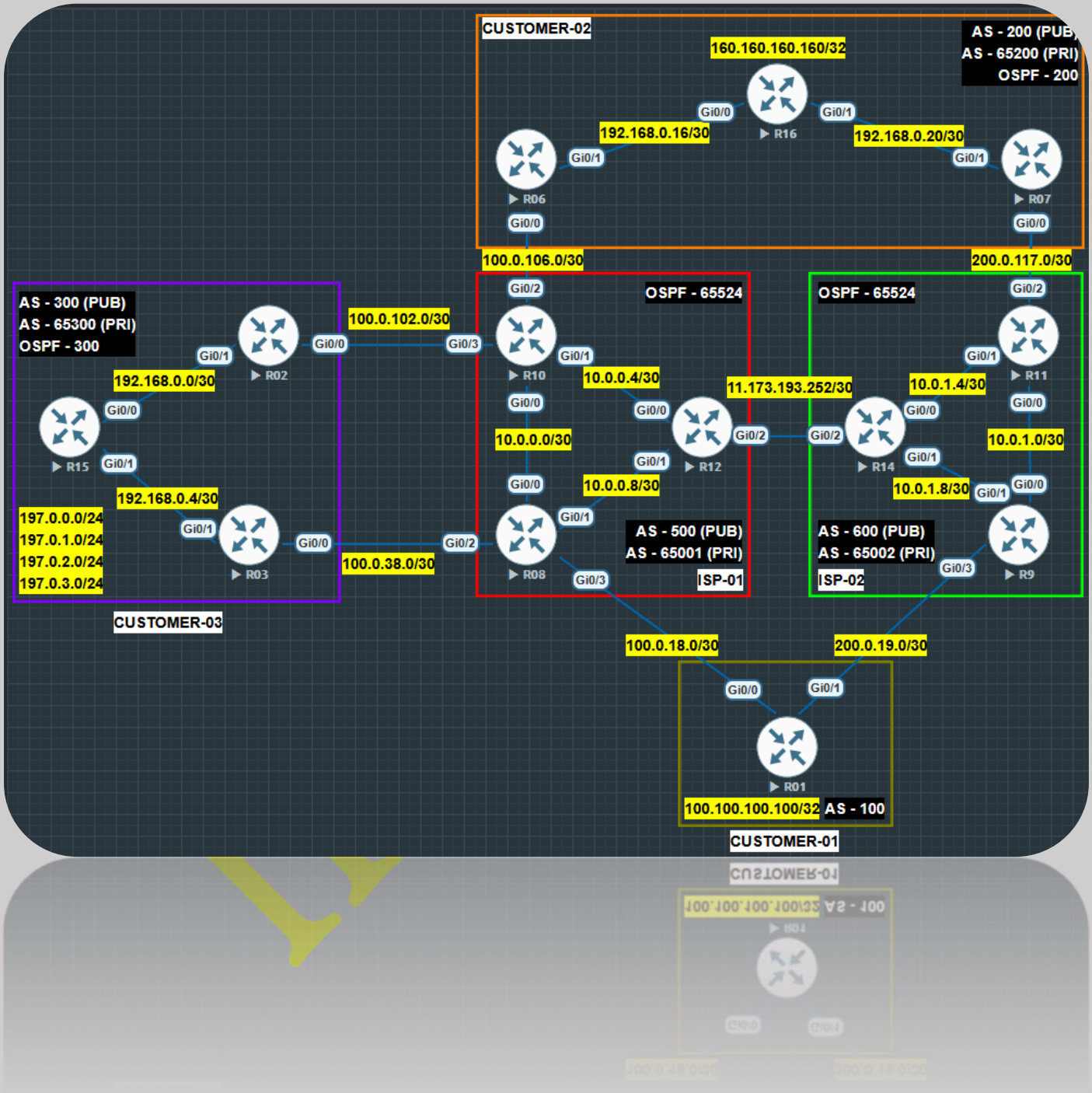
Enterprise Multi-Homed BGP Lab



Lab Requirements

Task 1 – ISP01

- Deploy OSPF (Process ID: 65524) as the IGP within ISP01.
- Establish an internal BGP architecture using:

- iBGP (AS 65001 – private ASN) for the core network
- eBGP (AS 500 – public ASN) for external connectivity

➢ Configure all iBGP sessions using Loopback0 interface as the update source.
➢ Implement a Route Reflector topology:
- R12 → Route Reflector (RR)
- R08, R10 → RR Clients

➢ Define a BGP peer-group named **CORE** for internal peers to simplify configuration.
➢ Enable BGP session authentication using MD5 with password:

Task 2 – ISP02

➢ Deploy OSPF (Process ID: 65524) as the IGP within ISP02.
➢ Establish an internal BGP architecture using:
- iBGP (AS 65002 – private ASN) for the core network
- eBGP (AS 600 – public ASN) for external connectivity

➢ Configure iBGP sessions using Loopback0 interface.
➢ Implement a Route Reflector topology:
- R14 → Route Reflector (RR)
- R09, R11 → RR Clients

➢ Define a BGP peer-group named **CORE** for internal peers to simplify configuration.
➢ Enable BGP MD5 authentication with password:

Task 3 – CUSTOMER01

➢ Configure eBGP (AS 100) on R01 toward both ISPs using directly connected interfaces.
➢ Implement primary/backup path selection:
- ISP02 → Primary exit
- ISP01 → Backup exit

➢ Enforce non-transit behavior between ISPs.
➢ Advertise only locally originated prefixes.
➢ Accept only a default route from ISPs.

Task 4 – CUSTOMER02

➢ Deploy OSPF (Process ID: 200) as the IGP.

- Establish BGP architecture:
  - iBGP (AS 65200 – private ASN) internally
  - eBGP (AS 200 – public ASN) toward ISPs
- Implement primary/backup path selection:
  - ISP01 → Primary exit
  - ISP02 → Backup exit
- Enforce non–transit behavior between ISPs.
- Advertise only locally originated routes.
- Accept only default routes from ISPs.

Task 5 – CUSTOMER03

- Deploy OSPF (Process ID: 300) as the IGP.
- Establish BGP architecture:
  - iBGP (AS 65300 – private ASN) internally
  - eBGP (AS 300 – public ASN) toward ISPs
- Implement primary/backup path selection:
  - R03 → Primary exit
  - R02 → Backup exit
- Advertise only locally originated routes.
- Accept only default routes from ISPs.
- Ensure return traffic symmetry:
  - ISP inbound traffic must prefer R03
- Implement route aggregation (summarization):
  - Advertise customer prefixes as a single summarized route to external ASes.

Task01 – ISP01

IGP: OSPF Configuration

hello interval is 3s, dead interval is 10s and network type is point-to-point

R10

```
router ospf 65524
 router-id 10.255.255.10
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.0.0.1 0.0.0.0 area 0
 network 10.0.0.5 0.0.0.0 area 0
 network 10.255.255.10 0.0.0.0 area 0
!
```

R08

```
router ospf 65524
 router-id 10.255.255.8
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.0.0.2 0.0.0.0 area 0
 network 10.0.0.9 0.0.0.0 area 0
 network 10.255.255.8 0.0.0.0 area 0
```

R12

```
router ospf 65524
 router-id 10.255.255.8
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.0.0.2 0.0.0.0 area 0
 network 10.0.0.9 0.0.0.0 area 0
 network 10.255.255.8 0.0.0.0 area 0
!
```

BGP Configurations

R10

```
router bgp 65001
 bgp router-id 10.255.255.10
 neighbor 10.255.255.12 remote-as 65001                    // To RR
 neighbor 10.255.255.12 password kolwin!!!!
 neighbor 10.255.255.12 update-source Loopback0
 neighbor 100.0.102.2 remote-as 300                        // To Customer 03
 neighbor 100.0.102.2 local-as 500 no-prepend replace-as
 neighbor 100.0.102.2 password kolwin!!!!
 neighbor 100.0.106.2 remote-as 200                        // To Customer 02
 neighbor 100.0.106.2 local-as 500 no-prepend replace-as
 neighbor 100.0.106.2 password kolwin!!!!
```

```
!
address-family ipv4
 neighbor 10.255.255.12 activate
 neighbor 10.255.255.12 next-hop-self
 neighbor 100.0.102.2 activate
 neighbor 100.0.102.2 default-originate
 neighbor 100.0.106.2 activate
 neighbor 100.0.106.2 default-originate
exit-address-family
!
```

R08

```
router bgp 65001
 bgp router-id 10.255.255.8
 neighbor 10.255.255.12 remote-as 65001                    // To RR
 neighbor 10.255.255.12 password kolwin!!!!
 neighbor 10.255.255.12 update-source Loopback0
 neighbor 100.0.18.2 remote-as 100                         // To Customer 01
 neighbor 100.0.18.2 local-as 500 no-prepend replace-as
 neighbor 100.0.18.2 password kolwin!!!!
 neighbor 100.0.38.2 remote-as 300                         // To Customer 03
 neighbor 100.0.38.2 local-as 500 no-prepend replace-as
 neighbor 100.0.38.2 password kolwin!!!!
 !
 address-family ipv4
```

```
 neighbor 10.255.255.12 activate
 neighbor 10.255.255.12 next-hop-self
 neighbor 100.0.18.2 activate
 neighbor 100.0.18.2 default-originate
 neighbor 100.0.38.2 activate
 neighbor 100.0.38.2 default-originate
exit-address-family
!
```

R12 (RR)

```
router bgp 65001
 bgp router-id 10.255.255.12
 neighbor CORE peer-group
 neighbor CORE remote-as 65001
 neighbor CORE password kolwin!!!!
 neighbor CORE update-source Loopback0
 neighbor 10.255.255.8 peer-group CORE                    // To R08
 neighbor 10.255.255.10 peer-group CORE                   // To R10
 neighbor 11.173.193.254 remote-as 600                    // To ISP02
 neighbor 11.173.193.254 local-as 500 no-prepend replace-as
 neighbor 11.173.193.254 password kolwin!!!!
 !
 address-family ipv4
  neighbor CORE route-reflector-client
  neighbor CORE next-hop-self
```

```
 neighbor 10.255.255.8 activate
 neighbor 10.255.255.10 activate
 neighbor 11.173.193.254 activate
exit-address-family
!
```

Task02 – ISP02

IGP: OSPF Configuration

hello interval is 3s, dead interval is 10s and network type is point-to-point

R11

```
router ospf 65524
 router-id 10.255.255.11
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.0.1.1 0.0.0.0 area 0
 network 10.0.1.6 0.0.0.0 area 0
 network 10.255.255.11 0.0.0.0 area 0
!
```

R09

```
router ospf 65524
 router-id 10.255.255.9
 auto-cost reference-bandwidth 1000
 passive-interface default
```

```
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.0.1.2 0.0.0.0 area 0
 network 10.0.1.10 0.0.0.0 area 0
 network 10.255.255.9 0.0.0.0 area 0
!
```

R14

```
router ospf 65524
 router-id 10.255.255.14
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.0.1.5 0.0.0.0 area 0
 network 10.0.1.9 0.0.0.0 area 0
 network 10.255.255.14 0.0.0.0 area 0
!
```

BGP Configurations

R11

```
router bgp 65002
 bgp router-id 10.255.255.11
 neighbor 10.255.255.14 remote-as 65002                    // To RR
 neighbor 10.255.255.14 password kolwin!!!!
 neighbor 10.255.255.14 update-source Loopback0
```

```
 neighbor 200.0.117.2 remote-as 200                          // To Customer 02
 neighbor 200.0.117.2 local-as 600 no-prepend replace-as
 neighbor 200.0.117.2 password kolwin!!!!
 !
 address-family ipv4
  neighbor 10.255.255.14 activate
  neighbor 10.255.255.14 next-hop-self
  neighbor 200.0.117.2 activate
  neighbor 200.0.117.2 default-originate
 exit-address-family
!
```

R09

```
router bgp 65002
 bgp router-id 10.255.255.9
 neighbor 10.255.255.14 remote-as 65002                      // To RR
 neighbor 10.255.255.14 password kolwin!!!!
 neighbor 10.255.255.14 update-source Loopback0
 neighbor 200.0.19.2 remote-as 100                           // To Customer 01
 neighbor 200.0.19.2 local-as 600 no-prepend replace-as
 neighbor 200.0.19.2 password kolwin!!!!
 !
 address-family ipv4
  neighbor 10.255.255.14 activate
  neighbor 10.255.255.14 next-hop-self
```

```
 neighbor 200.0.19.2 activate
 neighbor 200.0.19.2 default-originate
exit-address-family
!
```

R14 (RR)

```
router bgp 65002
 bgp router-id 10.255.255.14
 neighbor CORE peer-group
 neighbor CORE remote-as 65002
 neighbor CORE password kolwin!!!!
 neighbor CORE update-source Loopback0
 neighbor 10.255.255.9 peer-group CORE                    // To R09
 neighbor 10.255.255.11 peer-group CORE                   // To R11
 neighbor 11.173.193.253 remote-as 500                    // To ISP01
 neighbor 11.173.193.253 local-as 600 no-prepend replace-as
 neighbor 11.173.193.253 password kolwin!!!!
 !
 address-family ipv4
  neighbor CORE route-reflector-client
  neighbor CORE next-hop-self
  neighbor 10.255.255.9 activate
  neighbor 10.255.255.11 activate
  neighbor 11.173.193.253 activate
 exit-address-family
```

Task03 – Customer01

Customer 01 must not be transit between ISPs

```
ip prefix-list NOT-TRANSIT seq 10 permit 100.100.100.100/32
!
```

Customer 01 should accept only default route from its ISPs

```
ip prefix-list DEFAULT seq 10 permit 0.0.0.0/0
!
```

ISP02 is primary exit point and ISP01 is backup exit point

```
route-map WEIGHT permit 10
 set weight 500
!
```

BGP Configuration

R01

```
router bgp 100
 bgp router-id 100.100.100.100
 neighbor 100.0.18.1 remote-as 500                    // To ISP01
 neighbor 100.0.18.1 password kolwin!!!!
 neighbor 200.0.19.1 remote-as 600                    // To ISP02
 neighbor 200.0.19.1 password kolwin!!!!
 !
 address-family ipv4
  network 100.100.100.100 mask 255.255.255.255
  neighbor 100.0.18.1 activate
  neighbor 100.0.18.1 prefix-list DEFAULT in
```

```
 neighbor 100.0.18.1 prefix-list NOT-TRANSIT out
 neighbor 200.0.19.1 activate
 neighbor 200.0.19.1 prefix-list DEFAULT in
 neighbor 200.0.19.1 prefix-list NOT-TRANSIT out
 neighbor 200.0.19.1 route-map WEIGHT in
exit-address-family
!
```

Task04 – Customer02

R16

```
router ospf 200
 router-id 160.160.160.160
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.255.255.16 0.0.0.0 area 0
 network 192.168.0.18 0.0.0.0 area 0
 network 192.168.0.21 0.0.0.0 area 0
!
router bgp 65200
 bgp router-id 10.255.255.16
 neighbor 10.255.255.6 remote-as 65200                    // To R06
 neighbor 10.255.255.6 password kolwin!!!!
 neighbor 10.255.255.6 update-source Loopback1
```

```
 neighbor 10.255.255.7 remote-as 65200                    // To R07
 neighbor 10.255.255.7 password kolwin!!!!
 neighbor 10.255.255.7 update-source Loopback1
 !
 address-family ipv4
  network 160.160.160.160 mask 255.255.255.255
  neighbor 10.255.255.6 activate
  neighbor 10.255.255.7 activate
 exit-address-family
!
```

R06

```
router ospf 200
 router-id 192.168.0.17
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/1
 network 10.255.255.6 0.0.0.0 area 0
 network 192.168.0.17 0.0.0.0 area 0
!
```

Customer 02 must not be transit between ISPs

```
ip prefix-list NO-TRANSIT seq 10 permit 160.160.160.160/32
!
```

Customer 02 should accept only default route from its ISPs

```
ip prefix-list DEFAULT seq 10 permit 0.0.0.0/0
```

```
router bgp 65200
 bgp router-id 10.255.255.6
 neighbor 10.255.255.7 remote-as 65200                    // To R07
 neighbor 10.255.255.7 password kolwin!!!!
 neighbor 10.255.255.7 update-source Loopback0
 neighbor 10.255.255.16 remote-as 65200                   // To R16
 neighbor 10.255.255.16 password kolwin!!!!
 neighbor 10.255.255.16 update-source Loopback0
 neighbor 100.0.106.1 remote-as 500                       // To ISP01
 neighbor 100.0.106.1 local-as 200 no-prepend replace-as
 neighbor 100.0.106.1 password kolwin!!!!
 !
 address-family ipv4
  neighbor 10.255.255.7 activate
  neighbor 10.255.255.7 next-hop-self
  neighbor 10.255.255.16 activate
  neighbor 10.255.255.16 next-hop-self
  neighbor 100.0.106.1 activate
  neighbor 100.0.106.1 prefix-list DEFAULT in
  neighbor 100.0.106.1 prefix-list NO-TRANSIT out
 exit-address-family
!
```

R07

```
router ospf 200
```

```
 router-id 192.168.0.22
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/1
 network 10.255.255.7 0.0.0.0 area 0
 network 192.168.0.22 0.0.0.0 area 0
!
```

Customer 02 must not be transit between ISPs

```
ip prefix-list NO-TRANSIT seq 10 permit 160.160.160.160/32
!
```

Customer 02 should accept only default route from its ISPs

```
ip prefix-list DEFAULT seq 10 permit 0.0.0.0/0
!
```

R06 is primary exit point and R07 is backup exit point

```
ip prefix-list ASPATH seq 5 permit 0.0.0.0/0
!
route-map ASPATH permit 10
 match ip address prefix-list ASPATH
 set as-path prepend 65200 65200
!
router bgp 65200
 bgp router-id 10.255.255.7
 neighbor 10.255.255.6 remote-as 65200                    // To R06
 neighbor 10.255.255.6 password kolwin!!!!
```

```
 neighbor 10.255.255.6 update-source Loopback0
 neighbor 10.255.255.16 remote-as 65200                    // To R16
 neighbor 10.255.255.16 password kolwin!!!!
 neighbor 10.255.255.16 update-source Loopback0
 neighbor 200.0.117.1 remote-as 600                        // To ISP02
 neighbor 200.0.117.1 local-as 200 no-prepend replace-as
 neighbor 200.0.117.1 password kolwin!!!!
 !
 address-family ipv4
  neighbor 10.255.255.6 activate
  neighbor 10.255.255.6 next-hop-self
  neighbor 10.255.255.16 activate
  neighbor 10.255.255.16 next-hop-self
  neighbor 200.0.117.1 activate
  neighbor 200.0.117.1 prefix-list DEFAULT in
  neighbor 200.0.117.1 prefix-list NO-TRANSIT out
  neighbor 200.0.117.1 route-map ASPATH in
 exit-address-family
!
```

Task05 – Customer03

R15

```
router ospf 300
 router-id 192.168.0.2
 auto-cost reference-bandwidth 1000
```

```
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet0/1
 network 10.255.255.15 0.0.0.0 area 0
 network 192.168.0.1 0.0.0.0 area 0
 network 192.168.0.5 0.0.0.0 area 0
!
router bgp 65300
 bgp router-id 10.255.255.15
 neighbor CORE peer-group
 neighbor CORE remote-as 65300
 neighbor CORE password kolwin!!!!
 neighbor CORE update-source Loopback2028
 neighbor 10.255.255.2 peer-group CORE                    // To R02
 neighbor 10.255.255.3 peer-group CORE                    // To R03
 !
 address-family ipv4
  network 197.0.0.0
  network 197.0.1.0
  network 197.0.2.0
  network 197.0.3.0
```

The other ASes should see customer 03's prefixes as a single prefix

```
  aggregate-address 197.0.0.0 255.255.252.0 summary-only
  neighbor CORE route-reflector-client
```

```
 neighbor 10.255.255.2 activate
 neighbor 10.255.255.3 activate
exit-address-family
!
```

R03

```
router ospf 300
 router-id 192.168.0.6
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/1
 network 10.255.255.3 0.0.0.0 area 0
 network 192.168.0.6 0.0.0.0 area 0
!
```

Customer 03 should accept only default route from its ISPs

```
ip prefix-list DEFAULT seq 10 permit 0.0.0.0/0
!
router bgp 65300
 bgp router-id 10.255.255.3
 neighbor 10.255.255.15 remote-as 65300                    // To R15
 neighbor 10.255.255.15 password kolwin!!!!
 neighbor 10.255.255.15 update-source Loopback0
 neighbor 100.0.38.1 remote-as 500                         // To ISP01
 neighbor 100.0.38.1 local-as 300 no-prepend replace-as
 neighbor 100.0.38.1 password kolwin!!!!
```

```
 !
 address-family ipv4
  neighbor 10.255.255.15 activate
  neighbor 10.255.255.15 next-hop-self
  neighbor 100.0.38.1 activate
  neighbor 100.0.38.1 prefix-list DEFAULT in
 exit-address-family
!
```

R02

```
router ospf 300
 router-id 192.168.0.1
 auto-cost reference-bandwidth 1000
 passive-interface default
 no passive-interface GigabitEthernet0/1
 network 10.255.255.2 0.0.0.0 area 0
 network 192.168.0.2 0.0.0.0 area 0
!
```

Customer 03 should accept only default route from its ISPs

```
ip prefix-list DEFAULT seq 10 permit 0.0.0.0/0
!
```

ISP return traffic should come from R03

```
ip prefix-list WITH-ASPATH seq 1 permit 197.0.0.0/22
!
route-map AS01 permit 10
```

```
 match ip address prefix-list WITH-ASPATH
 set as-path prepend 65300 65300 65300 65300 65300
!
```

R03 is primary exit point and R02 is backup exit point

```
ip prefix-list ANYTHING seq 5 permit 0.0.0.0/0
!
route-map PRI-SEC permit 10
 match ip address prefix-list ANYTHING
 set as-path prepend 65300 65300
!
router bgp 65300
 bgp router-id 10.255.255.2
 neighbor 10.255.255.15 remote-as 65300                    // To R15
 neighbor 10.255.255.15 password kolwin!!!!
 neighbor 10.255.255.15 update-source Loopback0
 neighbor 100.0.102.1 remote-as 500                        // To ISP01
 neighbor 100.0.102.1 local-as 300 no-prepend replace-as
 neighbor 100.0.102.1 password kolwin!!!!
 !
 address-family ipv4
  neighbor 10.255.255.15 activate
  neighbor 10.255.255.15 next-hop-self
  neighbor 100.0.102.1 activate
  neighbor 100.0.102.1 prefix-list DEFAULT in
```

neighbor 100.0.102.1 route-map **PRI-SEC** in

neighbor 100.0.102.1 route-map **AS01** out

exit-address-family

Verification

R01 (Traceroute Results)

```
R01#traceroute 197.0.0.1 source lo0
Type escape sequence to abort.
Tracing the route to 197.0.0.1
VRF info: (vrf in name/id, vrf out name/id)
  1 200.0.19.1 [AS 600] 3 msec 2 msec 3 msec
  2 10.0.1.9 [AS 600] 4 msec 3 msec 4 msec
  3 11.173.193.253 [AS 600] 4 msec 5 msec 4 msec
  4 10.0.0.9 [AS 600] 4 msec 4 msec 5 msec
  5 100.0.38.2 [AS 600] 5 msec 5 msec 6 msec
  6 192.168.0.5 [AS 600] 6 msec *  7 msec
```

```
R01#traceroute 160.160.160.160 source lo0
Type escape sequence to abort.
Tracing the route to 160.160.160.160
VRF info: (vrf in name/id, vrf out name/id)
  1 200.0.19.1 [AS 600] 4 msec 4 msec 2 msec
  2 10.0.1.1 [AS 600] 3 msec 4 msec 4 msec
  3 200.0.117.2 [AS 600] 7 msec 7 msec 6 msec
  4 192.168.0.21 [AS 600] 6 msec *  7 msec
```

R16 (Traceroute Results)

```
R16#traceroute 100.100.100.100 source lo0
Type escape sequence to abort.
Tracing the route to 100.100.100.100
VRF info: (vrf in name/id, vrf out name/id)
  1 192.168.0.17 [AS 500] 4 msec 4 msec 2 msec
  2 100.0.106.1 [AS 500] 4 msec 4 msec 5 msec
  3 10.0.0.2 [AS 500] 6 msec 6 msec 5 msec
  4 100.0.18.2 [AS 500] 7 msec *  7 msec
```

```
R16#traceroute 197.0.0.1 source lo0
Type escape sequence to abort.
Tracing the route to 197.0.0.1
VRF info: (vrf in name/id, vrf out name/id)
  1 192.168.0.17 [AS 500] 3 msec 3 msec 2 msec
  2 100.0.106.1 [AS 500] 3 msec 4 msec 4 msec
  3 10.0.0.2 [AS 500] 5 msec 6 msec 6 msec
  4 100.0.38.2 [AS 500] 6 msec 7 msec 6 msec
  5 192.168.0.5 [AS 500] 8 msec *  7 msec
```

R15 (Traceroute Results)

```
R15#traceroute 160.160.160.160 source lo0
Type escape sequence to abort.
Tracing the route to 160.160.160.160
VRF info: (vrf in name/id, vrf out name/id)
  1 192.168.0.6 [AS 500] 4 msec 3 msec 2 msec
  2 100.0.38.1 [AS 500] 3 msec 3 msec 3 msec
  3 10.0.0.1 [AS 500] 4 msec 4 msec 3 msec
  4 100.0.106.2 [AS 500] 5 msec 6 msec 5 msec
  5 192.168.0.18 [AS 500] 6 msec *  6 msec
```

```
R15#traceroute 100.100.100.100 source lo03
Type escape sequence to abort.
Tracing the route to 100.100.100.100
VRF info: (vrf in name/id, vrf out name/id)
  1 192.168.0.6 [AS 500] 2 msec 2 msec 2 msec
  2 100.0.38.1 [AS 500] 4 msec 3 msec 3 msec
  3 100.0.18.2 [AS 500] 6 msec *  6 msec
```

Ko Lwin (Network)