CISCO PACKET TRACER

5. Design and set up the network for the following requirements. Assume that you are a network administrator at a XYZ company. Company have three departments connected with wan links.

Development department have 74 computers.

Production department have 52 computers.

Administrative department have 28 computers.

All departments are connected with each other via wan link.

Each wan link requires two IP addresses.

Subnet

- Dividing a network into two or more networks is called subnetting.
- When we perform Subnetting, all subnets have the same number of hosts, this is known as FLSM (Fixed length subnet mask). In FLSM all subnets use same subnet mask, this lead to inefficiencies.
- VLSM(Variable Length Subnet Mask) is a process of dividing an IP network into the subnets of different sizes without wasting IP addresses.
- In real life scenario, some subnets may require large number of host addresses while other may require only few addresses as in the above example.
- Therefore we are using VLSM for the solution.

VLSM Subnetting

- In VLSM Subnetting, we do Subnetting of subnets according the network requirement.
- Steps for VLSM Subnetting
- Find the largest segment. Segment which need largest number of hosts address.
- Do Subnetting to fulfill the requirement of largest segment.
- Assign the appropriate subnet mask for the largest segment.
- For second largest segments, take one of these newly created subnets and apply a different, more appropriate, subnet mask to it.
- Assign the appropriate subnet mask for the second largest segment.
- Repeat this process until the last network.

Now we know the steps of VLSM Subnetting. Let's understand it with above example. Our company requires 6 subnets and 160 hosts.

Step 1 :- Oder all segments according the hosts requirement (Largest to smallest).

Subnet	Segment	Hosts
1	Development	74
2	Production	52
3	Administrative	28
4	Wan link 1	2
5	Wan link 2	2
6	Wan link 3	2

Step 2 :- Do subnetting for largest segment.

Consider the IP address 192.168.1.0

Total 32 bits.

Last 8 bits used for hosts.(27 26252423222120)

Development department needs 74 host addresses.

We can use 128(27) addresses.

Total bits 32 - bits used for development department 7= /25

Number of subnets = 256/128=2 subnets.

Our largest segment needs 74 host addresses. /25 provide us two subnets with 126 hosts in each subnet.

192.168.1.0/25

Subnet	Subnet 1	Subnet 2
Network ID	192.168.1.0	192.168.1.128
First host address	192.168.1.1	192.168.1.129

Last host address	192.168.1.126	192.168.1.254
Broadcast ID	192.168.1.127	192.168.1.255

Step 3 :- Assign subnet mask to the largest segment. As you can see in above table, subnet 1 fulfill our largest segment requirement. Assign it to our segment.

Subnet mask 255.255.255.128(as leftmost 25 bits are 1)

Segment	Development
Requirement	74
CIDR	/25
Subnet mask	255.255.255.128
Network ID	192.168.1.0
First hosts	192.168.1.1
Last hosts	192.168.1.126
Broadcast ID	192.168.1.127

Step 4 :- Do subnetting for second largest segment from next available subnet. Next segment requires 52 host addresses. Subnetting of /25 has given us two subnets with 126 hosts in each, from that we have assigned first subnet to development segment. Second segment is available, we would do subnetting of this.

Production department needs 52 host addresses.

We can use 64(26) addresses.

Total bits 32 - bits used for production department 6= /26

Number os subnets = 256/64=4 subnets.

/26 provide us 4 subnets with 62 hosts in each subnet.

Subnet	Subnet 1	Subnet 2	Subnet 3	Subne
Network ID	0	64	128	192
First address	1	65	129	193
Last address	62	126	190	254
Broadcast ID	63	127	191	255

192.168.1.0/26

We cannot use subnet 1 and subnet 2 (address from 0 to 127) as they are already assigned to development department. We can assign subnet 3 to our production department.

Segment	Production
Requirement	52
CIDR	/26
Subnet mask	255.255.255.192
Network ID	192.168.1.128
First hosts	192.168.1.129
Last hosts	192.168.1.190
Broadcast ID	192.168.1.191

Step 5 :- Our next segment requires 28 hosts. From above subnetting we have subnet 3 and subnet 4 available. Do subnetting for the requirement of 28 hosts.

Admin department needs 28 host addresses.

We can use 32(25) addresses.

Total bits 32 - bits used for Admin department 5= /27

Number of subnets = 256/32=8 subnets.

Subnet	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Sub 7
Net ID	0	32	64	96	128	160	192
First Host	1	33	65	95	129	161	193
LastHost	30	62	94	126	158	190	222
Broadcast ID	31	63	95	127	159	191	223

192.168.1.0/27

Subnets 1 to 6 [address from 0 to 191] are already occupied by previous segments. We can assign subnet 7 to this segment.

Segment	Administrative
Requirement	28
CIDR	/27
Subnet mask	255.255.255.224
Network ID	192.168.1.192
First hosts	192.168.1.193
Last hosts	192.168.1.222
Broadcast ID	192.168.1.223

Step 6 :- Our last three segments require 2 hosts per subnet. Do subnetting for these.

WAN links needs 2 host addresses.

We can use 4(22) addresses.[2 host addresses +1 broadcast IP + 1 network IP)

Total bits 32 - bits used for wan links 2= /30

Number of subnets = 256/4=64 subnets.

192.168.1.0/30

Valid subnets are:-

0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96,100,104,108,112,116,120,124,128,132,136,140,144,148,152,156,160,164,168,172,176,180,184,188,192,196,200,204,208,212,216,220,224,228,232,236,240,244,248,252,256

From these subnets, subnet 1 to subnet 56 (Address from 0 - 220) are already assigned to previous segments. We can use 224,228, and 232 for wan links.

Subnet	Subnet 57	Subnet 58	Subnet 59
Network ID	224	228	232
First host	225	229	233
Last host	226	230	234
Broadcast ID	227	231	235

Assign these subnets to wan links.

Wan Link 1

Segments	Wan Link 1
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.224

First hosts	192.168.1.225
Last hosts	192.168.1.226
Broadcast ID	192.168.1.227

Wan Link 2

Segments	Wan Link 2
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.228
First hosts	192.168.1.229
Last hosts	192.168.1.230
Broadcast ID	192.168.1.231

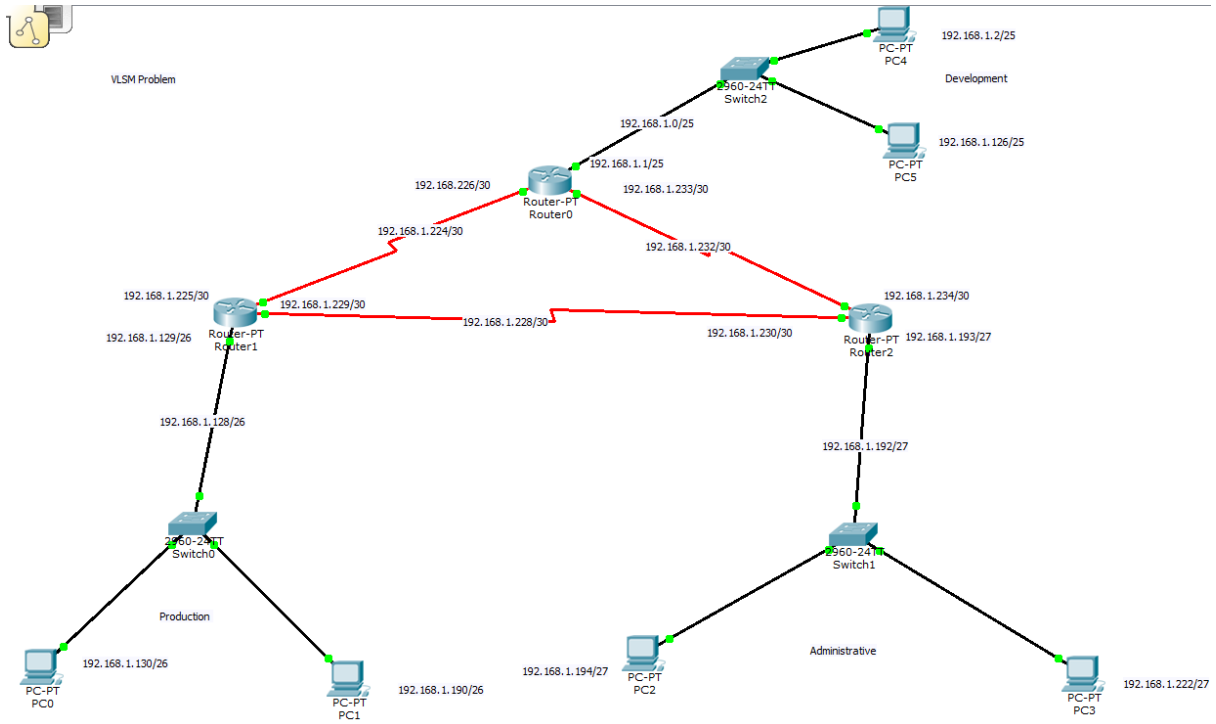
Wan link 3

Segments	Wan Link 3
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.232

First hosts	192.168.1.233
Last hosts	192.168.1.234
Broadcast ID	192.168.1.235

We have assigned IP addresses to all segments, still we have 20 addresses available. This is the magic of VLSM.

Design Topology



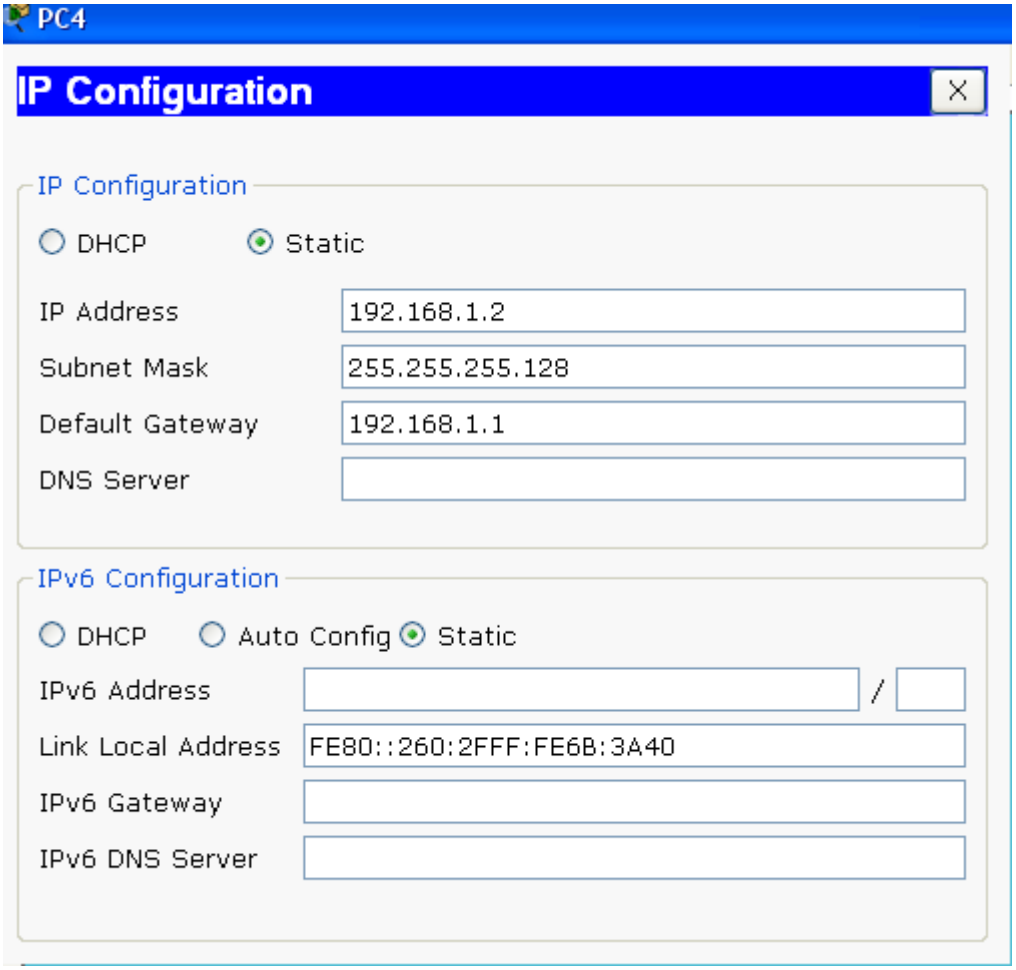
Procedure for creating network topology:

1. Insert PCs , Switches and Routers as in the above design.
2. Connect the PC to switch using copper straight through cable by selecting fast Ethernet ports.

3. Connect the switch to router using copper straight through cable by selecting fast Ethernet ports.
4. Connect the router to router using Serial DCE cable by selecting serial ports in router.

Procedure for configuring IP addresses for the PC:

1. Click on the PC
2. Select Desktop and go to IP Configuration
3. Set IP address, subnet mask and gate way for the particular host.



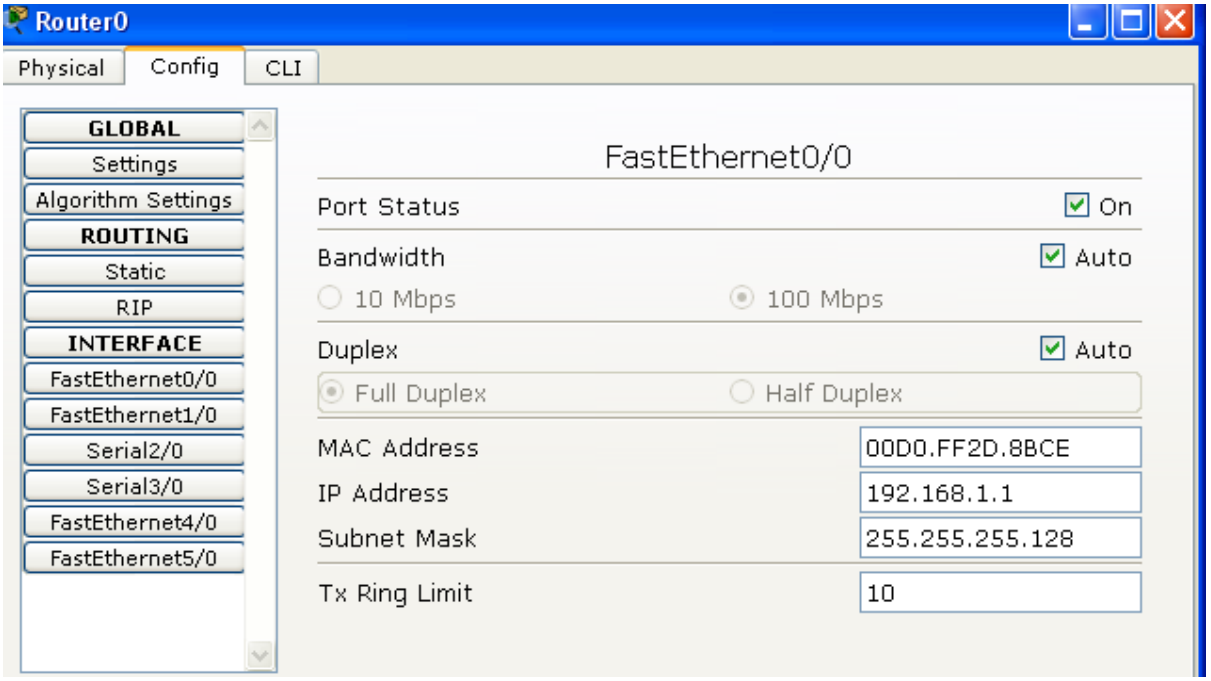
Same procedure is followed for all the PCs.

Host Name	Network ID	IP address	Subnet mask	Gateway
PC0	192.168.1.128/26	192.168.1.130/26	255.255.255.192	192.168.1.129/26
PC1	192.168.1.128/26	192.168.1.190/26	255.255.255.192	192.168.1.129/26
PC2	192.168.1.192/27	192.168.1.194/27	255.255.255.224	192.168.1.193/27
PC3	192.168.1.192/27	192.168.1.222/27	255.255.255.224	192.168.1.193/27
PC4	192.168.1.0/25	192.168.1.2/25	255.255.255.128	192.168.1.1/25

PC5	192.168.1.0/25	192.168.1.126/25	255.255.255.128	192.168.1.1/25

Procedure for configuring IP addresses on the Routers:

1. Click on the Router
2. Select config
3. In Interface select the particular port to set the IP addresses as below



Equivalent IOS Commands

Router>enable

Router#configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#interface FastEthernet0/0

Router(config-if)#ip address 192.168.1.1 255.255.255.128

Router(config-if)#no shutdown

Router(config-if)#exit

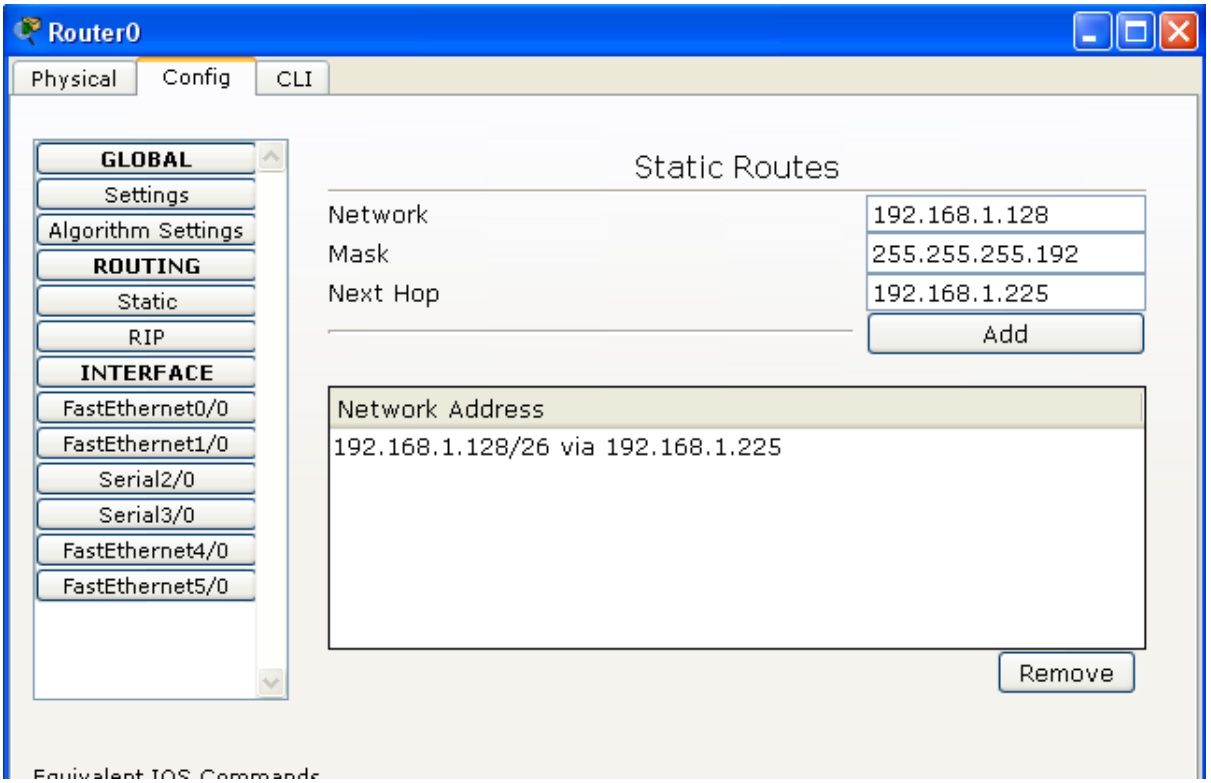
Same procedure is followed for all the Routers.

Static Routing Protocol

Static routing is a form of routing that occurs when a router uses a manually-configured routing entry, rather than information from a dynamic routing traffic.

Procedure for configuring static routes for routes:

1. Click on the Router
2. Select config
3. Click on Static
4. Add all the network addresses which are not directly connected to the router and mention the next hop IP addresses i.e. The next router from where it can connect to other network.



Equivalent Commands

Router>enable

Router#configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#ip route 192.168.1.128 255.255.255.192 192.168.1.225

Same procedure is followed for all the Routers.

Verifying the connection using Ping Command:

Ping command is a network utility command. Ping tools use Internet Control message Protocol (ICMP). Ping used to verify the connection between source PC to destination PC.

For example if you want to check the connection between PC4 and PC5, then follow the below steps

Click on PC4

Select Desktop and go to command Prompt

ping 192.168.1.126

If you get the reply as shown below then connection is said to be successful.