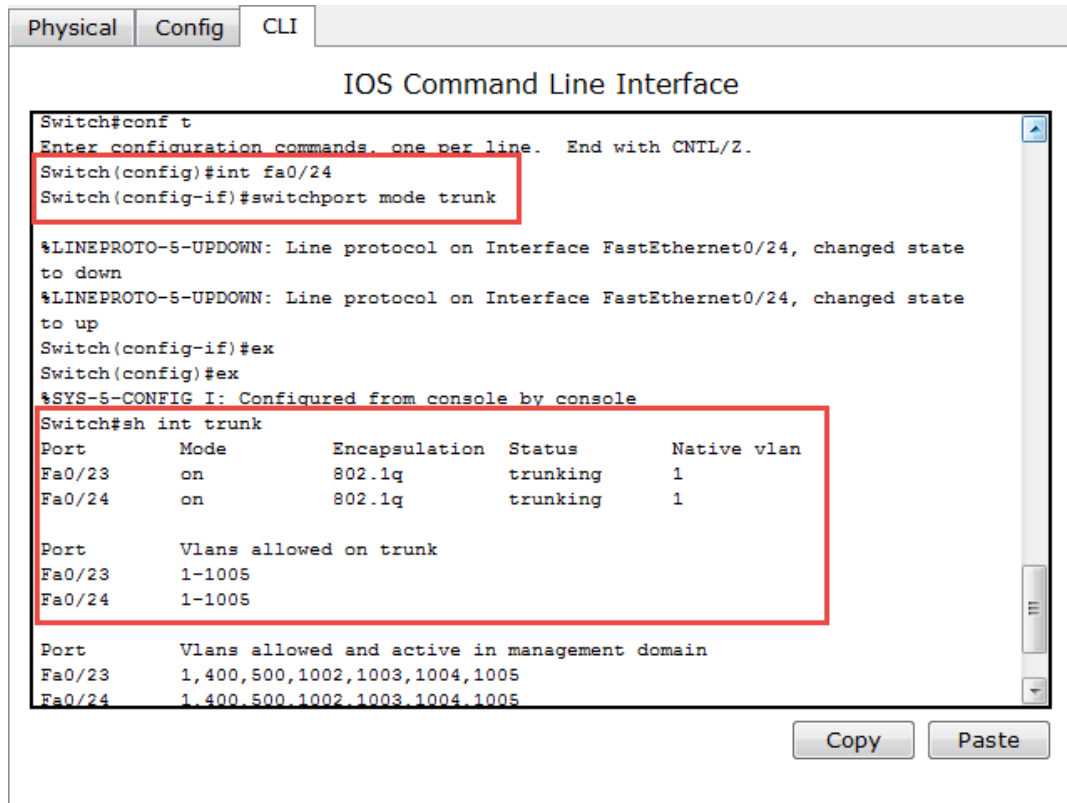


Figure 4.15: Switch1 configuration window.

To test that PC0 and PC4 which are in in the different VLAN group can communicate to each other, follow the following instructions:

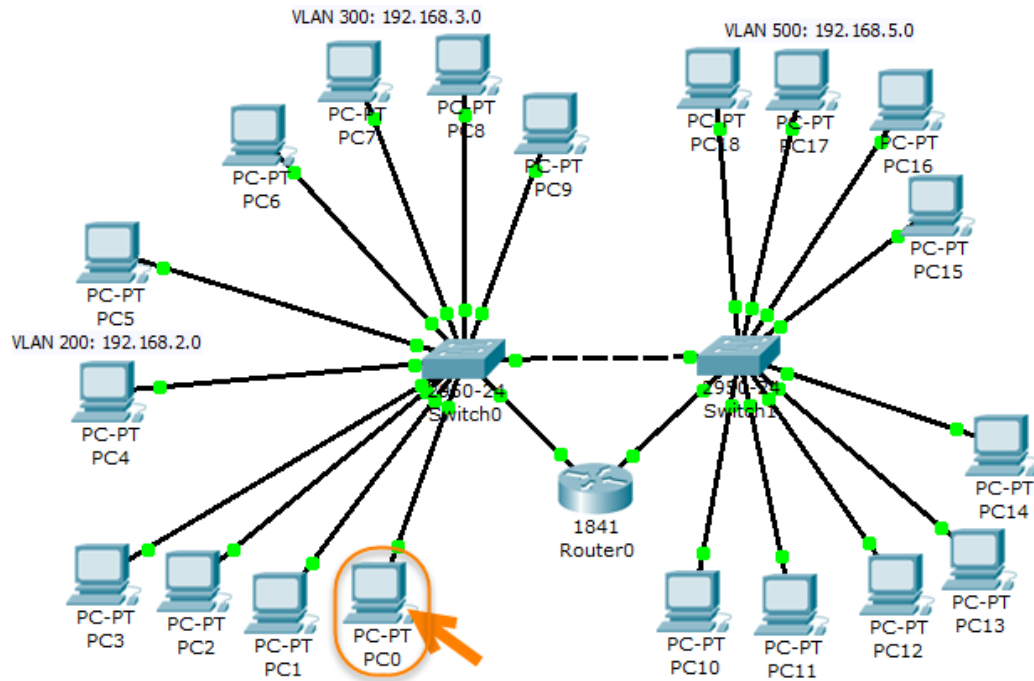


Figure 4.16: Pinging from PC0 to PC4.

Go to PC0 which has static IP address is 192.168.1.2 in VLAN100 and run command prompt under the Desktop tab as figure 4.16 and 4.17 shown.

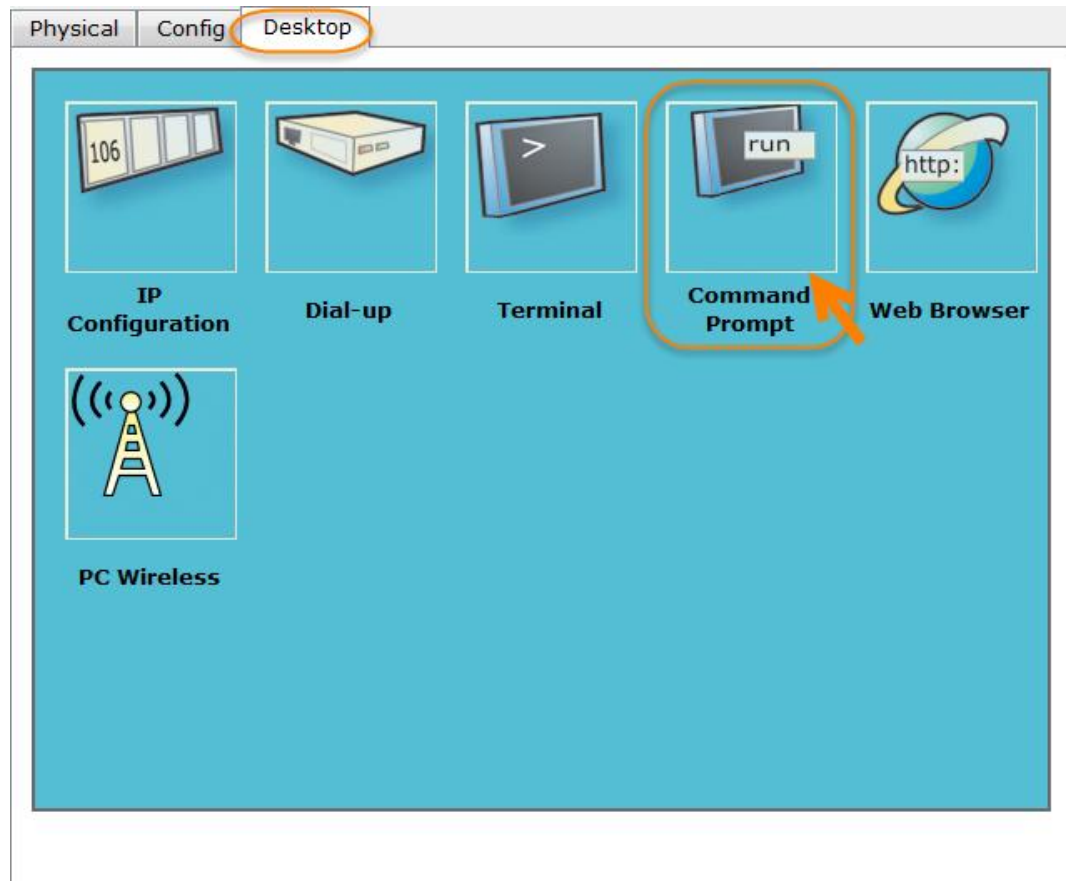
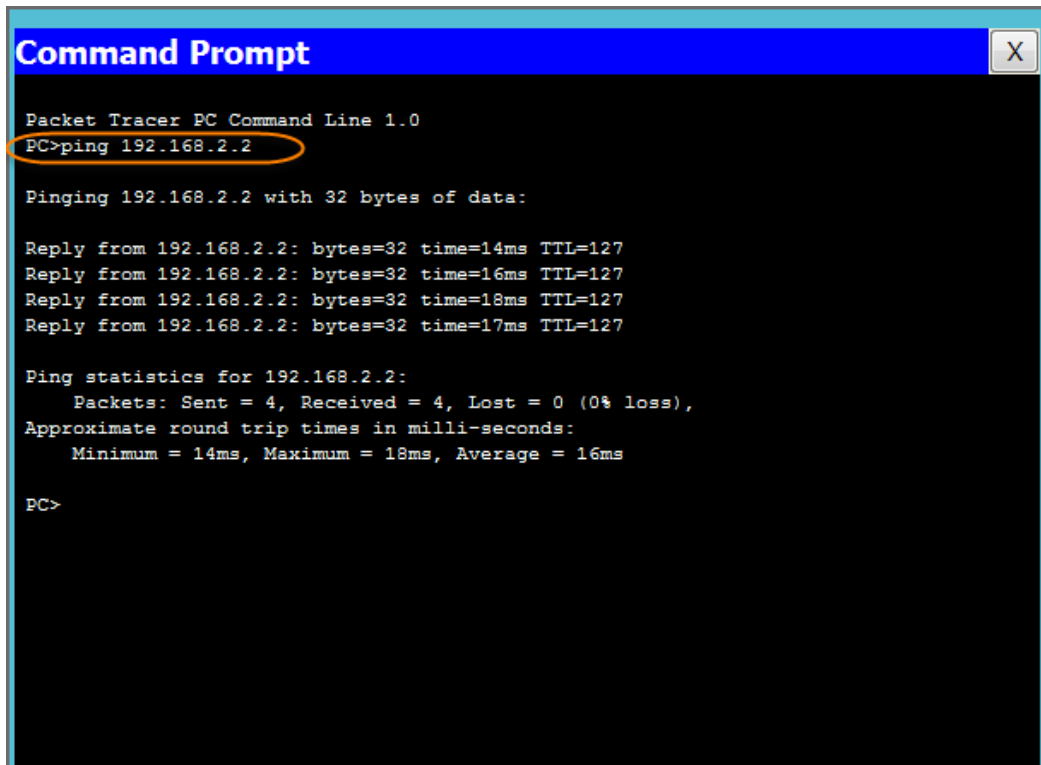


Figure 4.17: PC0 command prompt window.

In figure 4.18, type “ping” following by IP address of the laptop that wants to test. For example, ping 192.168.2.2 of PC4 in VLAN200 to see the result.

The image shows a screenshot of a 'Command Prompt' window from Packet Tracer. The window title is 'Command Prompt' and it has a close button (X) in the top right corner. The text inside the window is as follows:

```
Packet Tracer PC Command Line 1.0
PC>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Reply from 192.168.2.2: bytes=32 time=14ms TTL=127
Reply from 192.168.2.2: bytes=32 time=16ms TTL=127
Reply from 192.168.2.2: bytes=32 time=18ms TTL=127
Reply from 192.168.2.2: bytes=32 time=17ms TTL=127

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 14ms, Maximum = 18ms, Average = 16ms

PC>
```

The command 'PC>ping 192.168.2.2' is circled in orange.

Figure 4.18: PC0 command prompt window.

4.2 Capsa7

And from collect data of CPPD network system using Capsa7 application to be studied. In the sector that show volume of packet in system which monitoring. Found that the packet was send between users in the same group of working, which each sub division, has more the numbers of users in the system. Caused by the packet is not sent to the recipient, wherewith collide or packet loss. So user who is sender need for new transmission packet until the destination was received.

After testing configuration VLAN through switches and router for divide users to 5 groups. For grouping users that share same data placed in the same VLAN group. Found that the volume of packet in the system is greatly reduced. Because the packet that send from source to destination was encrypted. So the packet will be send to destination certainly. The number of resubmission and packet loss is reduced between transmissions.

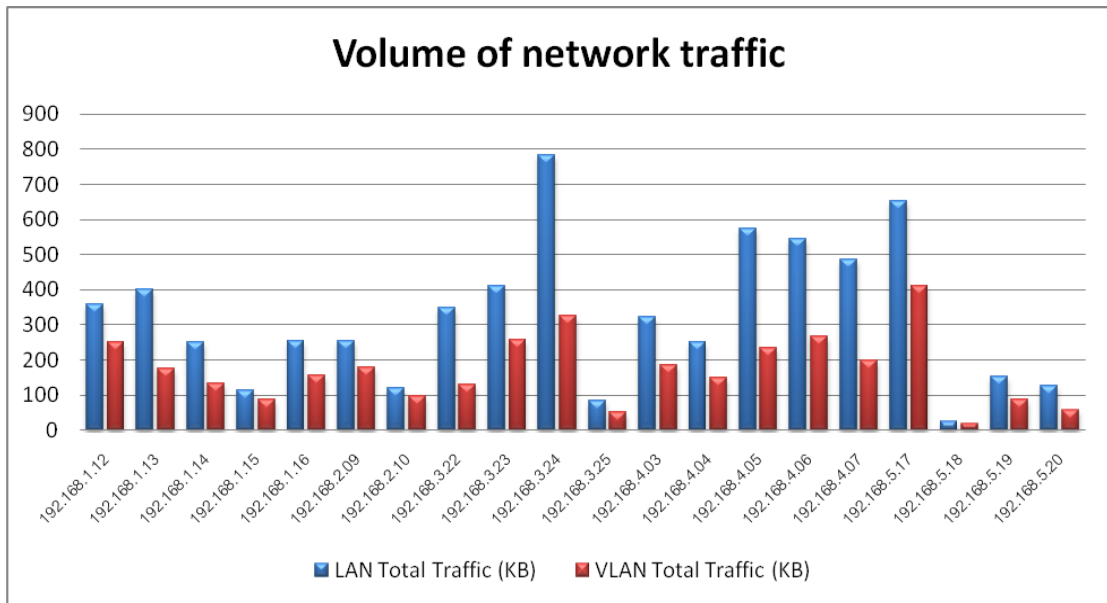


Figure 4.19: Comparing network traffic LAN via VLAN.

Overall, the network system that implementation by using VLAN, each user take less time to access the data in each group of the same type of working. And share information to each other within the organization quickly.

Lastly, about security when sending a packet which encapsulated transmission network, the users who irrelevant will not authorized to access or receive that packet. It made with the safety of a packet through the network more than ever.

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This chapter will conclude the reason why VLAN technology improves Consumer Protection Police Division's tradition LAN. According to the research, VLAN can save organization cost and time consuming, reduce in network traffic, and increase network performance, which can be summarized as follows.

In the budget perspective, VLAN implementation with CPPD, can save the cost of moving or changing office structure of CPPD without a new wiring or install additional network equipments. It can manage the network system via VLAN by adding or deleting users.

About the network traffic, the volume of data network traffic that running on VLAN implementation system instead of LAN. The amount of data traffic network drastically reduced. Due to the collision broadcast domain reduced, the packet loss between data transmission occurred less than the last. The user does not need to be repeated data transmission several times, which helps reduce the amount of data traffic in the system.

Of the above, user can access the data quickly. The data transmission between users as well as the last, due to the collision reduced. And data traffic in the network decreases as the foregoing. These cause overall system speed increases, and network system more efficiently.

VLAN is a technology which is suitable for the organizations or universities only because it can save reinstallation cost and manage the VLAN group easily. However, VLAN is not necessary for general households or small organization to apply this technology as it is complicated and needs expensive devices.

As mentioned in chapterII, Consumer Protection Police Division is an organization that consists of 5 divisions. In order to improve network quality and security of the organization, VLAN technology should be applied. As explained in

chapterIII, VLAN can reduce the chance of data collision and limit the broadcast traffic over the network by divide the network into sub network. In this case, CPPD's network is divided into 5 sub network and each sub network connects to 2 switches. The switches connect to each other via cross cable. This concept is called VLAN Trunk Protocol which enables two switches to communicate with each other. Router connects to the switches to route the destination in case packages are sent across VLAN group as implemented in chapterIV.

5.2 Recommendation

The purpose of this research study is to improve the network of an organization. For the learners who interested in this case study. They may further study or implement the VLAN concept to an organization. This case study would be able to support the learner some ideas about VLAN concept, advantage, disadvantage and how to implement VLAN in a real organization.

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