

Module 4 – BGP-LS Configuration Lab

Objective: All the routers are pre-configured with basic interface, OSPF and BGP configuration according to the following topology diagram. As part of the exercise, you will need to enable link-state distribution under OSPF, enable the BGP link-state address family and observe advertisements of link-state information. In addition, you will need to configure BGP egress peer engineering and observe its impact on BGP-LS.

Prerequisites: Knowledge of IGP, EGP, MPLS and Segment Routing is required.

The following will be the base topology and IP address plan used for this lab.

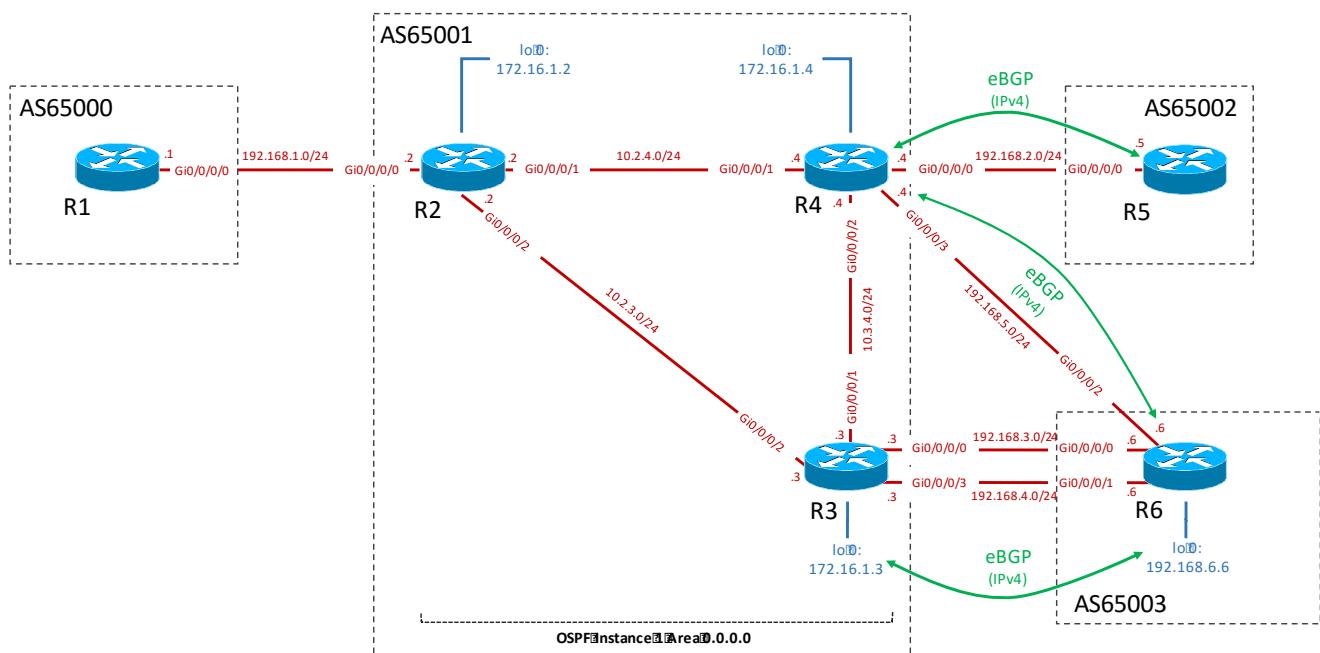


Figure 1 – BGP-LS Lab Base Configuration

Lab Notes

The BGP-LS lab topology comprises of 6 routers: R1, R2, R3, R4, R5 and R6. The routers perform the following functions:

- R1 => functions as a BGP-LS “consumer”, emulating an SDN controller
- R2, R3, R4 => part of AS65001, the main AS of interest.
- R5 => peer in AS65002
- R6 => peer in AS65003

All routers are running Cisco IOS-XRv 6.1.2 within GNS3. Login credentials are:

Username: cisco
Password: cisco

Multiple sets of identical topologies will be used. Workshop attendees will be split up into groups of 6 where each group member will be responsible for the configuration of a specific router. Note that routers R5 and R6 do not require configuration and it is expected that certain members of the group will share a router. A suggested split of responsibilities is as follows:

- R1 => one group member
- R2 => one group member
- R3 => two group members
- R4 => two group members

Please spend some time to be familiar with the network topology and addressing plan before you start building the configuration on the routers.

In this module, all required configurations are done in 2 parts.

Part 1. Base BGP-LS configuration.

The following figure reflects the network after the tasks in this part are completed.

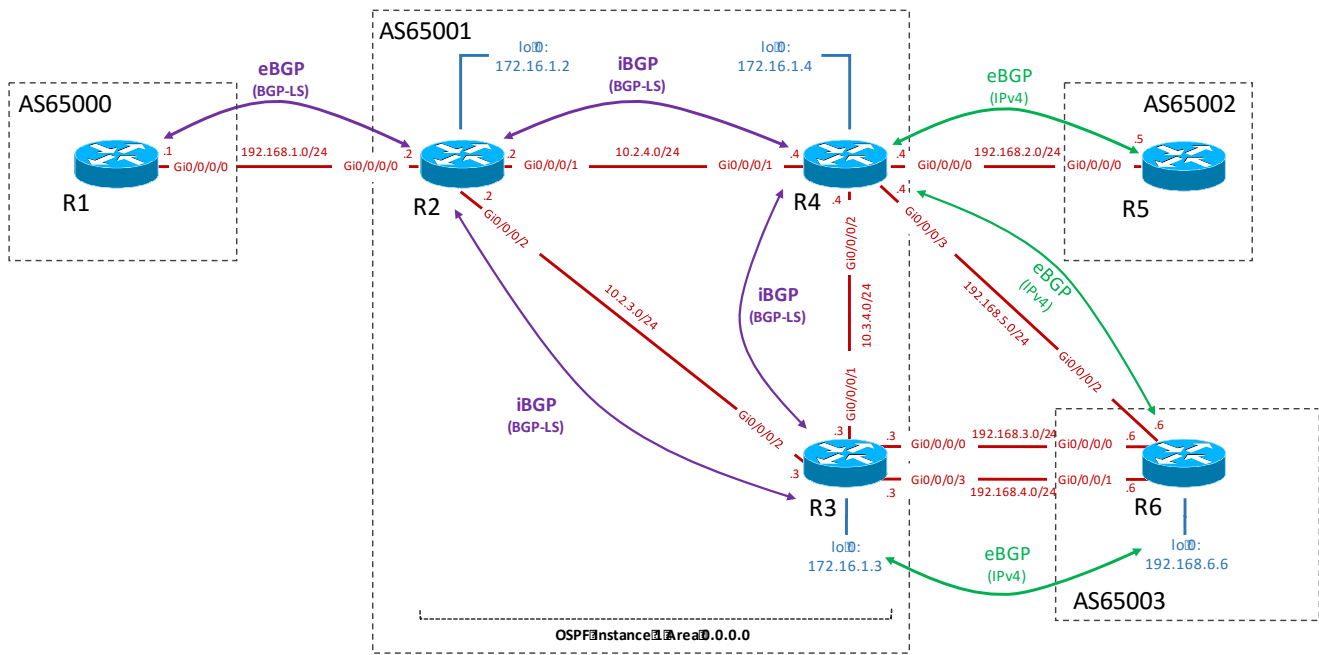


Figure 2 BGP-LS peering sessions

The intent of the first part is to do the following:

1. Configure R2 to distribute OSPF topology information into BGP.
2. Establish an eBGP session between R1 and R2 for the purpose of exchanging BGP link-state information.
3. Establish the following iBGP sessions to exchange link-state information between the members of AS 65001:
 - R2 <-> R4
 - R2 <-> R3
 - R3 <-> R4
4. Verify the link-state information in BGP

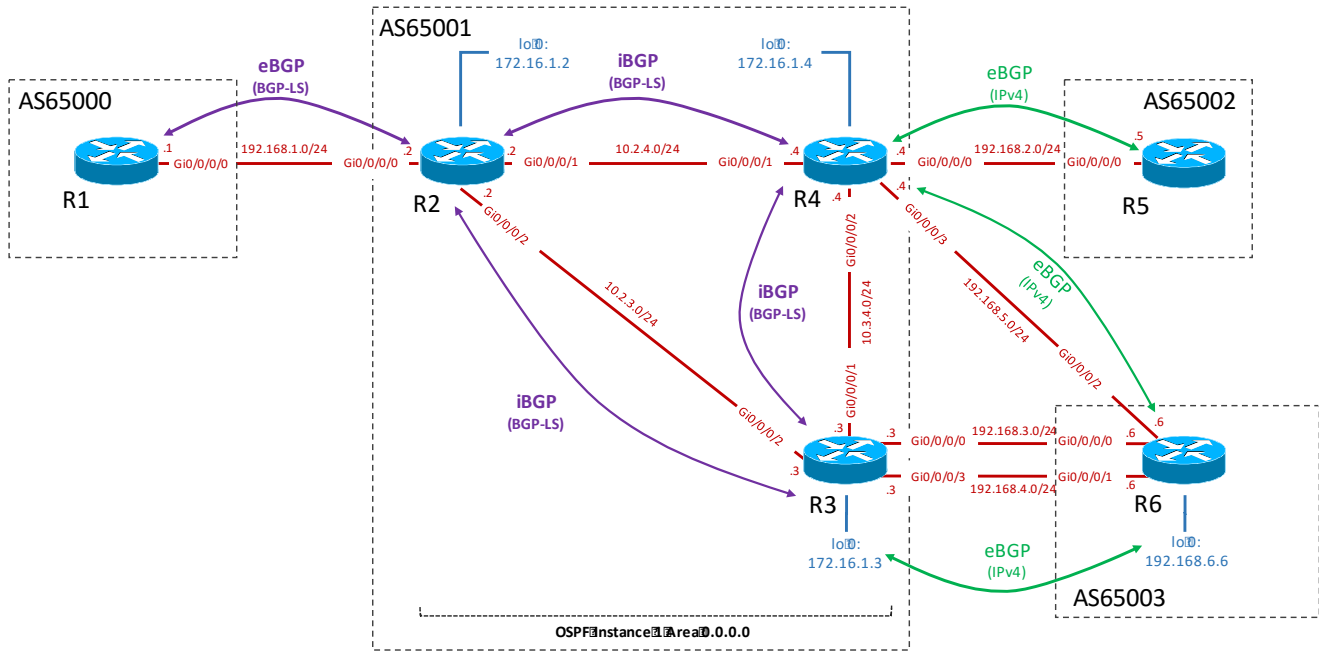
Part 2. Enabling BGP Egress Peer Engineering on routers R3 and R4

In this part, we will simply enable BGP egress peer engineering (EPE) on R3 and R4 and observe the impact on the link-state information carried over BGP.

Lab Exercise

1. Base BGP-LS configuration:

The following figure reflects the base BGP-LS configuration.



Note that different routers will require different configurations as described below.

Configuration for R1:

```

conf
route-policy PASS-ALL
pass
end-policy
! creates a route policy that allows all routes to pass through

router bgp 65000
bgp router-id 192.168.1.1
address-family ipv4 unicast
!
address-family link-state link-state
!
! enable the ipv4 unicast and link-state address families

neighbor 192.168.1.2
remote-as 65001
!
address-family link-state link-state
route-policy PASS-ALL in
route-policy PASS-ALL out
!
! create an eBGP session with R2 and enable BGP link-state address family
    
```

Configuration for R2:

```
conf
!
router ospf 1
distribute bgp-ls
!
! configure OSPF to distribute topology information to BGP-LS

route-policy PASS-ALL
pass
end-policy
! creates a route policy that allows all routes to pass through
!
router bgp 65001
bgp router-id 192.168.1.2
address-family ipv4 unicast
!
address-family link-state link-state
!
! enable the ipv4 unicast and link-state address families
!
neighbor 172.16.1.3
remote-as 65001
update-source Loopback0
address-family link-state link-state
!
! create an iBGP session with R3 and enable BGP link-state address family
!
neighbor 172.16.1.4
remote-as 65001
update-source Loopback0
address-family link-state link-state
!
! create an iBGP session with R4 and enable BGP link-state address family
!
neighbor 192.168.1.1
remote-as 65000
address-family link-state link-state
route-policy PASS-ALL in
route-policy PASS-ALL out
!
! create an eBGP session with R1 and enable BGP link-state address family
```

Configuration for R3:

```
conf
!
router bgp 65001
address-family link-state link-state
!
! enable the ipv4 unicast and link-state address families
!
neighbor 172.16.1.2
remote-as 65001
update-source Loopback0
address-family link-state link-state
!
```

```
! create an iBGP session with R2 and enable BGP link-state address family
!  
neighbor 172.16.1.4  
remote-as 65001  
update-source Loopback0  
address-family link-state link-state  
!  
! create an iBGP session with R4 and enable BGP link-state address family  
!
```

Configuration for R4:

```
conf  
!  
router bgp 65001  
address-family link-state link-state  
!  
! enable the ipv4 unicast and link-state address families  
!  
neighbor 172.16.1.2  
remote-as 65001  
update-source Loopback0  
address-family link-state link-state  
!  
! create an iBGP session with R2 and enable BGP link-state address family  
!  
neighbor 172.16.1.3  
remote-as 65001  
update-source Loopback0  
address-family link-state link-state  
!  
! create an iBGP session with R3 and enable BGP link-state address family  
!
```

Configuration for R5, R6:

No configuration required.

Please wait for all routers in your group to be configured before you issue the following verification commands. Please also do not move to the next part until advised to do so by your instructors.

Verify your configuration (on R1,R2,R3,R4):

The key objective of this lab is to get a detailed understanding of how link-state information is carried in BGP. The following verification commands will help you to do so.

```
show ospf neighbor
```

! only for routers in AS650001; ensure neighbors are up

```
show ospf database router
```

! only for routers in AS650001; ensure you understand in detail the contents of the OSPF database

```
show bgp summary
```

! summary of BGP operation

```
show bgp neighbors detail
```

! note the output describing the link-state address family

```
show bgp link-state link-state
```

! view the actual BGP link-state information

2. Enabling BGP Egress Peer Engineering (EPE)

In this part, we will simply enable BGP egress peer engineering (EPE) on R3 and R4 and observe the impact on the link-state information carried over BGP.

Configuration for R3:

```
conf
!
router bgp 65001
!
neighbor 192.168.6.6
 egress-engineering
exit
```

! Enables EPE for the eBGP session to R6

Configuration for R4:

```
conf
!
router bgp 65001
!
neighbor 192.168.2.5
 egress-engineering
exit
```

! Enables EPE for the eBGP session to R5

```
!
neighbor 192.168.5.6
 egress-engineering
exit
```

! Enables EPE for the eBGP session to R6

Please wait for all routers in your group to be configured before you issue the following verification commands.

Verify your configuration (on R1,R2,R3,R4):

```
show bgp summary
```

! summary of BGP operation

```
show bgp egress-engineering
```

! view BGP EPE details

```
show bgp link-state link-state
```

! view the actual BGP link-state information

Workshop templates for reference purpose only:

R1

Complete configuration

```
hostname R1
interface MgmtEth0/0/CPU0/0
 shutdown
!
interface GigabitEthernet0/0/0/0
 ipv4 address 192.168.1.1 255.255.255.0
!
interface GigabitEthernet0/0/0/1
 shutdown
!
interface GigabitEthernet0/0/0/2
 shutdown
!
interface GigabitEthernet0/0/0/3
 shutdown
!
route-policy PASS-ALL
 pass
end-policy
!
router bgp 65000
 bgp router-id 192.168.1.1
 address-family ipv4 unicast
!
 address-family link-state link-state
!
 neighbor 192.168.1.2
  remote-as 65001
  address-family ipv4 unicast
!
  address-family link-state link-state
  route-policy PASS-ALL in
  route-policy PASS-ALL out
!
!
end
```

R2

Complete configuration

```
hostname R2
interface Loopback0
 ipv4 address 172.16.1.2 255.255.255.255
!
interface MgmtEth0/0/CPU0/0
 shutdown
!
interface GigabitEthernet0/0/0/0
 ipv4 address 192.168.1.2 255.255.255.0
!
```

Monday, September 04, 2017

```
interface GigabitEthernet0/0/0/1
  ipv4 address 10.2.4.2 255.255.255.0
!
interface GigabitEthernet0/0/0/2
  ipv4 address 10.2.3.2 255.255.255.0
!
interface GigabitEthernet0/0/0/3
  shutdown
!
route-policy PASS-ALL
  pass
end-policy
!
router ospf 1
  distribute bgp-ls
  router-id 172.16.1.2
  network point-to-point
  area 0.0.0.0
    interface Loopback0
    !
    interface GigabitEthernet0/0/0/1
    !
    interface GigabitEthernet0/0/0/2
    !
  !
!
router bgp 65001
  bgp router-id 192.168.1.2
  address-family ipv4 unicast
  !
  address-family link-state link-state
  !
  neighbor 172.16.1.3
    remote-as 65001
    update-source Loopback0
    address-family link-state link-state
  !
  !
  neighbor 172.16.1.4
    remote-as 65001
    update-source Loopback0
    address-family link-state link-state
  !
  !
  neighbor 192.168.1.1
    remote-as 65000
    address-family ipv4 unicast
    !
    address-family link-state link-state
    route-policy PASS-ALL in
    route-policy PASS-ALL out
  !
!
end
```

R3

Complete configuration



```
hostname R3
interface Loopback0
  ipv4 address 172.16.1.3 255.255.255.255
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 192.168.3.3 255.255.255.0
!
interface GigabitEthernet0/0/0/1
  ipv4 address 10.3.4.3 255.255.255.0
!
interface GigabitEthernet0/0/0/2
  ipv4 address 10.2.3.3 255.255.255.0
!
interface GigabitEthernet0/0/0/3
  ipv4 address 192.168.4.3 255.255.255.0
!
route-policy PASS-ALL
  pass
end-policy
!
router static
  address-family ipv4 unicast
    192.168.6.6/32 GigabitEthernet0/0/0/0 192.168.3.6
    192.168.6.6/32 GigabitEthernet0/0/0/3 192.168.4.6
  !
!
router ospf 1
  router-id 172.16.1.3
  network point-to-point
  area 0.0.0.0
    interface Loopback0
    !
    interface GigabitEthernet0/0/0/1
    !
    interface GigabitEthernet0/0/0/2
    !
  !
!
router bgp 65001
  bgp router-id 172.16.1.3
  address-family ipv4 unicast
  !
  address-family link-state link-state
  !
  neighbor 172.16.1.2
    remote-as 65001
    update-source Loopback0
    address-family link-state link-state
  !
  !
  neighbor 172.16.1.4
    remote-as 65001
    update-source Loopback0
    address-family link-state link-state
  !
  !
  neighbor 192.168.6.6
    remote-as 65003
    ebgp-multihop 255
```

```
    egress-engineering
    update-source Loopback0
    address-family ipv4 unicast
      route-policy PASS-ALL in
      route-policy PASS-ALL out
    !
  !
!
end
```

R4

Complete configuration

```
hostname R4
interface Loopback0
  ipv4 address 172.16.1.4 255.255.255.255
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 192.168.2.4 255.255.255.0
!
interface GigabitEthernet0/0/0/1
  ipv4 address 10.2.4.4 255.255.255.0
!
interface GigabitEthernet0/0/0/2
  ipv4 address 10.3.4.4 255.255.255.0
!
interface GigabitEthernet0/0/0/3
  ipv4 address 192.168.5.4 255.255.255.0
!
route-policy PASS-ALL
  pass
end-policy
!
router ospf 1
  router-id 172.16.1.4
  network point-to-point
  area 0.0.0.0
    interface Loopback0
    !
    interface GigabitEthernet0/0/0/1
    !
    interface GigabitEthernet0/0/0/2
    !
  !
!
router bgp 65001
  bgp router-id 192.168.2.4
  address-family ipv4 unicast
  !
  address-family link-state link-state
  !
  neighbor 172.16.1.2
    remote-as 65001
    update-source Loopback0
    address-family ipv4 unicast
```

```
!
address-family link-state link-state
!
!
neighbor 172.16.1.3
remote-as 65001
update-source Loopback0
address-family link-state link-state
!
!
neighbor 192.168.2.5
remote-as 65002
egress-engineering
address-family ipv4 unicast
route-policy PASS-ALL in
route-policy PASS-ALL out
!
!
neighbor 192.168.5.6
remote-as 65003
egress-engineering
address-family ipv4 unicast
route-policy PASS-ALL in
route-policy PASS-ALL out
!
!
end
```

R5

Complete configuration

```
hostname R5
interface MgmtEth0/0/CPU0/0
shutdown
!
interface GigabitEthernet0/0/0/0
ipv4 address 192.168.2.5 255.255.255.0
!
interface GigabitEthernet0/0/0/1
shutdown
!
interface GigabitEthernet0/0/0/2
shutdown
!
interface GigabitEthernet0/0/0/3
shutdown
!
route-policy PASS-ALL
pass
end-policy
!
router bgp 65002
bgp router-id 192.168.2.5
address-family ipv4 unicast
!
neighbor 192.168.2.4
remote-as 65001
address-family ipv4 unicast
```

```
    route-policy PASS-ALL in
    route-policy PASS-ALL out
  !
!
!
end
```

R6

Complete configuration

```
hostname R6
interface Loopback0
  ipv4 address 192.168.6.6 255.255.255.255
!
interface MgmtEth0/0/CPU0/0
  shutdown
!
interface GigabitEthernet0/0/0/0
  ipv4 address 192.168.3.6 255.255.255.0
!
interface GigabitEthernet0/0/0/1
  ipv4 address 192.168.4.6 255.255.255.0
!
interface GigabitEthernet0/0/0/2
  ipv4 address 192.168.5.6 255.255.255.0
!
interface GigabitEthernet0/0/0/3
  shutdown
!
route-policy PASS-ALL
  pass
end-policy
!
router static
  address-family ipv4 unicast
    172.16.1.3/32 GigabitEthernet0/0/0/0 192.168.3.3
    172.16.1.3/32 GigabitEthernet0/0/0/1 192.168.4.3
  !
!
router bgp 65003
  bgp router-id 192.168.6.6
  address-family ipv4 unicast
  !
  neighbor 172.16.1.3
    remote-as 65001
    ebgp-multihop 255
    update-source Loopback0
    address-family ipv4 unicast
      route-policy PASS-ALL in
      route-policy PASS-ALL out
  !
!
  neighbor 192.168.5.4
    remote-as 65001
    address-family ipv4 unicast
      route-policy PASS-ALL in
      route-policy PASS-ALL out
  !
!
```



APNIC

!
end