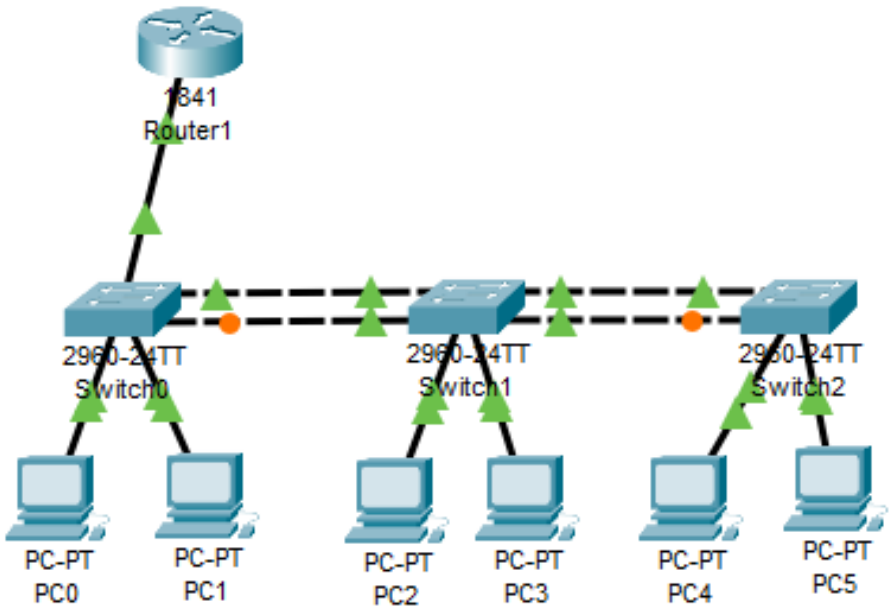
LAB 4 – Enhancing Switched Network

Objective: The main objective of this lab is to create a practice lab in packet tracer for the practice of VTP Server and Client configuration, DTP configuration, STP Configuration, Intra VLAN communication and Router on Stick Configuration. This lab will help you in understanding the VLAN practically.

Scenario for lab

Assume you are a network administrator in an Organization. The company has three offices. Offices are connected with each other via layer 2 links. For redundancy purpose each office has one more layer 2 link. The company has two department sales and management. In each office we have one PC from each department. Company has one router. You can use router's Ethernet port for inter VLAN communication.

Use the following network topology for this lab.



Configurations used in this topology are following

PCs Configuration

Device	IP Address	Subnet Mask	Gateway	VLAN	Connected With
PC0	10.0.0.2	255.0.0.0	10.0.0.1	VLAN 10	Office 1 Switch on F0/1
PC1	20.0.0.2	255.0.0.0	20.0.0.1	VLAN 20	Office 1 Switch on F0/2
PC2	10.0.0.3	255.0.0.0	10.0.0.1	VLAN 10	Office 2 Switch on F0/1
PC3	20.0.0.3	255.0.0.0	20.0.0.1	VLAN 20	Office 2 Switch on F0/2
PC4	10.0.0.4	255.0.0.0	10.0.0.1	VLAN 10	Office 3 Switch on F0/1
PC5	20.0.0.4	255.0.0.0	20.0.0.1	VLAN 20	Office 3 Switch on F0/2

Office 1 Switch Configuration

Port	Connected To	VLAN	Link	Status
F0/1	With PC0	VLAN 10	Access	OK
F0/2	With PC1	VLAN 20	Access	OK
Gig1/1	With Router	VLAN 10,20	Trunk	OK
Gig 1/2	With Switch2	VLAN 10,20	Trunk	OK
F0/24	Witch Switch2	VLAN 10,20	Trunk	STP - Blocked

Office 2 Switch Configuration

Port	Connected To	VLAN	Link	Status
F0/1	With PC0	VLAN 10	Access	OK
F0/2	With PC1	VLAN 20	Access	OK
Gig 1/2	With Switch1	VLAN 10,20	Trunk	OK
Gig 1/1	With Switch3	VLAN 10,20	Trunk	OK
F0/24	Witch Switch1	VLAN 10,20	Trunk	STP - Blocked
F0/23	Witch Switch3	VLAN 10,20	Trunk	STP - Blocked

Office 3 Switch Configuration

Port	Connected To	VLAN	Link	Status
F0/1	With PC0	VLAN 10	Access	OK
F0/2	With PC1	VLAN 20	Access	OK
Gig 1/1	With Switch2	VLAN 10,20	Trunk	OK
F0/24	Witch Switch1	VLAN 10,20	Trunk	STP - Blocked

Router Configuration

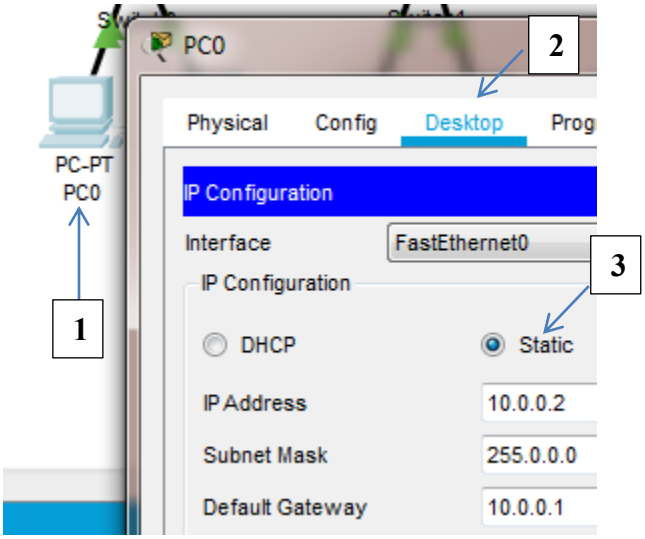
Port	Connected To	VLAN	Link	Status
Fa0/0	with Office 1 Switch Gig 1/2	VLAN 10, 20	Trunk	Ok

VLAN Configuration

VLAN Number	VLAN Name	Gateway IP	PCs
10	Sales	10.0.0.1	PC0,PC2,PC4
20	Management	20.0.0.1	PC1,PC3,PC5

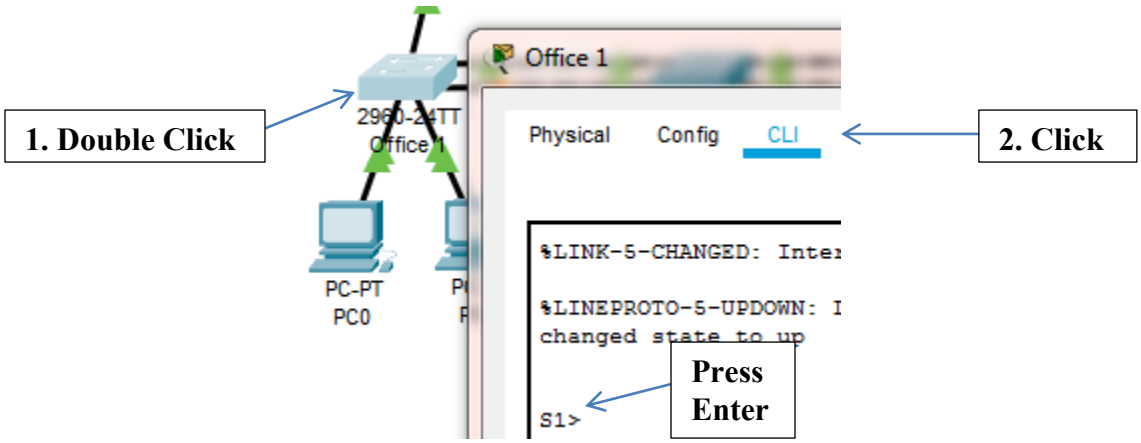
Activity 1: Assign IP Addresses to PCs

Assigning IP addresses is bit easy task in packet tracer. Just double Click on PC-PT and Click Desktop menu item and Click IP Configuration Select Static from radio option and fill IP address, subnet mask and default gateway IP in given input boxes. Use PC Configuration table to assign correct IP address.



Activity 2: Configure VTP Server

Configure **Office 1 Switch** as VTP Server. Double click on **Office 1 Switch** and Click **CLI** menu item and press **Enter key** to start CLI session.



By default all switches work as VTP server so we only need few commands to configure it. In following commands we will

- Set hostname to **S1**
- Set domain name to *example*
- Set password to *cisco*. (Password is case sensitive)

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S1
S1(config)#vtp mode server
Device mode already VTP SERVER.
S1(config)#vtp domain example
Changing VTP domain name from NULL to example
S1(config)#vtp password cisco
Setting device VLAN database password to cisco
S1(config)#
```

Activity 3: Configure VTP Client

Configure Office 2 Switch and Office 3 Switch as VTP client switch. Access **CLI** prompts of **Office 2 Switch** and execute following commands

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S2
S2(config)#vtp mode client
Setting device to VTP CLIENT mode.
S2(config)#vtp domain example
Changing VTP domain name from NULL to example
S2(config)#vtp password cisco
Setting device VLAN database password to cisco
S2(config)#
```

Now access **CLI** prompts of **Office 3 Switch** and enter following commands

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S3
S3(config)#vtp mode client
Setting device to VTP CLIENT mode.
S3(config)#vtp domain example
Changing VTP domain name from NULL to example
S3(config)#vtp password cisco
Setting device VLAN database password to cisco
S3(config)#
```

Activity 4: configure trunk on following interfaces

Switch	Interfaces
Office 1	Gig1/1, Gig1/2, F0/24
Office 2	Gig1/1, Gig1/2, F0/23, F0/24
Office 3	Gig1/1, Gig1/2

By default all interface on switch starts as access link. *switchport mode trunk* command is used to change connection link in trunk. Run this command from interface mode.

Office 1 Switch

```
S1(config)#interface fastEthernet 0/24
S1(config-if)#switchport mode trunk
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24,
changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24,
changed state to up
S1(config-if)#exit
S1(config)#interface gigabitEthernet 1/1
S1(config-if)#switchport mode trunk
S1(config-if)#exit
S1(config)#interface gigabitEthernet 1/2
S1(config-if)#switchport mode trunk
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/2,
changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/2,
changed state to up
S1(config-if)#exit
S1(config)#
```

Office 2 Switch

```
S2(config)#interface gigabitEthernet 1/1
S2(config-if)#switchport mode trunk
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/1,
changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/1,
changed state to up
S2(config-if)#exit
S2(config)#interface gigabitEthernet 1/2
S2(config-if)#switchport mode trunk
S2(config-if)#exit
S2(config)#interface fastEthernet 0/23
S2(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
S2(config-if)#exit
S2(config)#interface fastEthernet 0/24
S2(config-if)#switchport mode trunk
S2(config-if)#exit
```

Office 3 Switch

```
S3(config)#interface fastEthernet 0/24
S3(config-if)#switchport mode trunk
S3(config-if)#exit
S3(config)#interface gigabitEthernet 1/1
S3(config-if)#switchport mode trunk
S3(config-if)#exit
```

Activity 5: Creating VLAN

Office1 Switch is configured as VTP Server. Office2 and Office3 switches are configured as VTP clients. We only need to create VLANs in VTP Server. VTP Server will propagate this information to all VTP clients automatically.

vlan *vlan number* command is used to create the VLAN.

Office 1 Switch

```
S1(config)#vlan 10
S1(config-vlan)#exit
S1(config)#vlan 20
S1(config-vlan)#exit
S1(config)#
```

Activity 6: Assigning VLAN Membership

VLAN can be assigned statically or dynamically. We will also use static method to assign VLAN membership. **switchport access vlan [*vlan number*]** command is used to assign VLAN to the interface. Following commands will assign VLANs to the interfaces.

Office 1 Switch

```
S1(config)#interface fastEthernet 0/1
S1(config-if)#switchport access vlan 10
S1(config-if)#interface fastEthernet 0/2
S1(config-if)#switchport access vlan 20
```

Office 2 Switch

```
S2(config)#interface fastEthernet 0/1
S2(config-if)#switchport access vlan 10
S2(config-if)#interface fastEthernet 0/2
S2(config-if)#switchport access vlan 20
```

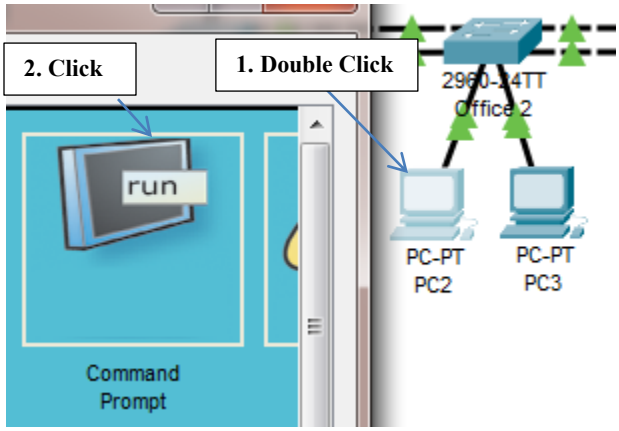
Office 3 Switch

```
S3(config)#interface fastEthernet 0/1
S3(config-if)#switchport access vlan 10
S3(config-if)#interface fastEthernet 0/2
S3(config-if)#switchport access vlan 20
```

We have successfully assigned VLAN membership. It's time to test our configuration. To test this configuration, we will use *ping* command. *ping* command is used to test connectivity between two devices. As per our configuration, devices from same VLAN can communicate. Devices from different VLANs must not be able to communicate with each other without router.

Activity 7: Testing VLAN configuration

Access PC's command prompt to test VLAN configuration. Double click **PC-PT** and click **Command Prompt**



We have two VLAN configurations VLAN 10 and VLAN 20. Let's test VLAN 10 first. In VLAN 10 we have three PCs with IP addresses 10.0.0.2, 10.0.0.3 and 10.0.0.4. These PCs must be able to communicate with each other's. At this point PCs from VLAN 10 should not be allowed to access PCs from VLAN 20. VLAN 20 also has three PCs 20.0.0.2, 20.0.0.3 and 20.0.0.4.

```
PC>ipconfig
IP Address.....: 10.0.0.3
Subnet Mask.....: 255.0.0.0
Default Gateway.....: 10.0.0.1
PC>ping 10.0.0.2
Reply from 10.0.0.2: bytes=32 time=1ms TTL=128
Reply from 10.0.0.2: bytes=32 time=0ms TTL=128
PC>ping 10.0.0.4
Reply from 10.0.0.4: bytes=32 time=1ms TTL=128
Reply from 10.0.0.4: bytes=32 time=1ms TTL=128
PC>ping 20.0.0.4
Request timed out.
Request timed out.
PC>ping 20.0.0.3
Request timed out.
Request timed out.
PC>ping 20.0.0.2
Request timed out.
Request timed out.
```

We have successfully implemented VLAN 10 now test VLAN 20.

Same as VLAN 10, PCs from VLAN 20 must be able to communicate with other PCs of same VLAN while they should not be able to access VLAN 10.

```
PC>ipconfig
IP Address.....: 20.0.0.3
Subnet Mask.....: 255.0.0.0
Default Gateway.....: 20.0.0.1
PC>ping 20.0.0.2
Reply from 20.0.0.2: bytes=32 time=34ms TTL=128
Reply from 20.0.0.2: bytes=32 time=0ms TTL=128
PC>ping 20.0.0.4
Reply from 20.0.0.4: bytes=32 time=12ms TTL=128
Reply from 20.0.0.4: bytes=32 time=0ms TTL=128
PC>ping 10.0.0.2
Request timed out.
Request timed out.
PC>ping 10.0.0.3
Request timed out.
Request timed out.
PC>ping 10.0.0.4
Request timed out.
Request timed out.
```

Activity 8: Configure Router on Stick

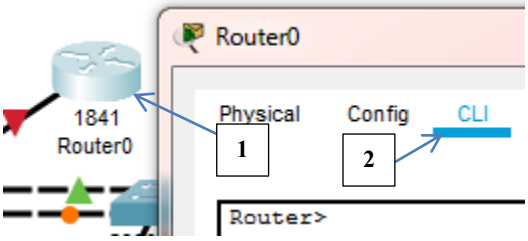
Typically routers are configured to receive data on one physical interface and forward that data from another physical interface based on its configuration. Each VLAN has a layer 3 address that should be configured as default gateway address on all its devices. In our scenario we reserved IP address 10.0.0.1 for VLAN 10 and 20.0.0.1 for VLAN 20.

With default configuration we need two physical interfaces on router to make this intra VLAN communication. Due to price of router, it's not a cost effective solution to use a physical interface of router for each VLAN. Usually a router has one or two Ethernet interface. For example if we have 50 VLANs, we would need nearly 25 routers in order to make intra VLANs communications. To deal with situation we use Router on Stick.

Router on Stick is router that supports trunk connection and has an ability to switch frames between the VLANs on this trunk connection. On this router, single physical interface is sufficient to make communication between our both VLANs.

Access command prompt of Router

To configure Router on Stick we have to access CLI prompt of Router. Click **Router** and Click **CLI** from menu items and Press **Enter key** to access the CLI

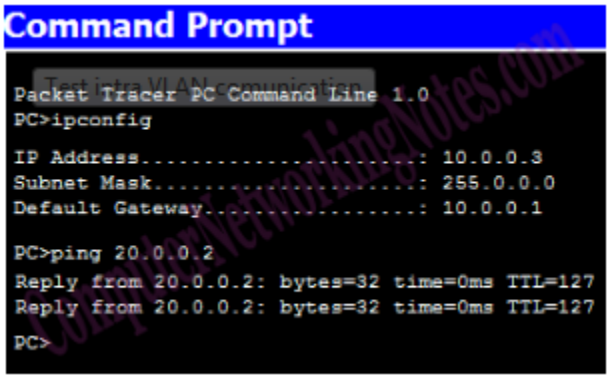


Run following commands in same sequence to configure Router on Stick

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface fastEthernet 0/0
Router(config-if)#no ip address
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface fastEthernet 0/0.10
Router(config-subif)#encapsulation dot1Q 10
Router(config-subif)#ip address 10.0.0.1 255.0.0.0
Router(config-subif)#exit
Router(config)#interface fastEthernet 0/0.20
Router(config-subif)#encapsulation dot1Q 20
Router(config-subif)#ip address 20.0.0.1 255.0.0.0
Router(config-subif)#exit
```

- In above configuration we broke up single physical interface [FastEthernet 0/0] into two logical interfaces, known as sub-interfaces. Router supports up to 1000 interfaces including both physical and logical.
- By default interface link works as access link. We need to change it into trunk link. encapsulation commands specify the trunk type and associate VLAN with sub-interface.
- In next step we assigned IP address to our sub-interface.

That's all configuration we need to switch VLANs. Now we can test different VLAN communications. To test intra VLANs communication open command prompt of PC and ping the PC of other VLAN.



PC [10.0.0.3] from VLAN 10 can now access PC [20.0.0.2] from VLAN 20.