

**Implementing VLANs**

**Project conducted by :**

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VLAN Configuration

Introduction

A VLAN is a virtual local area network that serves a very important purpose in today’s computer networking field. It refers to “a group of LANs that have different physical connections, but communicate as if they are connected on a single network segment.” [2] As a result, VLANs offer network administrators the ability to divide one physical network into several broadcast domains. An example of this performance advantage would be a broadcast domain made up of 10 users with the broadcast traffic intended for only 5 users. If these 5 users are placed on a separate VLAN, it can drastically reduce traffic . [5] Multiple VLANs are created using a trunk port which is a connection that carries traffic from one VLAN to another is used to divide physical connections as well. For our project we had to configure two switches and a router and implement VLANs.

For our project we had to configure two switches, a Cisco Catalyst 2900 Series XL Switch and a Cisco Catalyst 3500 Series XL Switch. We also had to configure a Cisco 2901 Router to implement two VLANs for the surrounding campus community, including; St. Cloud State University (SCSU), St. Cloud Technical College (SCTC), and Saint John’s University (SJU). This was accomplished by implementing three separate subnets and combining VLAN traffic for SCSU and SJU through one switch. The first switch will be connecting two VLANs, SCSU and SCTC; SCSU will be using the 172.18.0.0/24 sub network with a gateway of 172.18.0.1. SCTC will be using subnet 192.168.2.0/24 with 192.168.2.1 as the gateway. The third VLAN will be for St. John’s University with a subnet of 10.1.1.0/8 using the 10.1.1.1 as the gateway.

Benefits

VLANs offer many benefits that simplify computer networking. Some of these benefits are: [3]

* Increased performance – performance increase is achieved by grouping users into logical networks.
* Improved manageability – in today’s rapidly changing network environment, VLAN’s provide a much needed flexibility in allowing large networks to be managed easily.
* Network tuning and simplification of software configurations – VLANs allow network administrators the ability to fine tune the network by grouping users logically.
* Physical topology independence – VLAN’s allow devices to be relocated with their configurations still intact to another location.
* Increased security options – by using VLAN’s network administrators can increase security by assigning users that require access to confidential information into a different VLAN than the rest of the users.

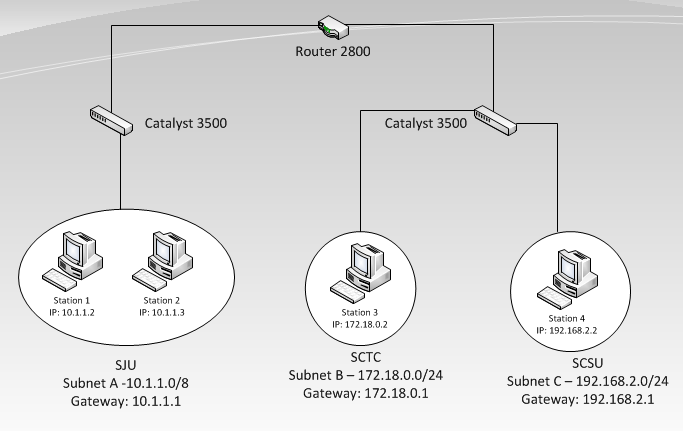
Project

Configuring SWITCH1 was relatively simple. There was just one subnet that contained two workstations. First, we configured the IP address and subnet mask in the two hosts and connected them to the switch. After that, we configured the router interface that was connected to SWITCH1 and assigned the IP address.  
We tested the configuration by pinging the two workstations that were connected from the router and vice versa from the two workstation to the router.

The second part required a few more commands to get everything working. In this section, we had to configure interVLAN routing since we had two separate VLANs on SWITCH2. To allow workstations in each of these VLANs to communicate, we had to create sub-interfaces on the router’s interface that was connected to SWITCH2. After that, we had to enable VLAN trunking.

VLAN trunking has an important benefit. Without trunking, we would have to dedicate separate links for each VLAN and we would also have to reserve ports on both ends of the devices. If we use trunking however, we can split one physical cable, into multiple logical cable and we would be able to carry traffic from multiple VLANs in one link.

If two workstations are on the same VLAN, they can communicate with each other in a simple manner. Host A sends a packet and the switch forwards the packet to host B as long as they are on the same VLAN. On the other hand, if two workstation on two different VLANs wish to communicate, and then we have to use a router or a layer 3 switch. Here, when host A on VLAN 4 sends a message to host B on VLAN 8, the packet(s) first traverse the switch on to the router, and then to the switch on the appropriate sub interface channel. In this scenario, we configured the router in a manner commonly referred to as ‘Router on a Stick’.

Below is the general diagram (exhibit 1.1) of the VLANs we setup:Exhibit 1.1

Sample Commands

Create VLANs  
VLAN DATABASE  
VLAN 20 NAME SCTC  
VLAN 40 NAME SCSU  
VLAN 60 NAME SJSB

Assign Ports (Interfaces)

CONFIGURE TERMINAL  
INTERFACE FASTETHERNET 0/2  
SWITCHPORT ACCESS VLAN 20  
NO SHUTDOWN

Remove Ports (Interfaces)

CONFIGURE TERMINAL  
INTERFACE FASTETHERNET 0/2  
NO SWITCHPORT ACCESS VLAN 20

Delete VLANs

VLAN DATABASE  
NO VLAN 2  
EXIT

Configure VLAN interfaces with IP address:

SWITCH#CONFIGURE TERMINAL  
SWITCH(CONFIG)#INTERFACE VLAN 40  
SWITCH(CONFIG-IF)#IP ADDRESS 172.18.0.4 255.255.255.0  
SWITCH(CONFIG-IF)#NO SHUTDOWN   
SWITCH(CONFIG-IF)#EXIT  
SWITCH(CONFIG)#IP DEFAULT-GATEWAY 172.18.0.1

Configuring Switchport Trunk

SWITCH(CONFIG)#INT FASTETHERNET 0/1

SWITCH(CONFIG-IF)#SWITCHPORT MODE TRUNK

SWITCH(CONFIG-IF)#SWITCHPORT TRUNK ENCAPSULATION DOT1Q

SWITCH(CONFIG-IF)#END

Configuring Sub Interfaces on the router

ROUTER(CONFIG)#INTERFACE FASTETHERNET 0/0  
ROUTER(CONFIG-IF)#NO IP ADDRESS  
ROUTER(CONFIG-IF)#NO SHUTDOWN  
  
ROUTER(CONFIG-IF)#INTERFACE FASTETHERNET0/0.1  
ROUTER(CONFIG-IF)#ENCAPSULATION DOT1Q 40   
ROUTER(CONFIG-IF)#IP ADDRESS 172.18.0.1 255.255.255.0  
  
ROUTER(CONFIG-IF)#INTERFACE FASTETHERNET0/0.2  
ROUTER(CONFIG-IF)#ENCAPSULATION DOT1Q 60  
ROUTER(CONFIG-IF)#IP ADDRESS 192.168.2.1 255.255.255.0

Study Conducted

With our overall group experience with configuring routers and switches being minimal; we conducted extensive research before attempting to setup or configure any equipment. Before beginning to research VLANs, we had assumed that we would be reading forums with similar questions and situations to which we were about to encounter, with perhaps some networking professionals providing input or tips. We were pleased to find that it was the complete opposite; Cisco had published very detailed guides and a plethora of other online documentation available for free both on their website and in PDF format. Cisco’s online guide includes step by step instructions for creating VLANs for either the catOS or, in our case, the IOS. This was extremely helpful because it provided real examples of command implementation and defined what each command does. It also provides tips for troubleshooting in case of any problems. Since there is a lot of new terminology throughout the guides that a standard end user may not be familiar with; Cisco provides hyperlinks to key terms and further defines them, such as “Understanding VLAN Trunk Protocol.” The most useful part of this online guide was the section called “Creating Ethernet VLANs on Catalyst Switches;” which provides progressive instructions to create a VLAN on a Cisco Catalyst Switch. Another very useful section of this guide was “Configuring a Gateway of Last Resort Using IP Commands,” which defined IP commands and provided diagrams to walk us through configuring IP settings.

The next massive provider of information to us was a 544 Paged PDF Document called “Catalyst 2950 Desktop Switch Software Configuration Guide,” [6] which was published by Cisco for the IOS and released in April 2002. We primarily used Chapter 13 – “Configuring VLANs,” both before starting our project as well as referencing it multiple times throughout the problems we faced when implementing the VLANs. This included;

* an overview of understanding VLANs
* a tutorial on configuring Normal-Range VLANs
* a brief explanation on Displaying VLANs
* an in-depth explanation on configuring VLAN Trunks

The final major resource that we found to be useful was an instructional video tutorial on HappyRouter.com; called, “How to Configure VLANs in the Cisco IOS.” [7] This provided us with a way to see commands being implemented and the results of those commands entered. The narrator also guides you through each instruction in great detail, explains what each command does, and interprets the results. This was a refreshing alternative to reading lines of code, and an effective way to become more familiar with configuring VLANs.

Conclusion

Our goal was to configure the Cisco 2901 Router along with the Cisco Catalyst 3500 and Catalyst 2900 switches to implement the network of three VLANs which we, for practical purposes, represented three universities in Central Minnesota: SCSU, STC, and St. John’s University. By configuring the three VLANs, we are interconnecting all of them to be able to communicate by their statics IP addresses but from within their respective VLANs.

References

[1] Frokwon.com, “*Creating and Maintaining VLANs”*, <http://www.frokwon.net/essays/VLAN.htm>

[2] Dell, “*What is VLAN Routing”,* <http://www.dell.com/downloads/global/products/pwcnt/en/app_note_38.pdf>, 2004

[3] UC Davis, “*VLAN Information”,* <http://net21.ucdavis.edu/newvlan.htm>

[4] David Passmore, John Freeman, ``The Virtual LAN Technology Report,'' March 7, 1997, <http://www.3com.com/nsc/200374.html> *A very good overview of VLAN's, their strengths, weaknesses, and implementation problems.*

[5] Cisco*, “VLANs and Trunking”,* <http://www.ciscopress.com/articles/article.asp?p=29803&seqNum=3>

[6] Cisco, “*Creating Ethernet VLANs on Catalyst Switches*” , <http://www.cisco.com/en/US/tech/tk389/tk689/technologies_configuration_example0918> 6a008009478e.shtml#topic1

[7] HappyRouter, “*How to Configure VLANs in the Cisco IOS*” ,   
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