

## LABORATORY 5: Subnetting

---

### Objectives

By the end of the laboratory, students will be able to

- design subnetting.
- add serial interface to router and configure serial interface.

### Introduction:

Given a block of IP addresses, the network administrator may want to divide the IP address block into smaller subnets to be assigned to different departments or functional groups.

Subnetting can be done either using Fixed-length Subnet Mask (FLSM) or Variable-length Subnet Mask (VLSM). FLSM is simpler to design as compared to VLSM, but FLSM has the problem of wasting large amount of unused IP addresses. This is due to the fact that FLSM allocates same size of IP address blocks to subnets regardless of how many host addresses are actually needed. For router-router interface, the subnet only needs two host addresses, but FLSM may assign large number of IP addresses to this subnet, and most of the IP addresses will be unused and wasted. VLSM, on the other hand, assign IP address blocks to subnets based on the host counts of the subnets. By allocating only enough IP addresses to subnets, VLSM drastically reduces the wastage of unused IP addresses.

There are two parts in this lab:

- (A) Introduction to subnetting using FLSM design
- (B) Independent learning activity on VLSM.

### Equipment:

Windows OS laptops with Cisco Packet Tracer installed.

#### (A) Fixed-length Subnet Mask (FLSM)

### Procedures:

#### 1. Design FLSM subnetting

- 1.1 You are given a block of IP addresses 200.15.11.0/24. Propose a FLSM subnetting scheme to meet the requirements listed in Table 5.1. Fill in Table 5.2 with your design parameters.

Subnet Name
LAN #1
LAN #2
LAN #3
WAN

**Table 5.1 – Requirement of 4 subnets**

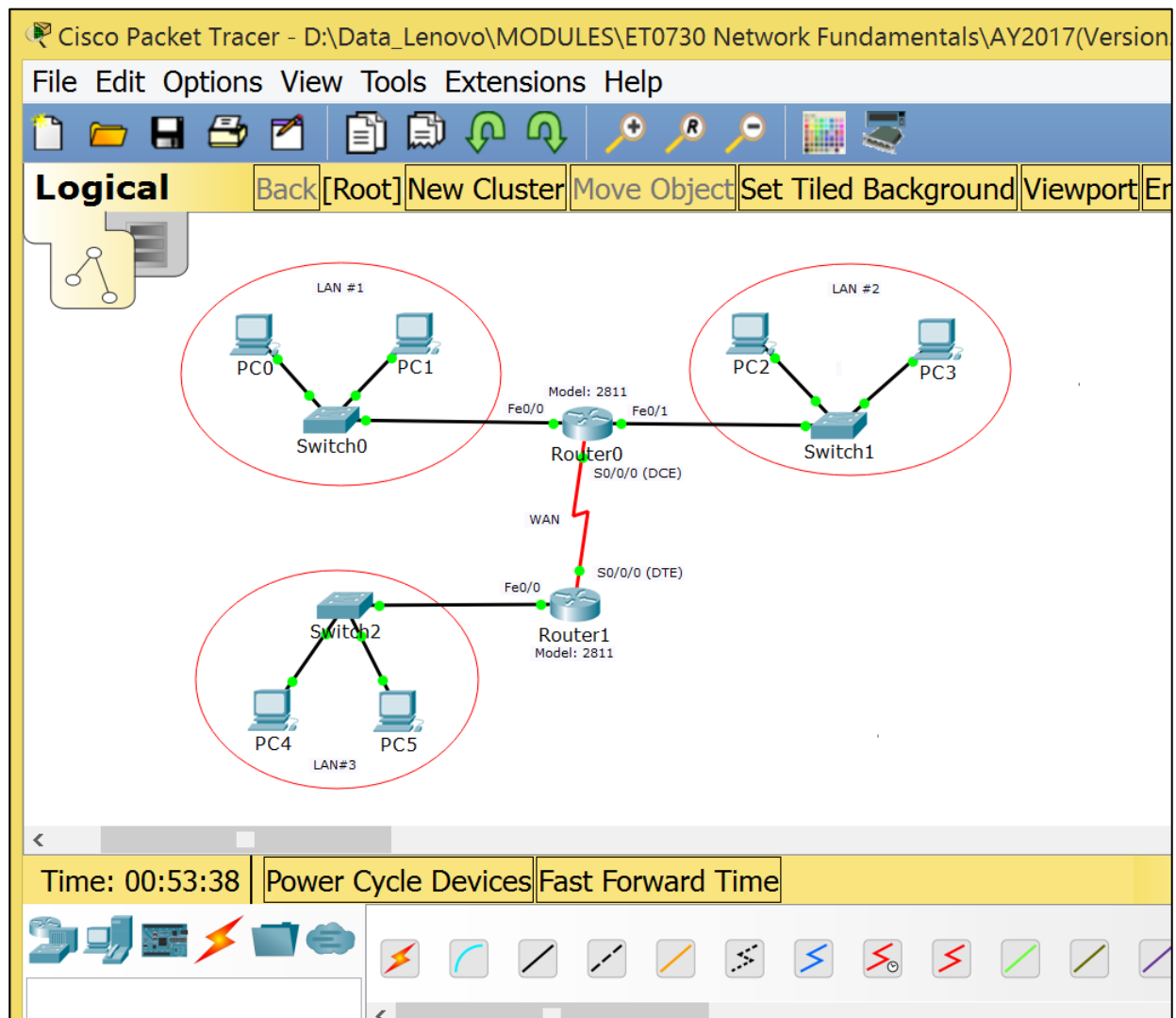
Subnet	Network ID	Host Address range	Broadcast Address	Subnet Mask
LAN #1	200.15.11.0/26	200.15.11.1 to 200.15.11.62	200.15.11.63	255.255.255.192
LAN #2	200.15.11.64/26	200.15.11.65 to 200.15.11.126	200.15.11.127	255.255.255.192
LAN #3	200.15.11.128/26	200.15.11.129 to 200.15.11.190	200.15.11.191	255.255.255.192
WAN	200.15.11.192/26	200.15.11.193 to 200.15.11.254	200.15.11.255	255.255.255.192

**Table 5.2 – FLSM subnetting design parameters for subnets in Table 5.1**  
*(Refer to lecture notes Chapter 5- FLSM Exercise Slide19)*

## 2. Construction and Configuration of a Computer Network for Testing FLSM subnetting

2.1 Construct the network shown in Figure 5.1. The 2811 routers do not come with serial interface. You need to add serial interface to the two routers by following the steps below:

- 2.1.1 Click the router and select “Physical” tab.
- 2.1.2 Click the power switch to power down the router.
- 2.1.3 From the panel on the left of Packet Tracer user interface, look for module “WIC-2T” (near the bottom, may need to scroll down). Click on the module and drag it to the right-hand, lower slot (Slot 0) of the 2811 router.
- 2.1.4 Click the power switch again to power up the router.
- 2.1.5 Close the router’s configuration interface.



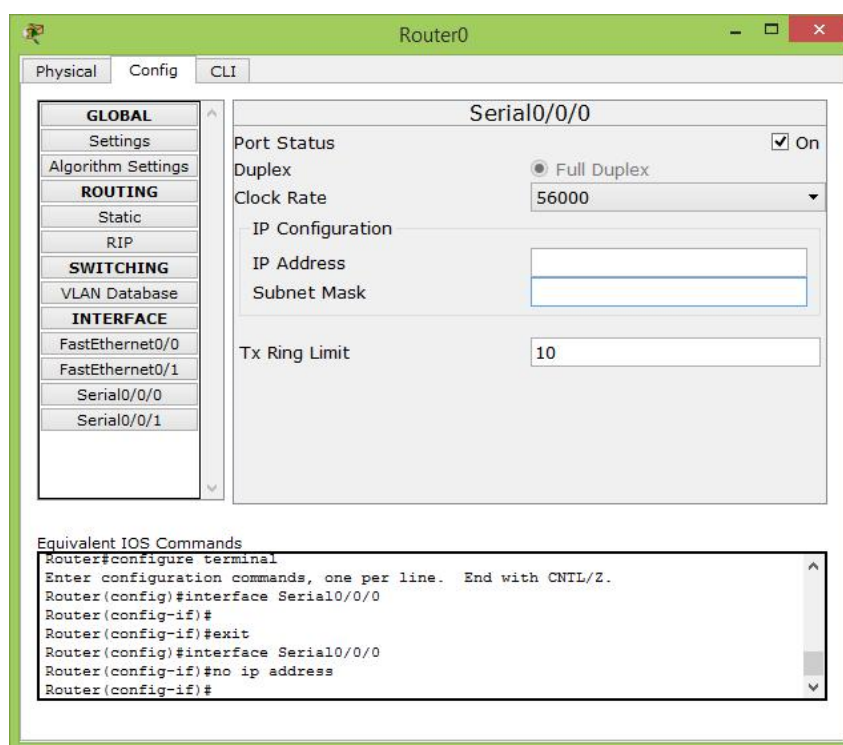
**Figure 5.1 - A network for verifying subnetting**

- 2.2 Configure the routers' Ethernet interface with the first valid host address (lowest IP address) of each LAN subnet. Configure the hosts with second and third valid host addresses. Remember to configure the default gateway setting of the hosts to the router's Ethernet interface. Record your settings using Table 5.3.
- 2.3 Configure the IP address of the serial interface of the two routers. Assign the lowest IP address to Router0's serial interface. Assign another IP address to Router1's serial interface. Record your settings using Table 5.3 too.

Device	IP Address	Subnet Mask	Default gateway
PC0	200.15.11.2/26	255.255.255.192	200.15.11.1
PC1	200.15.11.3/26	255.255.255.192	200.15.11.1
Router 0's Fe0/0	200.15.11.1/26	255.255.255.192	Not applicable
PC2	200.15.11.66/26	255.255.255.192	200.15.11.65
PC3	200.15.11.67/26	255.255.255.192	200.15.11.65
Router 0's Fe0/1	200.15.11.65/26	255.255.255.192	Not applicable
PC4	200.15.11.130/26	255.255.255.192	200.15.11.129
PC5	200.15.11.131/26	255.255.255.192	200.15.11.129
Router 1's Fe0/0	200.15.11.129/26	255.255.255.192	Not applicable
Router 0's S0/0/0	200.15.11.193/26	255.255.255.192	Not applicable
Router 1's S0/0/0	200.15.11.254/26	255.255.255.192	Not applicable

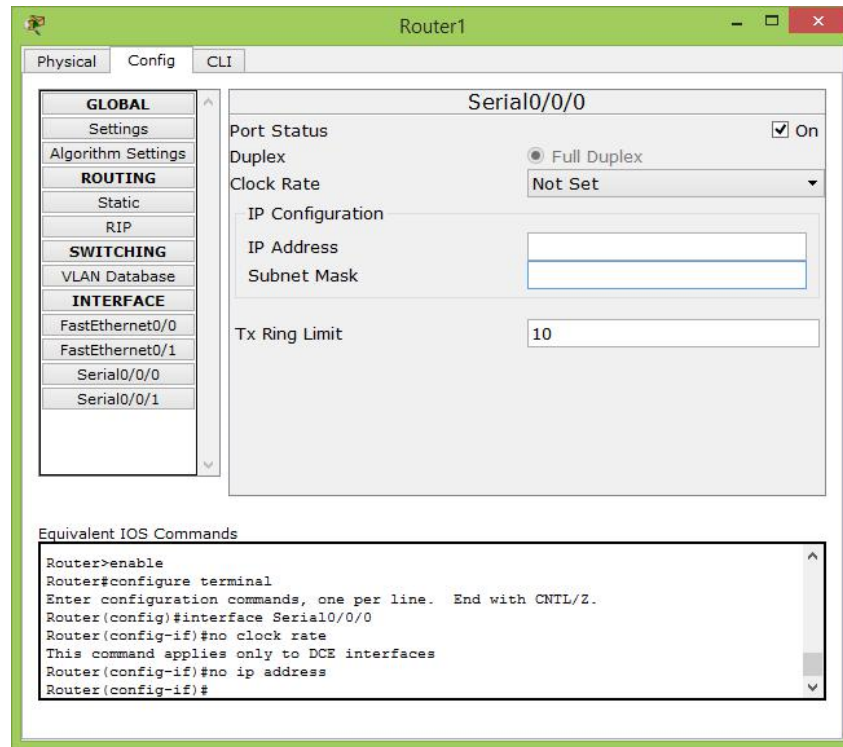
**Table 5.3 – IP address configuration of hosts and routers**

- 2.4 Router0's serial interface S0/0/0 will be the DCE, thus we need to set the clock rate to 56,000 bps, as illustrated in Figure 5.2.



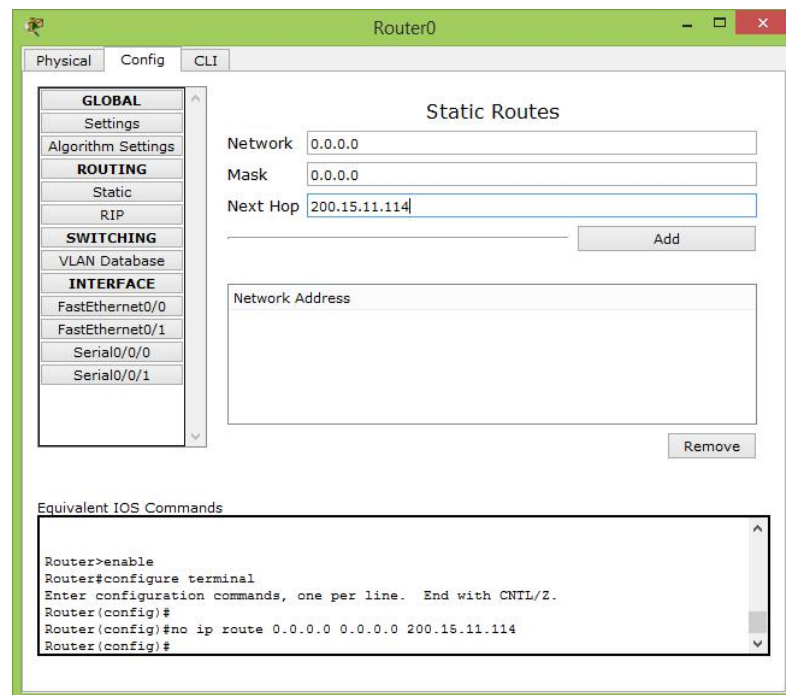
**Figure 5.2 – Setting the clock rate of Router0's serial interface S0/0/0**

- 2.5 Router1's serial interface is DTE, therefore there is no need to set the clock rate. Remember to set Router1's serial interface S0/0/0 to "Not set" for the clock rate, as shown in Figure 5.3.



**Figure 5.3 – Setting the clock rate of Router1's serial interface S0/0/0 to "Not Set"**

- 2.6 Configure Router0 with routing protocol RIP and default route, using the steps shows below. Routing protocol and default route will not be covered in this module. Just follow the steps to configure the router.
- 2.6.1 Click Router0, select the "Config" tab and then click "RIP".
  - 2.6.2 Enter "200.15.11.0" into the textbox at the top, then click the "Add" button.
  - 2.6.3 Click "Static", enter 0.0.0.0 into the textbox for "Network"; enter 0.0.0.0 into the textbox for "Mask"; and enter the IP address of Router1's serial interface (Note: Router1's serial interface, not Router0's serial interface) into the textbox for "Next Hop". Figure 5.4 shows an example.
  - 2.6.4 Click the "Add" button.
  - 2.6.5 Close the router configuration interface.



**Figure 5.4 – An example of setting default route for Router0**

- 2.7 Configure Router1 with routing protocol RIP and default route, using the steps shows below:
  - 2.7.1 Click Router1, select the “Config” tab and then click “RIP”.
  - 2.7.2 Enter “200.15.11.0” into the textbox at the top, then click the “Add” button.
  - 2.7.3 Click “Static”, enter 0.0.0.0 into the textbox for “Network”; enter 0.0.0.0 into the textbox for “Mask”; and enter the IP address of Router0’s serial interface (Note: Router0’s serial interface, not Router1’s serial interface) into the textbox for “Next Hop”.
  - 2.7.4 Click the “Add” button.
  - 2.7.5 Close the router configuration interface.

### 3. Verification of FLSM subnetting design and Network Configuration

- 3.1 Verify the connectivity between hosts in the same subnet. For example, PC0 should be able to ping PC1.
- 3.2 Verify the connectivity between a host and its default gateway. For example, PC0 should be able to ping the Ethernet interface of Router0.
- 3.3 Verify the connectivity between LAN #1 and LAN #2.
- 3.4 Verify the connectivity between LAN #1 and LAN #3.
- 3.5 Verify the connectivity between LAN #2 and LAN #3.

**(B) Variable-length Subnet Mask(VLSM)**

**4. Independent learning activity on VLSM**

Read the lecture notes “How to perform Subnetting using VLSM” in Chapter 5, Slide 26- 38.

**Procedures**

**4.1 Design VLSM subnetting**

Given a block of IP addresses **200.15.11.0/24**.

Propose a VLSM subnetting scheme to meet the requirements listed in Table 5.4.  
Show all working in the space provided.

Subnet Name	Requirement	Number of host bits required, <i>h</i>
LAN #1	Support 28 host addresses	
LAN #2	Support 20 host addresses	
LAN #3	Support 10 host addresses	
WAN	Point-to-point connection between two routers	

**Table 5.4 – Requirements of 5 VLSM subnets**

Fill in Table 5.5 with your design parameters.

Subnet	Network ID	Host Address range	Broadcast Address	Subnet Mask
LAN #1				
LAN #2				
LAN #3				
WAN				

**Table 5.5 – VLSM subnetting design parameters for subnets in Table 5.4**

#### 4.2 Construction and Configuration of a Computer Network for Testing VLSM subnetting

With the network shown in **Figure 5.1** and the design parameter in **Table 5.5**, complete **Table 5.6** and show it to your lecturer.

Device	IP Address	Subnet Mask	Default gateway
PC0			
PC1			
Router 0's Fe0/0			Not applicable
PC2			
PC3			
Router 0's Fe0/1			Not applicable
PC4			
PC5			
Router 1's Fe0/0			Not applicable
Router 0's S0/0/0			Not applicable
Router 1's S0/0/0			Not applicable

**Table 5.6– IP address configuration of hosts and routers**

Repeat Procedure 2 to construct and configure the network.



## **5. Verification of VLSM subnetting design and Network Configuration**

- 5.1 Verify the connectivity between hosts in the same subnet. For example, PC0 should be able to ping PC1.
- 5.2 Verify the connectivity between a host and its default gateway. For example, PC0 should be able to ping the Ethernet interface of Router0.
- 5.3 Verify the connectivity between LAN #1 and LAN #2.
- 5.4 Verify the connectivity between LAN #1 and LAN #3.
- 5.5 Verify the connectivity between LAN #2 and LAN #3.