CSG1105 Workshop Eleven

1 Introduction

This week we are going to extend our Packet Tracer (PT) skills. Last week, we constructed a simple network with two subnets connected by a router. This week we use VLANs to implement a network with four subnets with a router for inter-VLAN communication. With the VLANs, we can do functional grouping of users rather than requiring physical grouping using just switches with no VLANs.

2 Load the Base Network

1. Load Packet Tracer and open the file **workshop_11.pkt**.
2. Can you notice anything unusual about the configuration?
3. Possibly the four connections between the router and the switch? This is not an error, it's in fact the correct way to implement a network where you have a subnet for each VLAN and where the VLANs can be connected on multiple ports.
4. The four connections between the router and switch are acting as VLAN trunks which allow the devices to obtain their correct IP address from the correct DHCP pool (which we'll configure below), and also maintain connectivity between the different VLANs.

3 Implementing the Network Configuration

1. The easiest way to go about configuring the network is to start from the centre, then configure a cluster (or location) and verify its connectivity with itself. Once you have more than one cluster or location configured you can then verify connectivity between those locations.
2. We'll start with the Central Router which we will be setting up DHCP Pools and also configure the VLAN trunking.

3.1 Housekeeping Configuration

1. As we do for every previous tutorial we have the housekeeping configuration. I want you to enable privileged mode, then enter configuration terminal mode and following that you should type in '`no ip domain-lookup`', then configure the hostname, clock and banner. Once this is complete don't forget to use the command `write memory` in

privileged mode (not configure mode) to save this, so if you power cycle your devices they don't lose the configuration. If you need a refresher on the commands required, you can look at previous tutorials or watch a previous recording.

3.2 Subnet Calculation

1. We have been given the supernet (or allocated subnet) of 172.16.0.0/24 (255.255.255.0). We need to determine what level of subnetting to take this to for maximum efficiency of IP address and routing
2. As said we will be allocating a subnet for each VLAN in our network. For our sample topology we have 4 VLANs. When we are looking at something as simple as 4 VLANs with the minimal number of devices we can just split our /24 (255.255.255.0) network into 4 smaller subnets. This would mean our subnet mask then moves up to a /26 (255.255.255.192).
3. Each time we increase the subnet mask CIDR value by 1, we double the number of subnets. At the same time, we halve the number of available addresses. Starting with 1 subnet and 256 addresses at /24. So for example:

   /24 (255.255.255.0) = 1 subnet, 256 addresses
   (254 hosts, 1 network address, 1 broadcast address)
   /25 (255.255.255.128) = 2 subnets, 128 addresses each
   (126 hosts, 1 network address, 1 broadcast address each)
   /26 (255.255.255.192) = 4 subnets, 64 addresses each
   (62 hosts, 1 network address, 1 broadcast address each)
   etc.

4. Knowing that our subnet starts at 172.16.0.0/24 we can then use this network address to determine our subnets individual network addresses. Knowing that we are going to use a /26 mask, we can then add the number of addresses to our network address to find out each individual subnets starting network address. For example:

   172.16.0.0/26 = Subnet 1 + 64 (to get to next subnet)
   172.16.0.64/26 = Subnet 2 + 64 (to get to next subnet)
   172.16.0.128/26 = Subnet 3 + 64 (to get to next subnet)
   172.16.0.192/26 = Subnet 4

5. Our broadcast addresses will always be the last valid address in the subnet (which is 1 less than the start address of the next subnet). For example:

   172.16.0.63 = Broadcast for Subnet 1
   172.16.0.127 = Broadcast for Subnet 2
   172.16.0.191 = Broadcast for Subnet 3
   172.16.0.255 = Broadcast for Subnet 4

6. What happens with our next subnet (if we needed one)? If your broadcast address is 172.16.0.255, your next subnet would start at 172.16.1.0/26, and follow the same pattern as above (adding 64 to each starting address).

3.3 The Default Router

1. Lastly, to create our DHCP pools, we need to create their default gateway (or default-router). This is the port that our devices can use to leave their current network (or subnet). In your home setup, this would most likely be your modem's IP address (the one you use to configure it through your web browser).
2. For our devices, it is the port that you connect your DSL modem to. We'll assign a default-router as the first address in each of our networks. This would mean our subnets individual default routers would be:

   172.16.0.1/26 = Subnet 1 Default-Router
   172.16.0.65/26 = Subnet 2 Default-Router
   172.16.0.129/26 = Subnet 3 Default-Router
   172.16.0.193/26 = Subnet 4 Default-Router

3.4 Creating the DHCP Pools

1. We now have all the information required to create our DHCP pools in our router. So, lets enable privileged mode, then enter configuration terminal mode. Following that, enter the commands below:
2. Enter DHCP pool configuration `ip dhcp pool NAME`
3. This specifies that we want to enable a service on the TCP/IP layer, that service being DHCP and that we want to configure a pool with the name 'NAME', without spaces, this is just to make it easier to navigate our pools.
4. For example, `ip dhcp pool MechanicalEngineering`
5. Now, assign its network to the pool, `network 172.16.0.0 255.255.255.192`
6. This is essentially stating that this pool can allocate any IP address from 172.16.0.1 to 172.16.0.62 (keeping in mind that 172.16.0.0 and 172.16.0.63 are reserved for the start and broadcast addresses).
7. Now, let's assign our default gateway (referred to as router by Cisco) to the pools. `default-router 172.16.0.1`
8. Once done, type exit and begin to configure your next pools. For the remainder of the pools our commands will look like the below:

```
ip dhcp pool SoftwareEngineering
network 172.16.0.64 255.255.255.192
default-router 172.16.0.65
exit
ip dhcp pool Reception
network 172.16.0.129 255.255.255.192
default-router 172.16.0.129
exit
ip dhcp pool Wireless
network 172.16.0.192 255.255.255.192
default-router 172.16.0.193
exit
```

9. After doing this, you should use the command, `write memory`, when in enable mode

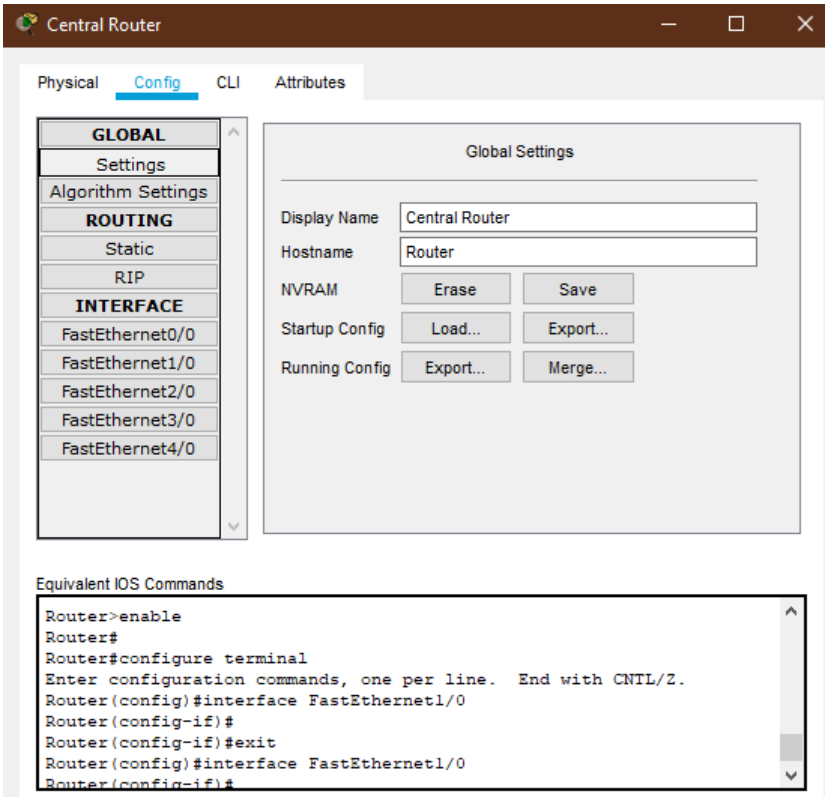
(not configure mode) to save this to the permanent memory.

3.5 Configuring the Default-Routers

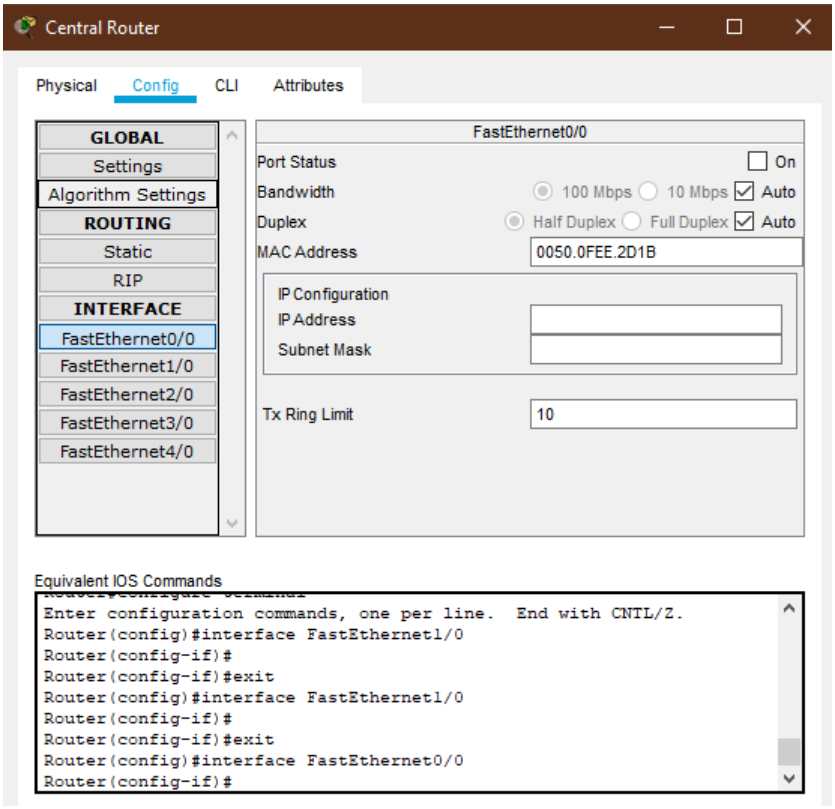
1. Our next step is to configure the default-routers for our pools. So far we have allocated them, but we currently have no ports active on the router to be the default-router. Let's look into how this is done.
2. As each of our VLANs have their own DHCP pool and therefore, their own default-router, our four connections will act as their own default router for each VLAN. So we'll assign them like so:

VLAN 100 - FastEthernet 0/0 - 172.16.0.1	VLAN 200 - FastEthernet 1/0 - 172.16.0.65
VLAN 300 - FastEthernet 2/0 - 172.16.0.129	VLAN 800 - FastEthernet 3/0 - 172.16.0.193

3. We need to configure the interfaces individually, this is done as we would normally do any other router interface, just like below. We'll start with FastEthernet 0/0 and progress down, we'll be using the GUI for this. So click on your router and go to the Config tab in the new window. You should see the window below.



Click on the label 'FastEthernet0/0' or something similar. You will then see the window below.



4. Now fill in the information like below:

   Port Status: On
   IP Address: 172.16.0.1
   Subnet Mask: 255.255.255.192

5. Then begin to do the same for the other 3 ports (FastEthernet 1/0 to 3/0). Use the information we have determined earlier, listed again below:

   FastEthernet1/0:
   Port Status: On
   IP Address 172.16.0.65
   Subnet Mask: 255.255.255.192

   FastEthernet2/0:
   Port Status: On
   IP Address: 172.16.0.129
   Subnet Mask: 255.255.255.192

   Fast Ethernet3/0:
   Port Status: On
   IP Address: 172.16.0.193
   Subnet Mask: 255.255.255.192

6. Once complete, return to the GLOBAL Settings pane that we first saw and click on the

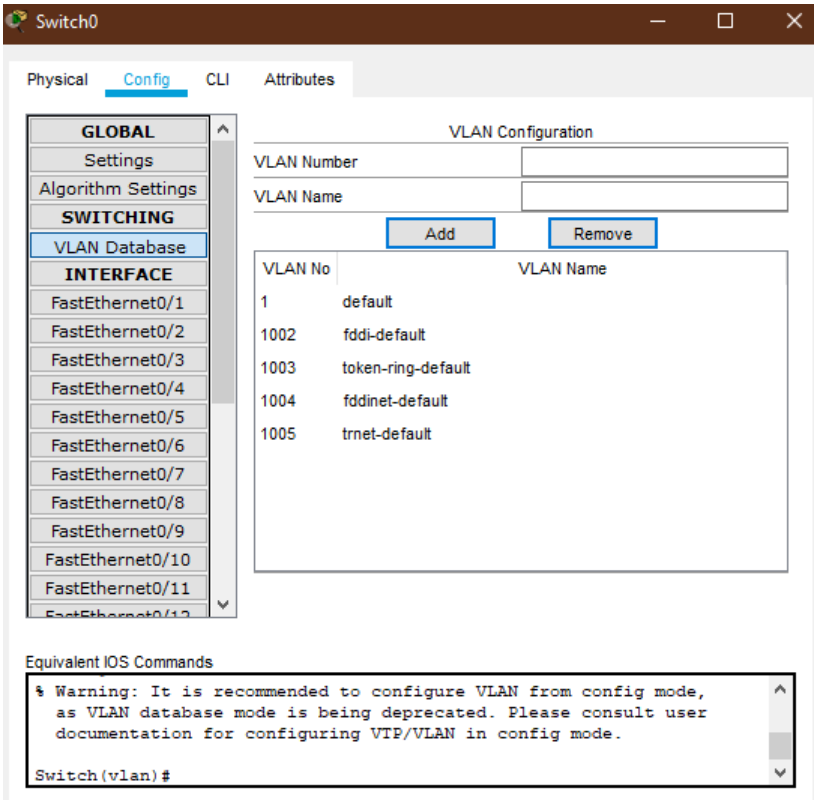
NVRAM Save button.

7. Now, onto configuring the switches, starting with the Central Switch.

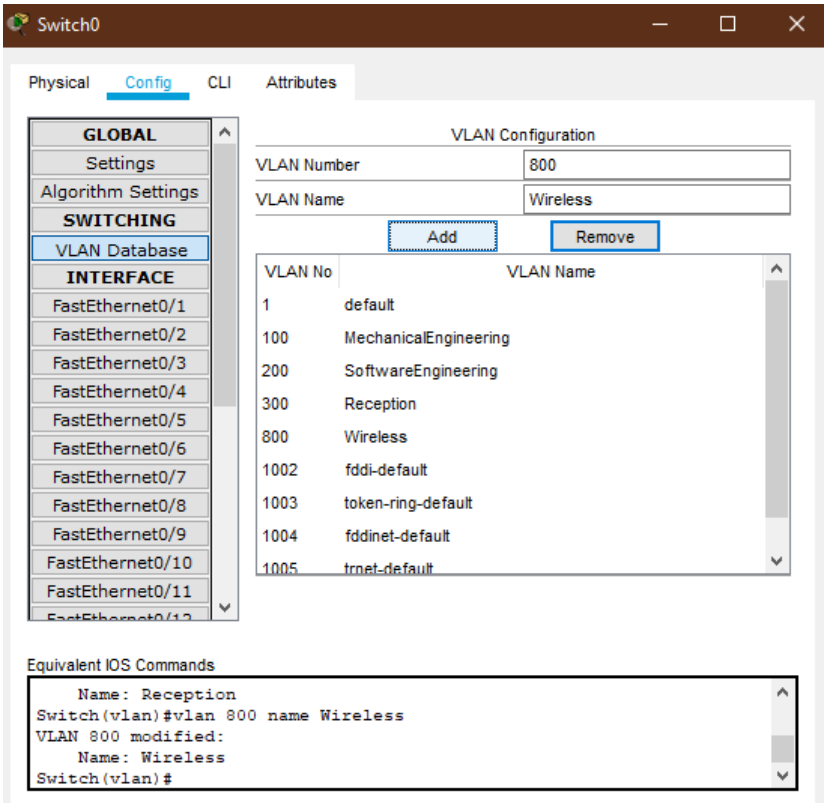
3.6 VLAN Creation for the Central Switch

1. To implement the VLAN on a switch there is two parts to this, firstly, you must declare the VLANs in the switch, then assign the VLANs to the individual ports.

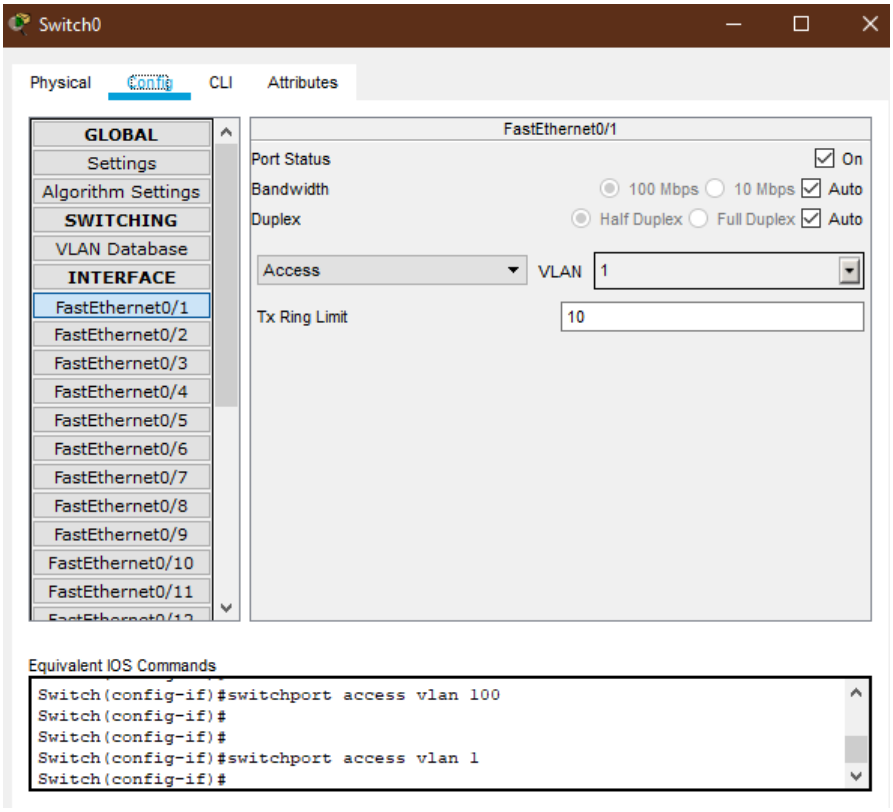
   Once again, open your switch window and then go to the Config tab, you will be greeted with a similar screen to the router.



   Notice on the left hand list there are different options now, please click on the VLAN Database button and we'll begin creating our VLANs. To do so, enter the VLAN number (100, 200, 300 or 800) and their name, without spaces, like the picture below.



Once you have added all of the VLANs to the VLAN Database we'll now start setting up our interfaces again. Let's click onto the first one, FastEthernet0/1. You should be able to see the following information.



2. We will be assigning the first four interfaces only one VLAN each. This is because they will be the bridge only for that VLAN to the router. So, all VLAN 100 traffic will be on FastEthernet0/1, all VLAN 200 traffic will be on FastEthernet0/2 and so on.

3. Change the information to reflect the following:

FastEthernet0/1:	FastEthernet0/2:
Port Status: On	Port Status: On
Access VLAN: 100	Access VLAN: 200
FastEthernet0/3:	FastEthernet0/4:
Port Status: On	Port Status: On
Access VLAN: 300	Access VLAN: 800

4. Now that we have set up our bridging interfaces to the router, lets now begin to assign the VLANs to the other interfaces. Let's start with Building 1 Level 1's interface, which is FastEthernet0/5. We want to change the word Access to Trunk and select all four VLANs.

   When you have multiple VLANs in use on the same interface (like the one leading to Building 2 Level 1 & Level 2)Port Status: On
   Trunk VLAN: 100, 200, 300, 800 &
   you will need to change the word Access to Trunk instead.

   NOTE: When deselecting the other VLANs in Trunk mode the list will show a random set of numbers. This is because it is using ranges to allow your values to be allowed. As

long as your correct VLANs are selected this is all that matters.

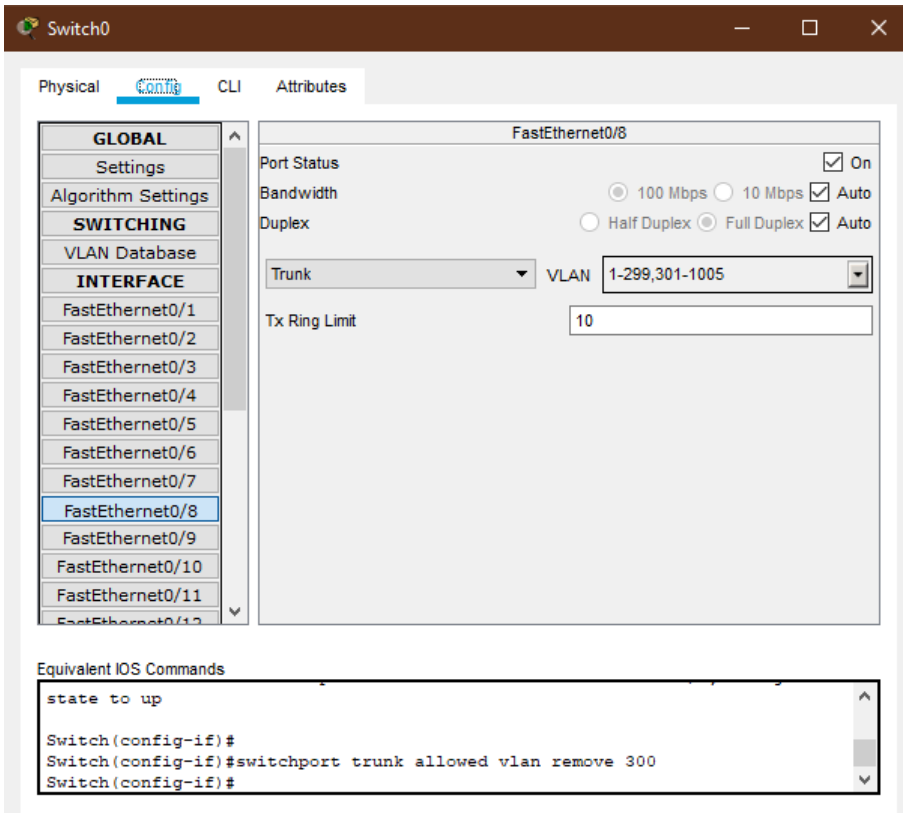
5. The following information should be for the other building locations:

   Building 1 Level 2:
   FastEthernet0/6
   Port Status: On
   Trunk VLAN: 100, 200, 300, 800

   Building 2 Level 1:
   FastEthernet0/7
   Port Status: On
   Trunk VLAN: 100, 200, 300, 800

   Building 1 Level 2:
   FastEthernet0/8
   Port Status: On
   Trunk VLAN: 100, 200, 300, 800

6. For an example of the Trunked list have a look below. You will notice it uses a strange looking range, but the VLANs are selected, this is normal.



Congratulations You've just set up your Central Router Switch. Now we need to set up the rest of the switches. We'll go through doing this for Building 1 Level 1 and move on through from there.

Building 1 Level 1 Switch: VLAN Database: 200 SoftwareEngineering FastEthernet0/1: Port Status: On Trunk VLAN: 200 FastEthernet0/2-5: Port Status: On Access VLAN: 200	**Building 1 Level 2** Switch: VLAN Database: 100 MechanicalEngineering FastEthernet0/1: Port Status: On Trunk VLAN: 100 FastEthernet0/2-5: Port Status: On Access VLAN: 100
Building 2 Level 1 Switch: VLAN Database: 300 Reception 800 Wireless FastEthernet0/1: Port Status: On Trunk VLAN: 300, 800 FastEthernet0/2: Port Status: On Access VLAN: 800 FastEthernet0/3-6: Port Status: On Access VLAN: 300	**Building 2 Level 2** Switch: VLAN Database: 100 MechanicalEngineering 200 SoftwareEngineering 800 Wireless FastEthernet0/1: Port Status: On Trunk VLAN: 100, 200, 800 FastEthernet0/2 Port Status: On Access VLAN: 800 FastEthernet0/3 & FastEthernet0/4: Port Status: On Access VLAN: 100 FastEthernet0/5 & FastEthernet0/6: Port Status: On Access VLAN: 200

4 SUMMARY

In this workshop, we have had a brief introduction to configuring VLANs and subnets with DHCP in Packet Tracer.