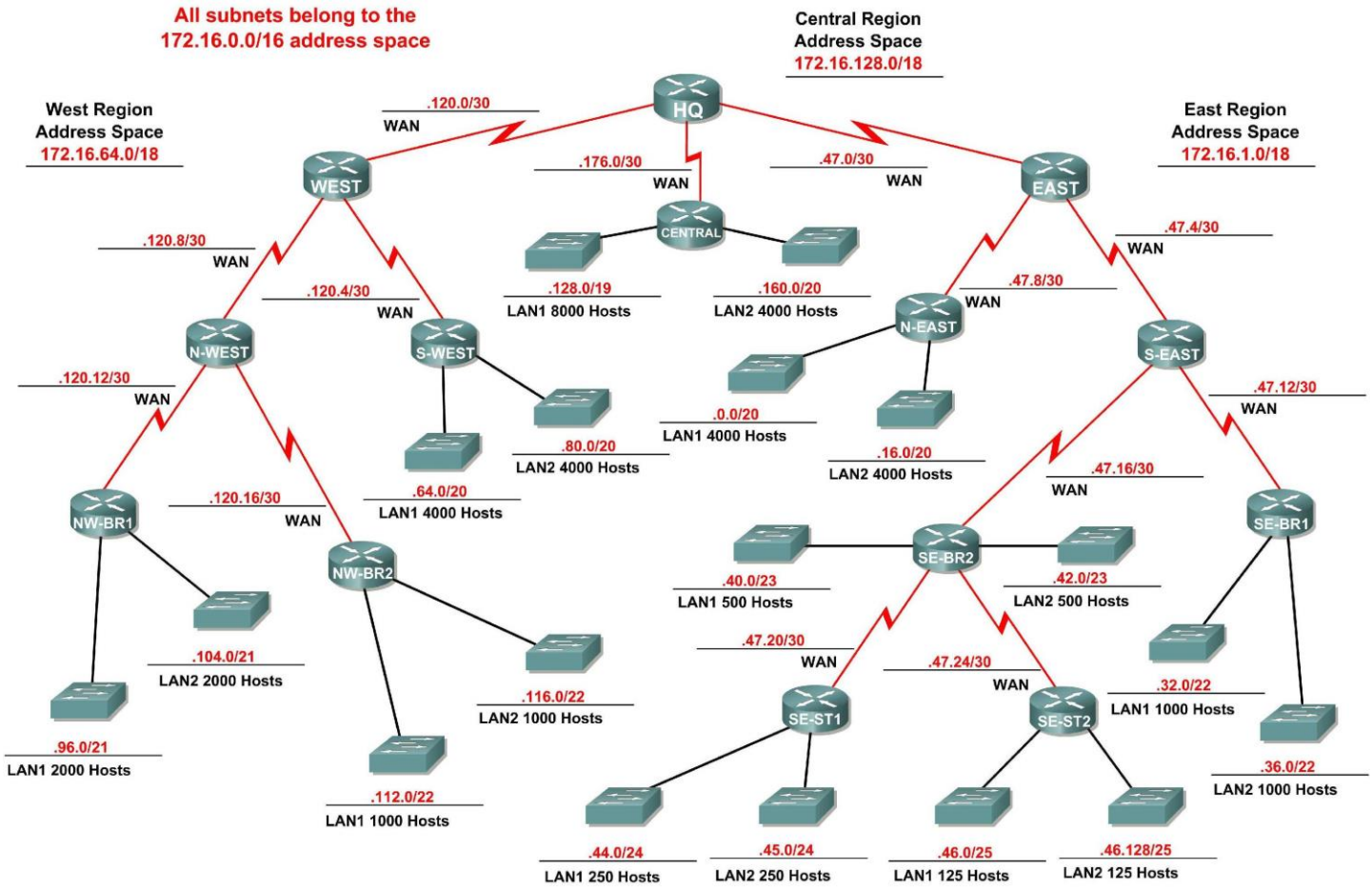
Activity 6.4.2: Challenge VLSM Calculation and Addressing Design

Topology Diagram



Learning Objectives:

- Determine the number of subnets needed.
- Determine the number of hosts needed for each subnet.
- Design an appropriate addressing scheme using VLSM.

Scenario

In this activity, you have been given the network address 172.16.0.0/16 to subnet and provide the IP addressing for the network shown in the Topology Diagram. VLSM will be used so that the addressing requirements can be met using the 172.16.0.0/16 network.

The network has the following addressing requirements:

- East Network Section
  - The N-EAST (Northeast) LAN1 will require 4000 host IP addresses.
  - The N-EAST (Northeast) LAN2 will require 4000 host IP addresses.
  - The SE-BR1 (Southeast Branch1) LAN1 will require 1000 host IP addresses.
  - The SE-BR1 (Southeast Branch1) LAN2 will require 1000 host IP addresses.
  - The SE-BR2 (Southeast Branch2) LAN1 will require 500 host IP addresses.
  - The SE-BR2 (Southeast Branch2) LAN2 will require 500 host IP addresses.
  - The SE-ST1 (Southeast Satellite1) LAN1 will require 250 host IP addresses.
  - The SE-ST1 (Southeast Satellite1) LAN2 will require 250 host IP addresses.
  - The SE-ST2 (Southeast Satellite2) LAN1 will require 125 host IP addresses.
  - The SE-ST2 (Southeast Satellite2) LAN2 will require 125 host IP addresses.
- West Network Section
  - The S-WEST (Southwest) LAN1 will require 4000 host IP addresses.
  - The S-WEST (Southwest) LAN2 will require 4000 host IP addresses.
  - The NW-BR1 (Northwest Branch1) LAN1 will require 2000 host IP addresses.
  - The NW-BR1 (Northwest Branch1) LAN2 will require 2000 host IP addresses.
  - The NW-BR2 (Northwest Branch2) LAN1 will require 1000 host IP addresses.
  - The NW-BR2 (Northwest Branch2) LAN2 will require 1000 host IP addresses.
- Central Network Section
  - The Central LAN1 will require 8000 host IP addresses.
  - The Central LAN2 will require 4000 host IP addresses.
- The WAN links between each of the routers will require an IP address for each end of the link.

(**Note:** Remember that the interfaces of network devices are also host IP addresses and are included in the above addressing requirements.)

Task 1: Examine the Network Requirements.

Examine the network requirements and answer the questions below. Keep in mind that IP addresses will be needed for each of the LAN interfaces.

1. How many LAN subnets are needed? _____ 18
2. How many subnets are needed for the WAN links between routers? _____ 13
3. How many total subnets are needed? _____ 31

4. What is the maximum number of host IP addresses that are needed for a single subnet? _____ 8,000
5. What is the least number of host IP addresses that are needed for a single subnet? _____ 125
6. How many IP addresses are needed for the East portion of the network? Be sure to include the WAN links between the routers. _____ 11,764
7. How many IP addresses are needed for the West portion of the network? Be sure to include the WAN links between the routers. _____ 10,410
8. How many IP addresses are needed for the Central portion of the network? Be sure to include the WAN links between the routers. _____ 12,002
9. What is the total number of IP addresses that are needed? _____ 34,176
10. What is the total number of IP addresses that are available in the 172.16.0.0/16 network? _____ 65,534
11. Can the network addressing requirements be met using the 172.16.0.0/16 network? _____ yes

Task 2: Divide the Network into Three Subnetworks.

Step 1: Determine the subnet information for each network section.

To keep the subnets of each of the major network sections contiguous, begin by creating a main subnet for each of the East, West, and Central network sections.

1. What is the smallest size subnet that can be used to meet the addressing requirement for the East network? _____ /18
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 16,382
3. What is the smallest size subnet that can be used to meet the addressing requirement for the West network? _____ /18
4. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 16,384
5. What is the smallest size subnet that can be used to meet the addressing requirement for the Central network? _____ /18
6. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 16,384

Step 2: Assign subnets.

1. Start at the beginning of the 172.16.0.0/16 network. Assign the first available subnet to the East section of the network.
2. Fill in the chart below with the appropriate information.

East Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.1.0	255.255.192.0	/18	172.16.0.1	172.16.63.254	172.16.63.255

3. Assign the next available subnet to the West section of the network.

4. Fill in the chart below with the appropriate information.

West Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.64.0	255.255.192.0	/18	172.16.64.1	172.16.127.254	172.16.127.255

5. Assign the next available subnet to the Central section of the network.
6. Fill in the chart below with the appropriate information.

Central Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.128.0	255.255.192.0	/18	172.16.128.1	172.16.191.254	172.16.191.255

Task 3: Design an IP Addressing Scheme for the Central Network.

Step 1: Determine the subnet information for the Central LAN1.

Use the address space that was designated for the Central network in Task 1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /19
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 8,190

Step 2: Assign subnet to Central LAN1.

Start at the beginning of the address space designated for the Central network.

1. Assign the first subnet to the Central LAN1.
2. Fill in the chart below with the appropriate information.

Central LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.128.0	255.255.224.0	/19	172.16.128.1	172.16.159.254	172.16.159.255

Step 3: Determine the subnet information for the Central LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /20
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 4,094

Step 4: Assign subnet to Central LAN2.

1. Assign the next available subnet to the Central LAN2.
2. Fill in the chart below with the appropriate information.

Central LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.160.0	255.255.240.0	/20	172.16.160.1	172.16.175.254	172.16.175.255

Step 5: Determine the subnet information for the WAN link between the Central router and the HQ router.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /30
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 2

Step 6: Assign subnet to WAN link.

1. Assign the next available subnet to the WAN link between the Central router and the HQ router.
2. Fill in the chart below with the appropriate information.

WAN link between Central and HQ Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.176.0	255.255.255.252	/30	172.16.176.1	172.16.176.2	172.16.176.3

Task 4: Design an IP Addressing Scheme for the West Network.

Step 1: Determine the subnet information for the S-WEST LAN1.

Use the address space that was designated for the West network in Task 1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /20
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 4,094

Step 2: Assign subnet to S-WEST LAN1.

Start at the beginning of the address space designated for the West network.

1. Assign the first subnet to the S-WEST LAN1.
2. Fill in the chart below with the appropriate information.

S-WEST LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.64.0	255.255.240.0	/20	172.16.64.1	172.16.79.254	172.16.79.255

Step 3: Determine the subnet information for the S-WEST LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /20
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 4,094

Step 4: Assign subnet to S-WEST LAN2.

1. Assign the next available subnet to the S-WEST LAN2.

2. Fill in the chart below with the appropriate information.

S-WEST LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.80.0	255.255.240.0	/20	172.16.80.1	172.16.95.254	172.16.95.255

Step 5: Determine the subnet information for the NW-BR1 LAN1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /21
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 2,046

Step 6: Assign subnet to NW-BR1 LAN1.

1. Assign the next available subnet to the NW-BR1 LAN1.
2. Fill in the chart below with the appropriate information.

NW-BR1 LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.96.0	255.255.248.0	/21	172.16.96.1	172.16.103.254	172.16.103.255

Step 7: Determine the subnet information for the NW-BR1 LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /21
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 2,046

Step 8: Assign subnet to NW-BR1 LAN2.

1. Assign the next available subnet to the NW-BR1 LAN2.
2. Fill in the chart below with the appropriate information.

NW-BR1 LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.104.0	255.255.248.0	/21	172.16.104.1	172.16.111.254	172.16.111.255

Step 9: Determine the subnet information for the NW-BR2 LAN1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /22
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 1,022

Step 10: Assign subnet to NW-BR2 LAN1.

1. Assign the next available subnet to the NW-BR2 LAN1.

2. Fill in the chart below with the appropriate information.

NW-BR2 LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.112.0	255.255.252.0	/22	172.16.112.1	172.16.115.254	172.16.115.255

Step 11: Determine the subnet information for the NW-BR2 LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /22
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 1,022

Step 12: Assign subnet to NW-BR2 LAN2.

1. Assign the next available subnet to the NW-BR2 LAN2.
2. Fill in the chart below with the appropriate information.

NW-BR2 LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.116.0	255.255.252.0	/22	172.16.116.1	172.16.119.254	172.16.119.255

Step 13: Determine the subnet information for the WAN links between the routers in the West network.

1. How many router to router WAN links are present in the West network? _____ 5
2. How many IP addresses are needed for each of these WAN links? _____ 2
3. What is the smallest size subnet that can be used to meet this requirement? _____ /30
4. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 2

Step 14: Assign subnets to WAN links.

1. Assign the next available subnets to the WAN links between the routers.
2. Fill in the chart below with the appropriate information.

WAN links between the Routers in the West Network

WAN Link	Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
HQ to WEST	172.16.120.0	255.255.255.252	/30	172.16.120.1	172.16.120.2	172.16.120.3
WEST to S-WEST	172.16.120.4	255.255.255.252	/30	172.16.120.5	172.16.120.6	172.16.120.7
WEST to N-WEST	172.16.120.8	255.255.255.252	/30	172.16.120.9	172.16.120.10	172.16.120.11
N-WEST to NW-BR1	172.16.120.12	255.255.255.252	/30	172.16.120.13	172.16.120.14	172.16.120.15
N-WEST to NW-BR2	172.16.120.16	255.255.255.252	/30	172.16.120.17	172.16.120.18	172.16.120.19

Task 5: Design an IP Addressing Scheme for the East Network.

Step 1: Determine the subnet information for the N-EAST LAN1.

Use the address space that was designated for the East network in Task 1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /20
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 4,094

Step 2: Assign subnet to N-EAST LAN1.

Start at the beginning of the address space designated for the East network.

1. Assign the first subnet to the N-EAST LAN1.
2. Fill in the chart below with the appropriate information.

N-EAST LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.0.0	255.255.240.0	/20	172.16.0.1	172.16.15.254	172.16.15.255

Step 3: Determine the subnet information for the N-EAST LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /20
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 4,094

Step 4: Assign subnet to N-EAST LAN2.

1. Assign the next available subnet to the N-EAST LAN2.
2. Fill in the chart below with the appropriate information.

N-EAST LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.16.0	255.255.240.0	/20	172.16.16.1	172.16.31.254	172.16.31.255

Step 5: Determine the subnet information for the SE-BR1 LAN1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /22
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 1,022

Step 6: Assign subnet to SE-BR1 LAN1.

1. Assign the next available subnet to the SE-BR1 LAN1.

2. Fill in the chart below with the appropriate information.

SE-BR1 LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.32.0	255.255.252.0	/22	172.16.32.1	172.16.35.254	172.16.35.255

Step 7: Determine the subnet information for the SE-BR1 LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /22
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 1,022

Step 8: Assign subnet to SE-BR1 LAN2.

1. Assign the next available subnet to the SE-BR1 LAN2.
2. Fill in the chart below with the appropriate information.

SE-BR1 LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.36.0	255.255.252.0	/22	172.16.36.1	172.16.39.254	172.16.39.255

Step 9: Determine the subnet information for the SE-BR2 LAN1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /23
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 510

Step 10: Assign subnet to SE-BR2 LAN1.

1. Assign the next available subnet to the SE-BR2 LAN1.
2. Fill in the chart below with the appropriate information.

SE-BR2 LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.40.0	255.255.254.0	/23	172.16.40.1	172.16.41.254	172.16.41.255

Step 11: Determine the subnet information for the SE-BR2 LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /23
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 510

Step 12: Assign subnet to SE-BR2 LAN2.

1. Assign the next available subnet to the SE-BR2 LAN2.

2. Fill in the chart below with the appropriate information.

SE-BR2 LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.42.0	255.255.254.0	/23	172.16.42.1	172.16.43.254	172.16.43.255

Step 13: Determine the subnet information for the SE-ST1 LAN1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /24
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 254

Step 14: Assign subnet to SE-ST1 LAN1.

1. Assign the next available subnet to the SE-ST1 LAN1.
2. Fill in the chart below with the appropriate information.

SE-ST1 LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.44.0	255.255.255.0	/24	172.16.44.1	172.16.44.254	172.16.44.255

Step 15: Determine the subnet information for the SE-ST1 LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /24
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 254

Step 16: Assign subnet to SE-ST1 LAN2.

1. Assign the next available subnet to the SE-ST1 LAN2.
2. Fill in the chart below with the appropriate information.

SE-ST1 LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.45.0	255.255.255.0	/24	172.16.45.1	172.16.45.254	172.16.45.255

Step 17: Determine the subnet information for the SE-ST2 LAN1.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /25
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 126

Step 18: Assign subnet to SE-ST2 LAN1.

1. Assign the next available subnet to the SE-ST2 LAN1.

2. Fill in the chart below with the appropriate information.

SE-ST2 LAN1 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.46.0	255.255.255.128	/25	172.16.46.1	172.16.46.126	172.16.46.127

Step 19: Determine the subnet information for the SE-ST2 LAN2.

1. What is the smallest size subnet that can be used to meet this requirement? _____ /25
2. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 126

Step 20: Assign subnet to SE-ST2 LAN2.

1. Assign the next available subnet to the SE-ST2 LAN2.
2. Fill in the chart below with the appropriate information.

SE-ST2 LAN2 Subnet

Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
172.16.46.128	255.255.255.128	/25	172.16.46.129	172.16.46.254	172.16.46.255

Step 21: Determine the subnet information for the WAN links between the routers in the East network.

1. How many router to router WAN links are present in the East network? _____ 7
2. How many IP addresses are needed for each of these WAN links? _____ 2
3. What is the smallest size subnet that can be used to meet this requirement? _____ /30
4. What is the maximum number of IP addresses that can be assigned in this size subnet? _____ 2

Step 22: Assign subnets to WAN links.

1. Assign the next available subnets to the WAN links between the routers.
2. Fill in the chart below with the appropriate information.

WAN links between the Routers in the East Network

WAN link	Network Address	Decimal Subnet Mask	CIDR Subnet Mask	First Usable IP Address	Last Usable IP Address	Broadcast Address
HQ to EAST	172.16.47.0	255.255.255.252	/30	172.16.47.1	172.16.47.2	172.16.47.3
EAST to S-EAST	172.16.47.4	255.255.255.252	/30	172.16.47.5	172.16.47.6	172.16.47.7
EAST to N-EAST	172.16.47.8	255.255.255.252	/30	172.16.47.9	172.16.47.10	172.16.47.11
S-EAST to SE-BR1	172.16.47.12	255.255.255.252	/30	172.16.47.13	172.16.47.14	172.16.47.15
S-EAST to SE-BR2	172.16.47.16	255.255.255.252	/30	172.16.47.17	172.16.47.18	172.16.47.19
SE-BR2 to SE-ST1	172.16.47.20	255.255.255.252	/30	172.16.47.21	172.16.47.22	172.16.47.23
SE-BR2 to SE-ST2	172.16.47.24	255.255.255.252	/30	172.16.47.25	172.16.47.26	172.16.47.27

