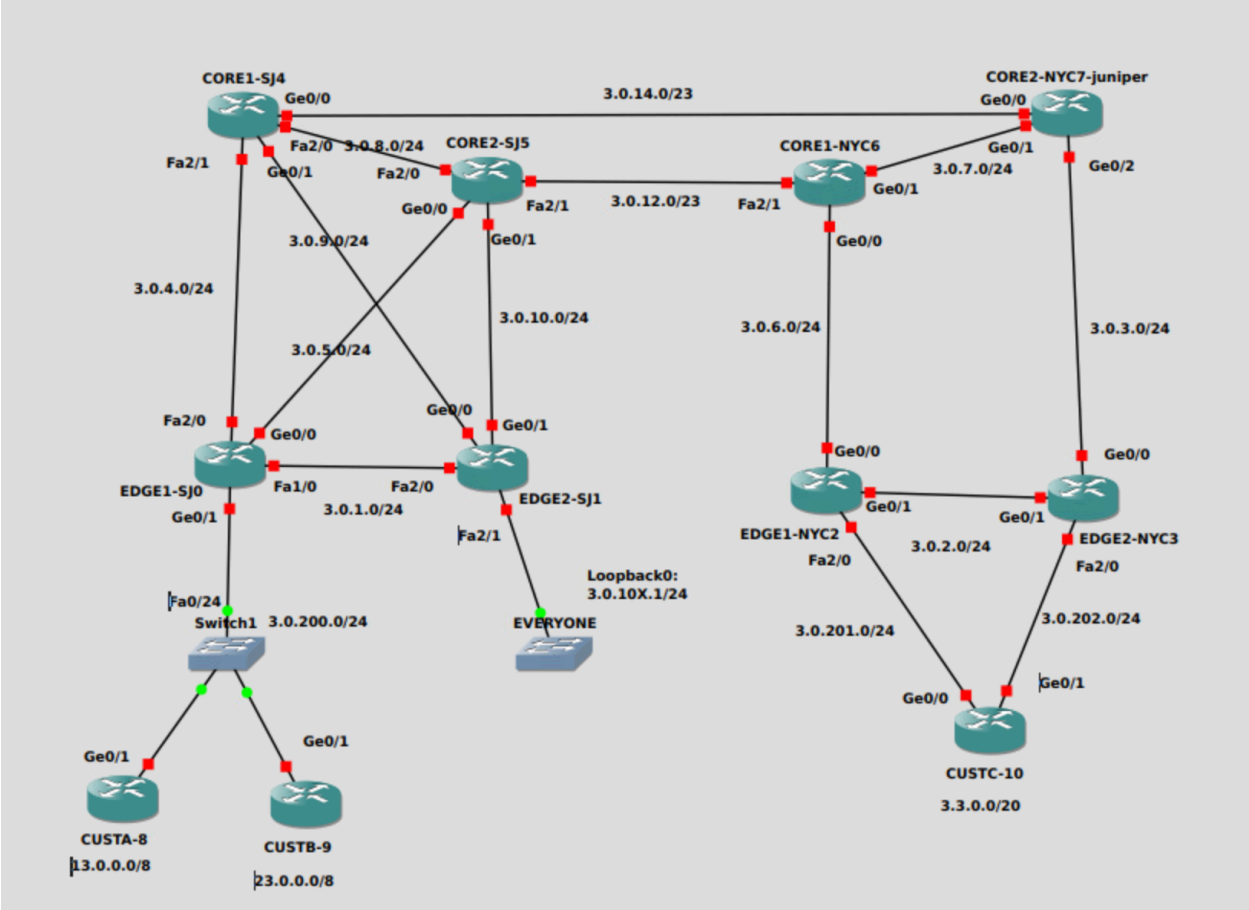
Computer #33 Mobaxterm master password: admin123

Juniper:
Show configuration | display set

SUBNETTING:
ASN 3
3.0.0.0/8

/23



TLEN5370 - Lab 3

Lab 3

Logistics

Write, erase the routers and start from scratch with a default config.
Each group will use X.0.0.0/8 where X is the group number for backbone and customer IP space.
Each group will use ASN X where X is the group number.
Connect your EDGE2.SJO1 router to the exchange switch designated by the instructor. Your EDGE routers interface connecting to the switch should be 9.0.0.X/8
Set up your network so that you can telnet to your routers vs moving the console cable.

OBJECTIVE 1

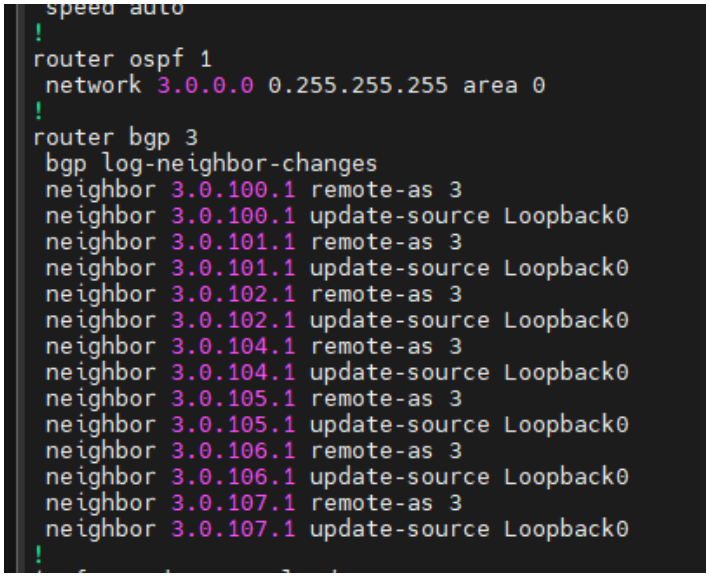
Design and configure a hierarchical backbone topology per the following drawing, notes and requirements

- EDGE2.NYC1 or EDGE2.SJO1 is a Juniper.
- All routers are running BGP in a resilient manner.
- Your /8 is in BGP. This should be the *only* static route in your network in this objective.
- We are only building 2 cities for this lab but assume there are 25 more similar sites on your network.
- Assume any given city could have up to 10 EDGE routers.
- Question 1.1 - What IGP design decisions did you make?
    - We are using iBGP as our IGP. We did this because it is scalable across an increase of routers and we are doing a full mesh configuration. We are initially using OSPF to establish iBGP between all the routers
- Question 1.2 - Show *relevant* IGP config snips from CORE1.SJO1, EDGE2.SJO1 and EDGE2.NYC1.

EDGE2.SJ1:

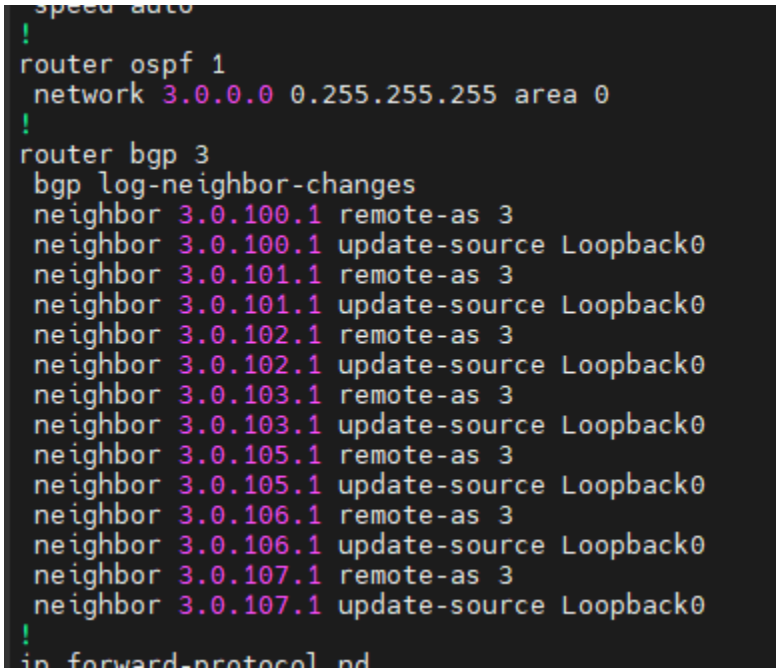
```
 no ip address
!
router ospf 1
 network 3.0.0.0 0.255.255.255 area 0
!
router bgp 3
 bgp log-neighbor-changes
 neighbor 3.0.100.1 remote-as 3
 neighbor 3.0.100.1 update-source Loopback0
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.103.1 remote-as 3
 neighbor 3.0.103.1 update-source Loopback0
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
!
ip forward-protocol nd
```

EDGE2.NYC3:



```
 speed auto
!
router ospf 1
 network 3.0.0.0 0.255.255.255 area 0
!
router bgp 3
 bgp log-neighbor-changes
 neighbor 3.0.100.1 remote-as 3
 neighbor 3.0.100.1 update-source Loopback0
 neighbor 3.0.101.1 remote-as 3
 neighbor 3.0.101.1 update-source Loopback0
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
!
```

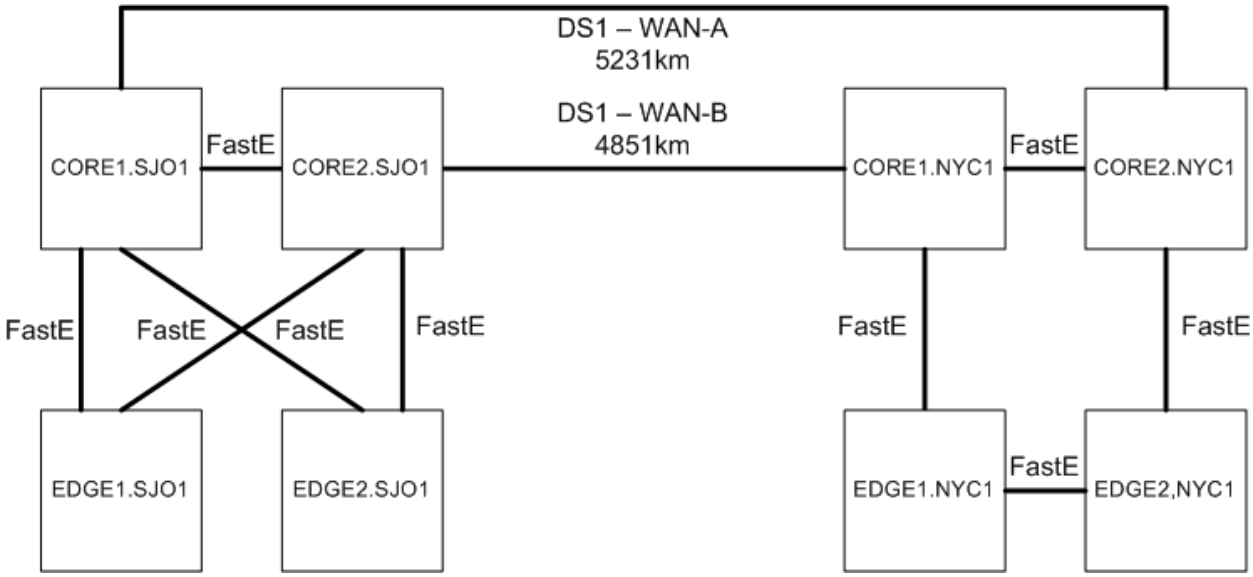
CORE1.SJ4:



```
 speed auto
!
router ospf 1
 network 3.0.0.0 0.255.255.255 area 0
!
router bgp 3
 bgp log-neighbor-changes
 neighbor 3.0.100.1 remote-as 3
 neighbor 3.0.100.1 update-source Loopback0
 neighbor 3.0.101.1 remote-as 3
 neighbor 3.0.101.1 update-source Loopback0
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.103.1 remote-as 3
 neighbor 3.0.103.1 update-source Loopback0
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
!
ip forward-protocol nd
```

- Question 1.3 - What BGP design decisions did you make?
    - See above for BGP design (1.1)
- Question 1.4 - Show *relevant* BGP config snips from CORE1.SJO1, EDGE2.SJO1 and EDGE2.NYC1.
    - BGP configs are also included in obj 1.2
- Question 1.5 - What is the redundant intra-site capacity for each of the EDGE routers? (disregard WAN)

- Verify you have reachability to all routers from all routers.



OBJECTIVE 2
Design a routing policy that accounts for network relationships of customer, peer, and transit. Consider that any given EDGE router could have any relationship type

- Build route policy in and out for each relationship type. Give them a standard name of '{relationship}-in' and '{relationship)-out'

Relationships

- AS <-> Peer
    - Be mutually beneficial, share all IGP routes between each other
    - Filter AS number for outbound traffic to only send routes that we know.
    - IN
        - Local pref higher - (200)
    - OUT
        - OUR AS#
            - ^3$
        - Local pref higher than Transit - (200)
- AS <-> Transit
    - Pay money to transit
    - IN
        - Local pref LOWER than peer - (100)
    - OUT
        - Default route
        - Local pref LOWER than Peer - (100)
- AS <-> Cost
    - Receive money from cost
    - Send them a default route to AS network

    - IN
        - Allow AS routes
    - OUT
        - Send routing table for eBGP or static route from customer
- Incorporate protection mechanisms and or sanity filtering for your network and the connecting networks as appropriate.
- Question 2.1 - How would you set things up to reduce costs? What assumptions might you make about the types of relationships as they relate to costs?
    - Use the peer over the transit whenever possible. Always advertise everything to customers to increase the chance of customers using us. Always have a default route to transit if peer does not have a route.
- Question 2.2 - How do you differentiate your received routes by relationship and determine the routes to send to each relationship? Provide a key.
    - We can tag the routes using communities to identify where the traffic came from and where to send the traffic
        - PEER community, TRANSIT community, and CUSTOMER community.
- Question 2.3 - What sort of policy do you need for a statically routed customer?
    - We need a static route policy back to the customer.
- Question 2.4 - Show *relevant* route-policy config snips from a cisco EDGE router and a juniper EDGE router for all relationship types.

```
ip as-path access-list 1 permit (^$)|(_23$|_33$)
!
!
!
ip prefix-list customer-deny-in seq 5 deny 10.0.0.0/8 le 32
ip prefix-list customer-deny-in seq 10 deny 172.16.0.0/12 le 32
ip prefix-list customer-deny-in seq 15 deny 192.168.0.0/16 le 32
ip prefix-list customer-deny-in seq 20 permit 0.0.0.0/0 le 32
!
!
!
!
route-map transit-out permit 10
 match as-path 1
!
route-map peer-in permit 10
 set local-preference 200
!
route-map customer-in permit 10
 match ip address prefix-list customer-deny-in
!
route-map peer-out permit 10
 match as-path 1
!
route-map transit-in permit 10
 set local-preference 100
!
```

OBJECTIVE 3
Design and configure customer connections per the following drawing and requirements

- Each customer router is managed by your group. You are responsible for the configuration and operation.
- While we are only configuring one or two customers per router in the lab plan for several hundred per edge router.
- CUST A is statically routed and announcing the IP space (10+X).0.0.0/8 Set a loopback on the customer router of (10+X).0.0.1/32
- Question 3.1 - Show *relevant* config snips from the CUST A router?

```
interface Loopback0
 ip address 13.0.0.1 255.255.255.255
!
```

```
!
ip route 0.0.0.0 0.0.0.0 3.0.200.1
!
!
!
```

- Question 3.2 - Show *relevant* config snips from the EDGE router?

```
!
router ospf 1
 redistribute static
 network 3.0.0.0 0.255.255.255 area 0
!
router bgp 3
 bgp log-neighbor-changes
 network 3.0.0.0
 network 13.0.0.0
 neighbor 3.0.101.1 remote-as 3
 neighbor 3.0.101.1 update-source Loopback0
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.103.1 remote-as 3
 neighbor 3.0.103.1 update-source Loopback0
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
 neighbor 3.0.200.3 remote-as 23
!
```

```
!
!
ip route 3.0.0.0 255.0.0.0 Null0
ip route 13.0.0.0 255.0.0.0 3.0.200.2
!
```

- CUST B is running BGP and is using ASN (20+X) and announcing the IP space (20+X).0.0.0/8. Set a loopback on the customer router of (20+X).0.0.1/32
- Question 3.3 - Show *relevant* config snips from the CUST B router?

```
Gateway of last resort is not set

      3.0.0.0/8 is variably subnetted, 4 subnets, 4 masks
B        3.0.0.0/8 [20/0] via 3.0.200.1, 00:50:17
C        3.0.200.0/24 is directly connected, GigabitEthernet0/1
L        3.0.200.3/32 is directly connected, GigabitEthernet0/1
B        3.3.0.0/20 [20/0] via 3.0.200.1, 00:18:12
B     13.0.0.0/8 [20/0] via 3.0.200.2, 00:36:35
      23.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
S        23.0.0.0/8 is directly connected, Null0
C        23.0.0.1/32 is directly connected, Loopback0
CUSTB-9#
```

```
!
interface Loopback0
 ip address 23.0.0.1 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
 media-type rj45
!
interface GigabitEthernet0/1
 ip address 3.0.200.3 255.255.255.0
 duplex auto
 speed auto
 media-type rj45
!
```

```
 speed auto
!
router bgp 23
 bgp log-neighbor-changes
 network 23.0.0.0
 neighbor 3.0.200.1 remote-as 3
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
ip route 23.0.0.0 255.0.0.0 Null0
!
!
```

- Question 3.4 - Show *relevant* config snips from the EDGE router?

```
 media-type rj45
!
interface GigabitEthernet0/1
 ip address 3.0.200.1 255.255.255.0
 duplex auto
 speed auto
 media-type rj45
!
```

```
!
router ospf 1
 redistribute static
 network 3.0.0.0 0.255.255.255 area 0
!
router bgp 3
 bgp log-neighbor-changes
 network 3.0.0.0
 network 13.0.0.0
 neighbor 3.0.101.1 remote-as 3
 neighbor 3.0.101.1 update-source Loopback0
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.103.1 remote-as 3
 neighbor 3.0.103.1 update-source Loopback0
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
 neighbor 3.0.200.3 remote-as 23
!
```

- CUST C is running BGP with you and using ASN (30+X) They are using X.X.0.0/20 of your address space. Set a loopback on the customer router of X.X.0.1/32.
- Question 3.5 - Show *relevant* config snips from the CUST C router?

```
 speed auto
!
router bgp 33
 bgp log-neighbor-changes
 network 3.3.0.0 mask 255.255.240.0
 neighbor 3.0.201.1 remote-as 3
 neighbor 3.0.202.1 remote-as 3
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
ip route 3.3.0.0 255.255.240.0 Null0
!
```

```
Gateway of last resort is not set

      3.0.0.0/8 is variably subnetted, 7 subnets, 4 masks
B        3.0.0.0/8 [20/0] via 3.0.201.1, 00:17:21
C        3.0.201.0/24 is directly connected, GigabitEthernet0/0
L        3.0.201.2/32 is directly connected, GigabitEthernet0/0
C        3.0.202.0/24 is directly connected, GigabitEthernet0/1
L        3.0.202.2/32 is directly connected, GigabitEthernet0/1
S        3.3.0.0/20 is directly connected, Null0
C        3.3.0.1/32 is directly connected, Loopback0
B     13.0.0.0/8 [20/0] via 3.0.201.1, 00:17:21
B     23.0.0.0/8 [20/0] via 3.0.201.1, 00:17:21
CUSTC-10#
```

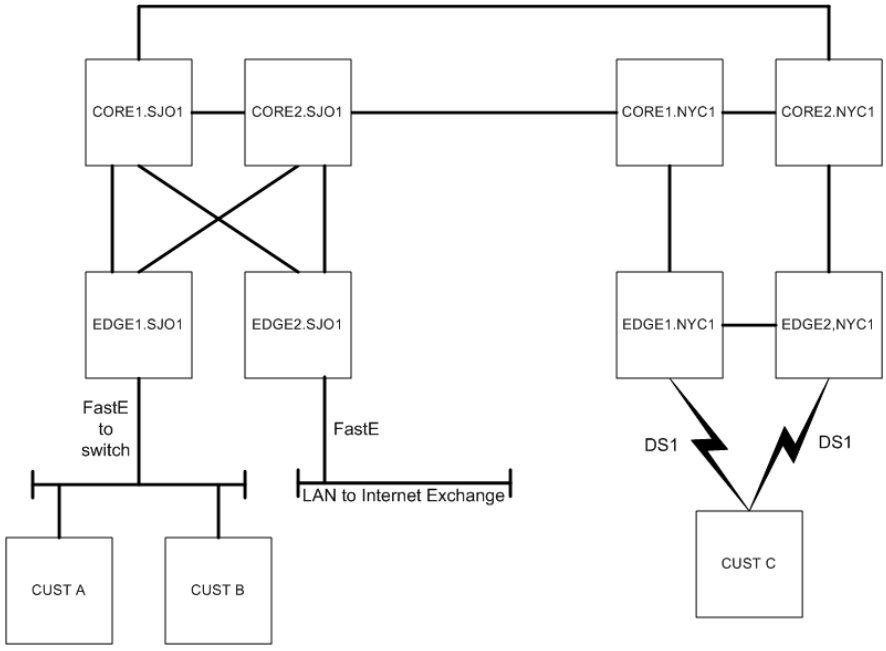
- Question 3.6 - Show *relevant* config snips from the EDGE routers?

```
serial restart-delay 0

interface FastEthernet2/0
 ip address 3.0.201.1 255.255.255.0
duplex auto
speed auto
```

```
router bgp 3
 bgp log-neighbor-changes
 neighbor 3.0.100.1 remote-as 3
 neighbor 3.0.100.1 update-source Loopback0
 neighbor 3.0.101.1 remote-as 3
 neighbor 3.0.101.1 update-source Loopback0
 neighbor 3.0.103.1 remote-as 3
 neighbor 3.0.103.1 update-source Loopback0
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
 neighbor 3.0.201.2 remote-as 33
```

```
 speed auto
!
interface FastEthernet2/0
 ip address 3.0.202.1 255.255.255.0
 duplex auto
 speed auto
!
router ospf 1
 network 3.0.0.0 0.255.255.255 area 0
!
router bgp 3
 bgp log-neighbor-changes
 neighbor 3.0.100.1 remote-as 3
 neighbor 3.0.100.1 update-source Loopback0
 neighbor 3.0.101.1 remote-as 3
 neighbor 3.0.101.1 update-source Loopback0
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
 neighbor 3.0.202.2 remote-as 33
!
```



OBJECTIVE 4

Design and configure your peering and transit connections across the Internet Exchange Switch

- Set up a 'transit' connection across the exchange switch to group X+1 (you are their customer)
- Question 4.1 - Show *relevant* config snips from the EDGE router?

```
 neighbor 9.0.0.5 next-hop-self
EDGE2.SJ1#show ip route | sec 9.0.0.5
B       5.0.0.0/8 [20/0] via 9.0.0.5, 01:04:25
        9.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
B       15.0.0.0/8 [20/0] via 9.0.0.5, 00:58:54
B       25.0.0.0/8 [20/0] via 9.0.0.5, 00:58:24
B       35.0.0.0/8 [20/0] via 9.0.0.5, 00:58:24
        100.0.0.0/24 is subnetted, 1 subnets
EDGE2.SJ1#
```

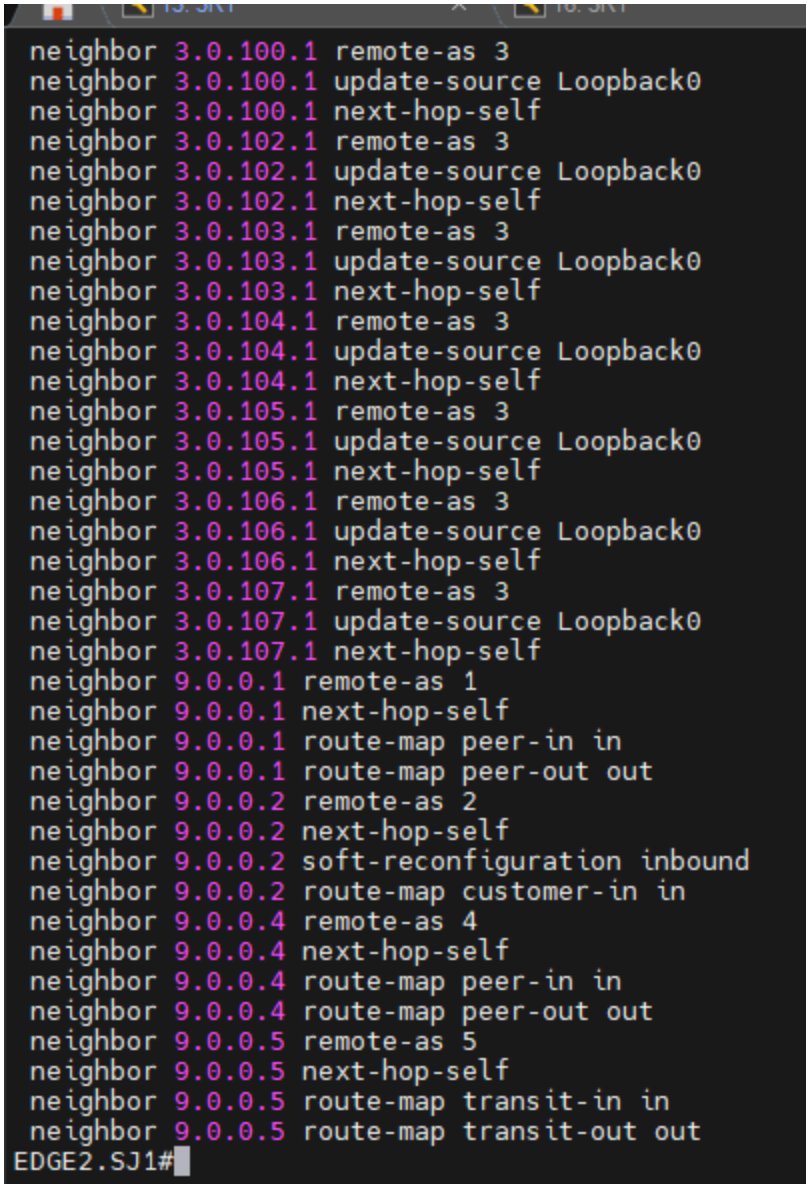
```
EDGE2.SJ1#
EDGE2.SJ1#show run | sec bgp
router bgp 3
 bgp log-neighbor-changes
 neighbor 3.0.100.1 remote-as 3
 neighbor 3.0.100.1 update-source Loopback0
 neighbor 3.0.100.1 next-hop-self
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.102.1 next-hop-self
 neighbor 3.0.103.1 remote-as 3
 neighbor 3.0.103.1 update-source Loopback0
 neighbor 3.0.103.1 next-hop-self
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.104.1 next-hop-self
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.105.1 next-hop-self
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.106.1 next-hop-self
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
 neighbor 3.0.107.1 next-hop-self
 neighbor 9.0.0.1 remote-as 1
 neighbor 9.0.0.2 remote-as 2
 neighbor 9.0.0.2 next-hop-self
 neighbor 9.0.0.2 soft-reconfiguration inbound
 neighbor 9.0.0.5 remote-as 5
 neighbor 9.0.0.5 next-hop-self
EDGE2.SJ1#
```

- Set up a 'customer' connection across the exchange switch to group X-1
- Question 4.2 - Show *relevant* config snips from the EDGE router?

```
EDGE2.SJ1#
EDGE2.SJ1#show ip route | sec 9.0.0.2
B     2.0.0.0/8 [20/0] via 9.0.0.2, 00:15:09
      3.0.0.0/8 is variably subnetted, 30 subnets, 5 masks
B        12.0.0.0/8 [20/0] via 9.0.0.2, 00:15:09
B        12.0.0.1/32 [20/0] via 9.0.0.2, 00:14:38
B     22.0.0.0/8 [20/0] via 9.0.0.2, 00:15:09
EDGE2.SJ1#
```

```
EDGE2.SJ1#
EDGE2.SJ1#show run | sec bgp
router bgp 3
 bgp log-neighbor-changes
 neighbor 3.0.100.1 remote-as 3
 neighbor 3.0.100.1 update-source Loopback0
 neighbor 3.0.100.1 next-hop-self
 neighbor 3.0.102.1 remote-as 3
 neighbor 3.0.102.1 update-source Loopback0
 neighbor 3.0.102.1 next-hop-self
 neighbor 3.0.103.1 remote-as 3
 neighbor 3.0.103.1 update-source Loopback0
 neighbor 3.0.103.1 next-hop-self
 neighbor 3.0.104.1 remote-as 3
 neighbor 3.0.104.1 update-source Loopback0
 neighbor 3.0.104.1 next-hop-self
 neighbor 3.0.105.1 remote-as 3
 neighbor 3.0.105.1 update-source Loopback0
 neighbor 3.0.105.1 next-hop-self
 neighbor 3.0.106.1 remote-as 3
 neighbor 3.0.106.1 update-source Loopback0
 neighbor 3.0.106.1 next-hop-self
 neighbor 3.0.107.1 remote-as 3
 neighbor 3.0.107.1 update-source Loopback0
 neighbor 3.0.107.1 next-hop-self
 neighbor 9.0.0.1 remote-as 1
 neighbor 9.0.0.2 remote-as 2
 neighbor 9.0.0.2 next-hop-self
 neighbor 9.0.0.2 soft-reconfiguration inbound
 neighbor 9.0.0.5 remote-as 5
 neighbor 9.0.0.5 next-hop-self
EDGE2.SJ1#
```

- Set up a 'peering' connection across the exchange switch to all other groups
- Question 4.3 - Show *relevant* config snips from the EDGE router?



OBJECTIVE 5
Multihomed customers and failures

- CUST C has disconnect their connection to your EDGE1.NYC1 router and has chosen to establish it with group X+1's EDGE1.NYC1 router. They are still using your IP space.
- Question 5.1 - What if anything do you need to do for this to work?
    - First we would have to negotiate the address space between our customer C interface and the transit edge interface. Once the connection is in the same network, to allow for the transit network to advertise customer C, we must establish an eBGP connection with them by configuring their neighbor IP with their remote AS. Our eBGP configuration should advertise the 3.3.0.0/20 network in 3.0.0.0/8 to them via eBGP.

- CUST C wants to send all outbound traffic via the interface to you but receive all inbound traffic via group X+1. Please assist them.
- Question 5.2 - What changes were required and where?
    - For all outbound traffic via our network, we will use a higher local preference on the interface so that it will always choose our interface first for sending out traffic. If the interface fails, the lower local preference will be preferred which is the transit. For all inbound traffic, we will have an AS-path prepending on our router so that while traffic can go out through our router, it will be forced to come back into the transit router because of the longer AS-path of our router.
- CUST C's link to you has failed. Make sure your network can still reach them.
- Question 5.3 - What is necessary for this to work correctly?
    - Given that we have configured the interface of the transit correctly and we are advertising eBGP in their AS, and on top of the route-maps we configured in 5.2, it should prefer all outbound and inbound traffic to only the transit link. Because both connections advertise eBGP and are configured correctly, we should still have full connectivity. We always need to advertise a more specific route through the transit network just in case the transit network has a summary route from the outgoing edge router.

OBJECTIVE 6
Wrap up

- Question 6.1 - What did you learn from this lab?
    - We learned all about BGP and how it interacts with other service providers.
- Question 6.2 - What was the least useful part of this lab?
    - Layer 1 connectivity
- Question 6.3 - What was the most useful part of this lab?
    - How connections between peer, transit, and customers work and how route-map works in the real world. BGP next-hop-self was very valuable along with iBGP.
