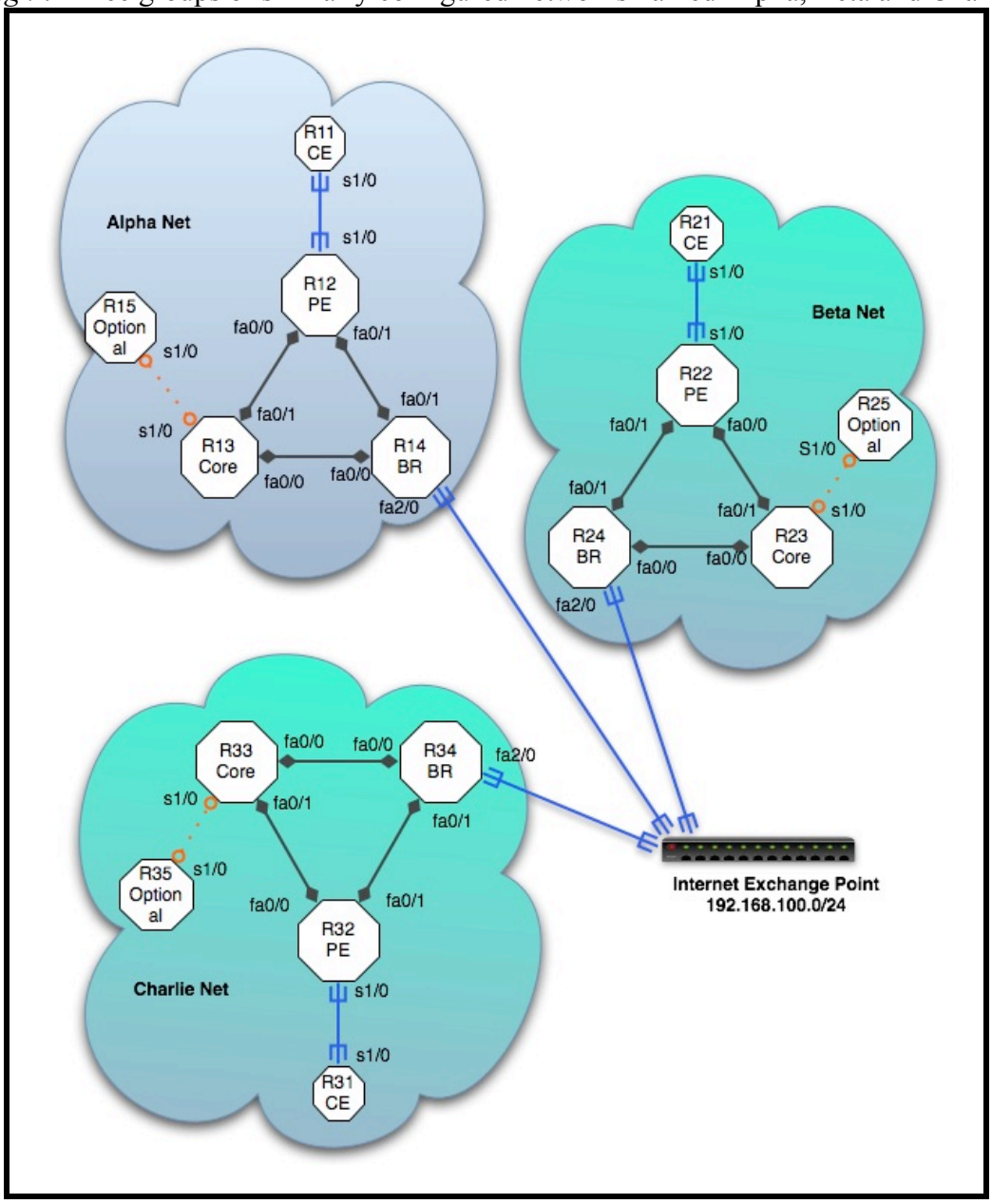
ISP Network Workshop Module 2 :
Basic Network Connectivity with OSPF, iBGP and eBGP

Objective : Setup the basic connectivity and construct a regular ISP network

Design : Three groups of similarly configured networks named Alpha, Beta and Charlie.



IP Address Allocations:

Alpha Net – AS 100	10.1.0.0/19	Alpha Customer – AS 65501	10.0.1.0/24
Beta Net – AS 200	10.2.0.0/19	Beta Customer – AS 65502	10.0.2.0/24
Charlie Net – AS 300	10.3.0.0/19	Charlie Customer – AS65503	10.0.3.0/24

Section 1 : Setup Basic Connectivity

1. Each Network has been allocation a block of IP address for their internal use. A special block has also been assigned for their respective customer. The group will now setup internal connectivity within their routers. For allocation of IP addresses, students should use the following basic tenet.

   - Select a subnet for loopback addresses as part of Infrastructure
     i. Loopback addresses are configured as /32
   - Select a subnet for point to point address as part of Infrastructure
     i. All point to point addresses should be /30
   - Keep the rest aside for Customer allocations.

An example for Charlie Net can be

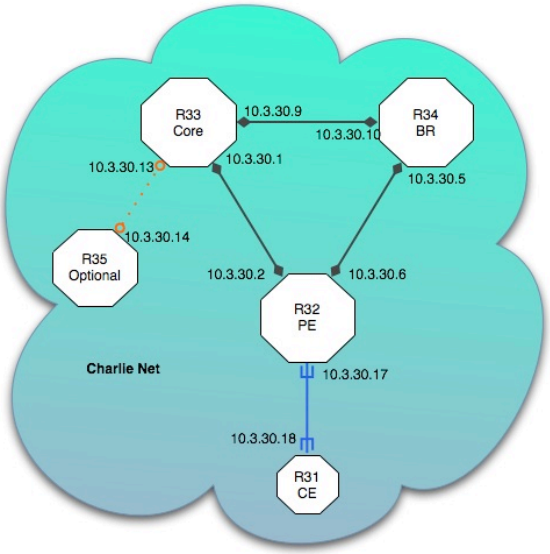
10.3.0.0				10.3.31.255
10.3.0.0	**-**	**10.3.29.255**	**10.3.30.0 -**	**10.3.31.255**
Customers			*Infrastructure /23*	

Within the Infrastructure /23, further allocation can be made

10.3.30.0				10.3.31.255
10.3.30.0	**-**	**10.3.31.127**	**10.3.31.128 -**	**10.3.31.255**
Point to Points block			*Loopbacks /25*	

Further, the actual assignment can be as follows:

Loopbacks	R32	10.3.31.128
	R33	10.3.31.129
	R34	10.3.31.130
	R35	10.3.31.131
Point to Point	R32 ← → R33	10.3.30.0/30
	R32 ← → R34	10.3.30.4/30
	R33 ← → R34	10.3.30.8/30
	R33 ← → R35	10.3.30.12/30
	R32 ← → R31	10.3.30.16/30



Section 2 : Setup OSPF, iBGP

1. OSPF : We use OSPF as the IGP to carry infrastructure routes. Students should configure OSPF in the network. OSPF should run between the main routers in the network, for example in Beta Net it would be R21, R22, R23.

   Example of Configuration on R23

```
router ospf 200
log-adjacency-changes
passive interface default
no passive-interface FastEthernet0/0
no passive-interface FastEthernet0/1
network 10.2.31.129 0.0.0.0 area 0
network 10.2.30.8 0.0.0.3 area 0
network 10.2.30.12 0.0.0.3 area 0
```

   You can check your OSPF status with the following commands

```
show ip route ospf
show ip ospf
show ip ospf neighbor
show ip ospf interface
show ip ospf database
```

2. iBGP : iBGP will be used to carry customer and transit prefixes across the network. We'll configure full mesh iBGP between all routers in the network. i.e, R11, R12, R13 in Alpha Net.

   Example of Configuration on R13

```
router bgp 100
network 10.1.0.0 mast 255.255.224.0
neighbor 10.1.31.128 remote-as 100
neighbor 10.1.31.128 description iBGP with PE Router R12
neighbor 10.1.31.128 update-source loopback 0
neighbor 10.1.31.130 remote-as 100
neighbor 10.1.31.130 description iBGP with BR Router R14
neighbor 10.1.31.130 update-source loopback 0
```

   You need to add the pull up route to announce the route.

```
ip route 10.1.0.0 255.255.224.0 Null 0
```

   You can check the BGP status with the following commands

```
show ip bgp summary
show ip bgp
show ip route
show ip bgp neighbor <neighbor IP> advertised-routes
show ip bgp <neighbor IP> routes
```

3. Configuration for 'Optional Router'
   The optional router is not used for all exercises, but if your workshop uses the router, you can configure the basic connectivity with the router at this point.
   - Configure the interfaces and addressing.
   - Configure OSPF on the optional router and also add the network statement for the /30 on the core router
   - The iBGP session on the 'optional router' varies according to the specific purpose in the lab. Consult the lab instructor before configuring.

Section 3 : Setup eBGP and Prefix Filter with Customer

Each network has two routers with eBGP connections. The border router and the provider edge router. As part of this section, we setup BGP session first with the customer, and then later with other providers through the interconnection point. We'll apply filters for everyone. Students are expected to work in teams. Do note that while iBGP sessions are setup with the loopback address, eBGP sessions are setup with the connected interface address.

1. eBGP with the Customer

   Configure the additional eBGP session with the customer. Example on R12

```
router bgp 100
neighbor 10.1.31.18 remote-as 65501
neighbor 10.1.31.18 description eBGP with Customer R11
```

   Example configuration on R11

```
router bgp 65501
network 10.0.1.0 mask 255.255.255.0
neighbor 10.1.31.17 remote-as 100
neighbor 10.1.31.17 description eBGP with Provider R12
```

   Don't forget to add the pull up route.

2. Applying Prefix-list with Customer Network

   Best practice is to install prefix list on both the customer router and the provider router, and in both direction. You can refer to the slides for details.

   Example configuration on R12

```
router bgp 100
neighbor 10.1.31.18 remote-as 65501
neighbor 10.1.31.18 description eBGP with Customer R11
neighbor 10.1.31.18 prefix-list customer1-rotues in
neighbor 10.1.31.18 prefix-list default out

ip prefix-list default permit 0.0.0.0/32

ip prefix-list customer1-routes permit 10.0.1.0/24
ip prefix-list customer1-routes deny 0.0.0.0/0 le 32
```

   Example configuration on R11

```
router bgp 65501
network 10.0.1.0 mask 255.255.255.0
neighbor 10.1.31.17 remote-as 100
neighbor 10.1.31.17 description eBGP with Provider R12
neighbor 10.1.31.17 prefix-list default in
neighbor 10.1.31.17 prefix-list my-routes out

ip prefix-list default permit 0.0.0.0/32

ip prefix-list my-routes permit 10.0.1.0/24
ip prefix-list my-route deny 0.0.0.0/0 le 32
```

3. Configuring uRPF on customer link

   It is recommended that all single homed customers be configured with strict mode uRPF
   On R12

```
interface serial0/0
ip verify unicast source reachable-via rx
```

Section 4: Setup eBGP and Prefix Filter with Other Providers

In this section we'll configure eBGP session with the other providers. We'll use an IXP in the middle to connect to other providers. The IXP address assignment is as follows.

Alpha Net – AS 100	192.168.100.1
Beta Net – AS 200	192.168.100.2
Charline Net – AS 300	192.168.100.3

1. eBGP with other providers

   eBGP sessions are setup with the interface address. Example for R34.

```
router bgp 300
neighbor 192.168.100.1 remote-as 100
neighbor 192.168.100.1 description eBGP with AS100
neighbor 192.168.100.2 remote-as 200
neighbor 192.168.100.2 description eBGP with AS200
```

2. Applying prefix list to the other providers, example for R34

```
router bgp 300
neighbor 192.168.100.1 remote-as 100
neighbor 192.168.100.1 description eBGP with AS100
neighbor 192.168.100.1 prefix-list alphanet in
neighbor 192.168.100.1 prefix-list our-routes out
neighbor 192.168.100.2 remote-as 200
neighbor 192.168.100.2 description eBGP with AS200
neighbor 192.168.100.2 prefix-list betanet in
neighbor 192.168.100.2 prefix-list our-routes out

ip prefix-list our-routes permit  10.3.0.0/19
ip prefix-list our-routes permit 10.0.3.0/24
ip prefix-list our-routes deny 0.0.0.0/0 le 32

ip prefix-list alphanet permit 10.1.0.0/19
ip prefix-list alphanet permit 10.0.1.0/24
ip prefix-list alphanet deny 0.0.0.0/0 le 32

ip prefix-list betanet permit 10.2.0.0/19
ip prefix-list betanet permit 10.0.2.0/24
ip prefix-list betanet deny 0.0.0.0/0 le 32
```

3. Note about IXP next-hop

   In a shared interconnect fabric like the IXP, the address range is shared between all providers. This presents an issue for the providers on propagating the IXP next-hop within their networks. This can be resolved by the IXP facing router by announcing itself as the next-hop over iBGP for all routes received over the IXP.

   Example for R14

```
router bgp 100
neighbor 10.1.31.128 remote-as 100
neighbor 10.1.31.128 description iBGP with PE Router R12
neighbor 10.1.31.128 update-source loopback 0
neighbor 10.1.31.128 next-hop-self
neighbor 10.1.31.129 remote-as 100
neighbor 10.1.31.129 description iBGP with BR Router R13
neighbor 10.1.31.129 update-source loopback 0
neighbor 10.1.31.129 next-hop-self
```

4. Note about peer-groups
   In most cases, providers will apply the same set of policies towards a similar set of BGP peers. This is true for both iBGP and eBGP peers. It makes it easier to use BGP peer groups to manage such peers.

Section 4 : Configuring MD5 authentication for OSPF and BGP (For Security Workshops)

The instructor must have described the benefits of using authentication for routing protocols in the class. We'll configure authentication of routing protocols in this section.

1. Configuring MD5 in OSPF
   All the routers in the same OSPF area must have the same authentication string. First of all, OSPF must be configured to look for authentication string. After that each interface on which OSPF is active needs to be configured.

   Example R12

```
router ospf 100
area 0 authentication message-digest

interface FastEthernet0/0
ip ospf message-digest-key 1 md5 W00tyob

interface FastEthernet0/1
ip ospf message-digest-key 1 md5 W00tyob
```

2. Configuring BGP MD5 authentication
   BGP passwords are set up on a per session basis. for both iBGP and eBGP. In practice, most networks use the same key for all iBGP sessions, and use a per-peer MD5 password for eBGP sessions.

   Example for R14, you have to add the following

```
router bgp 100
neighbor 10.1.31.128 remote-as 100
neighbor 10.1.31.128 password iBGPpass
neighbor 10.1.31.129 remote-as 100
neighbor 10.1.31.129 password iBGPpass
neighbor 192.168.100.2 remote-as 200
neighbor 192.168.100.2 remote-as betapass
neighbor 192.168.100.3 remote-as 300
neighbor 192.168.100.3 password charliepass
```

3. Service Password Encryption

   To encrypt the MD5 strings in the configuration file, you should use the following global command in cisco routers.

```
service-password-encryption
```

Section 5 : Ingress Route filtering for Bogons

Best practices indicate that all BGP speakers should filter bogons and well known reserved addresses. It's best practice to include them as a template for all new prefix-list you create for any customers or peers, even if you use community based, or as-path based or maximum prefix based filters.