

version 4



IEWB-RS Technology Labs

BGP

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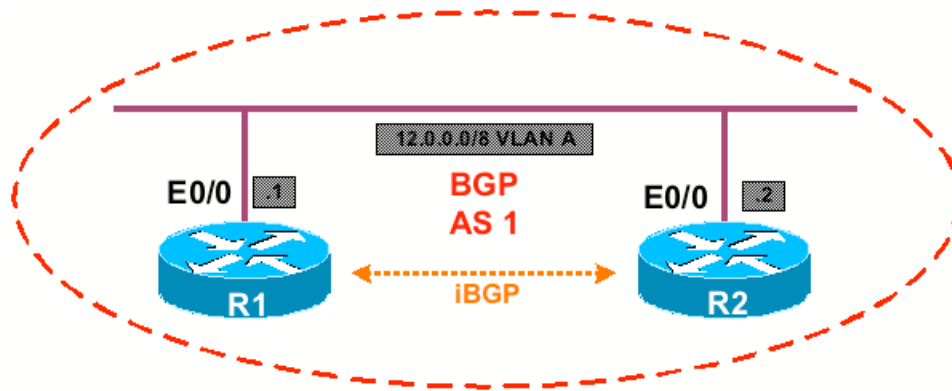
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ESTABLISHMENT OF BGP PEERING RELATIONSHIPS	1
BGP UPDATE SOURCE MISMATCH	6
BGP UPDATE SOURCE MODIFICATION	10
IBGP SYNCHRONIZATION.....	14
TRANSITING NON-BGP SPEAKING DEVICES - REDISTRIBUTION.....	26
TRANSITING NON-BGP SPEAKING DEVICES - TUNNELING	32
BGP BESTPATH SELECTION - WEIGHT.....	38
BGP BESTPATH SELECTION – LOCAL PREFERENCE	43
BGP BESTPATH SELECTION – LOCAL PREFERENCE	48
BGP BESTPATH SELECTION – MED.....	53
BGP BESTPATH SELECTION – ORIGIN	58
BGP NEXT-HOP PROCESSING – NEXT-HOP-SELF.....	63
BGP NEXT-HOP PROCESSING – MANUAL MODIFICATION	66
BGP NEXT-HOP PROCESSING – IGP REDISTRIBUTION.....	69
BGP COMMUNITES – NO-EXPORT.....	73
BGP COMMUNITES – NO-ADVERTISE	79
BGP ROUTE REFLECTION.....	86
BGP CONFEDERATION	92
BGP COMMUNITIES – LOCAL AS.....	98
BGP REGULAR EXPRESSIONS	105
BGP OUTBOUND ROUTE FILTERING (ORF).....	112
BGP AGGREGATION.....	119
BGP AGGREGATION – SUMMARY ONLY	125
BGP AGGREGATION – SUPPRESS MAP	130
BGP AGGREGATION – UNSUPPRESS MAP	137
BGP AGGREGATION – AS-SET	145
BGP AGGREGATION – ADVERTISE MAP	149
BGP ALLOW AS IN	153

Establishment of BGP Peering Relationships

Objective: Configure a BGP peering relationship between R1 and R2



Directions

- Configure R1's interface Ethernet0/0 with the IP address of 12.0.0.1/8
- Configure R2's interface Ethernet0/0 with the IP address of 12.0.0.2/8
- Configure R1 and R2 to be in BGP AS 1
- Configure a BGP neighbor statement on R1 specifying R2's interface Ethernet0/0 as the remote peer
- Configure a BGP neighbor statement on R2 specifying R1's interface Ethernet0/0 as the remote peer

Ask Yourself

- What are the requirements of establishing a BGP peering relationship?
- What does BGP use for a transport?
- Who is the TCP client of a BGP session? The TCP server?
- How can you verify this?
- What affects the client/server relationship?
- Change R1's BGP router-id to 12.0.0.3, what happens?

Final Configuration

```
R1:
interface Ethernet0/0
 ip address 12.0.0.1 255.0.0.0
!
router bgp 1
 bgp router-id 12.0.0.3
 neighbor 12.0.0.2 remote-as 1
```

R2:

```
interface Ethernet0/0
 ip address 12.0.0.2 255.0.0.0
!
router bgp 1
 neighbor 12.0.0.1 remote-as 1
```

Verification

R1#**debug ip packet detail**

R1#**clear ip bgp ***

%BGP-5-ADJCHANGE: neighbor 12.0.0.2 Down User reset

! R2 initiates BGP session with a TCP SYN, R2 is the client

IP: s=12.0.0.2 (Ethernet0/0), d=12.0.0.1 (Ethernet0/0), len 44, rcvd 3

TCP src=11001, dst=179, seq=41546943, ack=0, win=16384
SYN

! R1 replies with TCP SYN ACK, R1 is the server

IP: tableid=0, s=12.0.0.1 (local), d=12.0.0.2 (Ethernet0/0), routed via RIB

! R2 replies with TCP ACK, connection is open

IP: s=12.0.0.2 (Ethernet0/0), d=12.0.0.1 (Ethernet0/0), len 40, rcvd 3

TCP src=11001, dst=179, seq=41546944, ack=3175302907, win=16384 ACK

%BGP-5-ADJCHANGE: neighbor 12.0.0.2 Up

R2#**debug ip packet detail**

R2#**clear ip bgp ***

%BGP-5-ADJCHANGE: neighbor 12.0.0.1 Down User reset

! R2 initiates BGP session with a TCP SYN, R2 is the client

IP: tableid=0, s=12.0.0.2 (local), d=12.0.0.1 (Ethernet0/0), routed via RIB

! R1 replies with TCP SYN ACK, R1 is the server

IP: s=12.0.0.1 (Ethernet0/0), d=12.0.0.2 (Ethernet0/0), len 44, rcvd 3

```
TCP src=179, dst=11002, seq=3515518643, ack=1299268873,
win=16384 ACK SYN
```

```
! R2 replies with TCP ACK, connection is open
```

```
IP: tableid=0, s=12.0.0.2 (local), d=12.0.0.1
(Ethernet0/0), routed via RIB
```

```
%BGP-5-ADJCHANGE: neighbor 12.0.0.1 Up
```

```
R1#show ip bgp summary
```

```
BGP router identifier 12.0.0.1, local AS number 1
```

```
BGP table version is 1, main routing table version 1
```

```
Neighbor      V   AS MsgRcvd MsgSent   TblVer  InQ OutQ
Up/Down    State/PfxRcd
```

```
12.0.0.2      4   1     41     41       1    0   0
00:01:34      0
```

```
R2#show ip bgp summary
```

```
BGP router identifier 12.0.0.2, local AS number 1
```

```
BGP table version is 1, main routing table version 1
```

```
Neighbor      V   AS MsgRcvd MsgSent   TblVer  InQ OutQ
Up/Down    State/PfxRcd
```

```
12.0.0.1      4   1     41     41       1    0   0
00:01:12      0
```

```
R2#
```

```
After changing R1's router ID to 12.0.0.3
```

```
R1#debug ip packet detail
```

```
! R1 initiates BGP session with a TCP SYN
```

```
! R1 has the higher router-id, now it is the client
```

```
IP: tableid=0, s=12.0.0.1 (local), d=12.0.0.2
(Ethernet0/0), routed via RIB
```

```
! R2 replies with TCP SYN ACK, R2 is the server
```

```
IP: s=12.0.0.2 (Ethernet0/0), d=12.0.0.1 (Ethernet0/0), len
44, rcvd 3
```

```
TCP src=179, dst=11002, seq=373831508, ack=1271983282,
```

```
win=16384 ACK SYN
```

```
! R1 replies with TCP ACK, connection is open
```

```
IP: tableid=0, s=12.0.0.1 (local), d=12.0.0.2  
(Ethernet0/0), routed via RIB
```

```
R2#debug ip packet detail
```

```
! R1 initiates BGP session with a TCP SYN
```

```
! R1 has the higher router-id, now it is the client
```

```
IP: s=12.0.0.1 (Ethernet0/0), d=12.0.0.2 (Ethernet0/0), len  
44, rcvd 3
```

```
TCP src=11002, dst=179, seq=1271983281, ack=0,  
win=16384 SYN
```

```
! R2 replies with TCP SYN ACK, R2 is the server
```

```
IP: tableid=0, s=12.0.0.2 (local), d=12.0.0.1  
(Ethernet0/0), routed via RIB
```

```
! R1 replies with TCP ACK, connection is open
```

```
IP: s=12.0.0.1 (Ethernet0/0), d=12.0.0.2 (Ethernet0/0), len  
40, rcvd 3
```

```
TCP src=11002, dst=179, seq=1271983282, ack=373831509,  
win=16384 ACK
```

```
R1#show ip bgp summary
```

```
BGP router identifier 12.0.0.3, local AS number 1
```

```
BGP table version is 1, main routing table version 1
```

```
Neighbor      V  AS  MsgRcvd  MsgSent  TblVer  InQ  OutQ  
Up/Down  State/PfxRcd
```

```
12.0.0.2      4   1    74      74       1    0    0  
00:02:24      0
```

```
R2#show ip bgp summary
```

```
BGP router identifier 12.0.0.2, local AS number 1
```

```
BGP table version is 1, main routing table version 1
```

```
Neighbor      V  AS  MsgRcvd  MsgSent  TblVer  InQ  OutQ  
Up/Down  State/PfxRcd
```

```
12.0.0.1      4   1    73      73       1    0    0
```

00:01:31

0

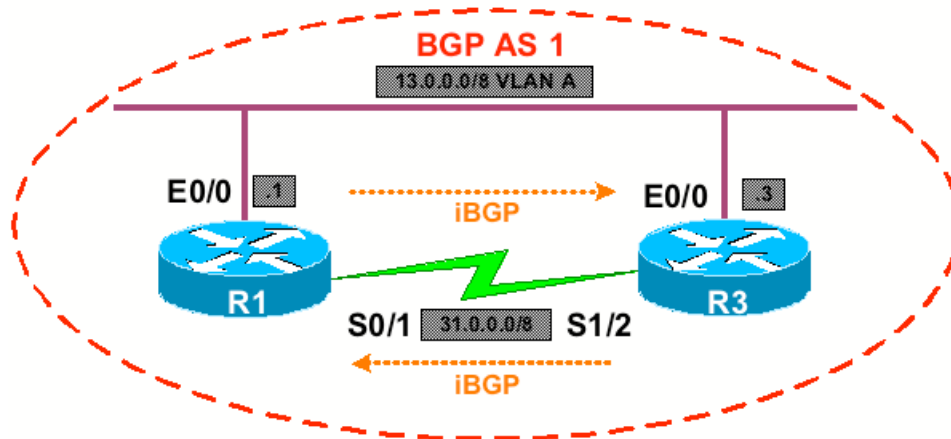


Recommended Reading

[Explanation of the Three-Way Handshake via TCP/IP](#)

BGP Update Source Mismatch

Objective: Configure a BGP peering relationship between R1 and R3. R1 should peer with R3's Ethernet interface, while R3 should peer with R1's Serial interface



Directions

- Configure the IP addressing per the diagram
- Configure R1 and R3 in BGP AS 1
- Configure R1 to peer with R3's interface Ethernet0/0
- Configure R3 to peer with R1's interface Serial1/2

Ask Yourself

- What source IP address does a BGP speaker use for peering?
- How does this affect the establishment of a peering relationship?
- Can this address be modified? If so, how?
- What are the advantages of modifying this address?

Final Configuration

```
R1:
interface Ethernet0/0
 ip address 13.0.0.1 255.0.0.0
!
interface Serial0/1
 ip address 31.0.0.1 255.0.0.0
 clockrate 64000
!
router bgp 1
```

```
neighbor 13.0.0.3 remote-as 1
```

R3:

```
interface Ethernet0/0
 ip address 13.0.0.3 255.0.0.0
!
interface Serial1/2
 ip address 31.0.0.3 255.0.0.0
!
router bgp 1
 neighbor 31.0.0.1 remote-as 1
```

Verification**R1#debug ip packet detail**

IP packet debugging is on (detailed)

R1#debug ip bgp

BGP debugging is on

! R3 sends R1 a TCP SYN to start a BGP session

IP: s=31.0.0.3 (Serial1/2/1), d=31.0.0.1 (Serial1/2/1), len 44, rcvd 3

TCP src=11009, dst=179, seq=3354450520, ack=0, win=16384
SYN

! R1 rejects the connection with ACK RST, it has no peering to 31.0.0.3

IP: tableid=0, s=31.0.0.1 (local), d=31.0.0.3 (Serial1/2/1), routed via RIB

IP: s=31.0.0.1 (local), d=31.0.0.3 (Serial1/2/1), len 40, sending

TCP src=179, dst=11009, seq=0, ack=3354450521, win=0 **ACK**
RST

! R1 tries to start a BGP session with R3

BGP: 13.0.0.3 went from Idle to Active

BGP: 13.0.0.3 open active, delay 6880ms

BGP: 13.0.0.3 open active, local address 13.0.0.1

IP: tableid=0, s=13.0.0.1 (local), d=13.0.0.3 (Ethernet0/0), routed via RIB

! R3 rejects the connection with ACK RST, it has no peering to

```
13.0.0.1
IP: tableid=0, s=13.0.0.3 (Ethernet0/0), d=13.0.0.1
(Ethernet0/0), routed via RIB
IP: s=13.0.0.3 (Ethernet0/0), d=13.0.0.1 (Ethernet0/0), len
40, rcvd 3
TCP src=179, dst=11020, seq=0, ack=123733113, win=0 ACK
RST
BGP: 13.0.0.3 open failed: Connection refused by remote host
```

```
R3#debug ip packet detail
```

```
IP packet debugging is on (detailed)
```

```
R3#debug ip bgp
```

```
BGP debugging is on
```

```
! R3 tries to start a BGP session with R1
BGP: 31.0.0.1 went from Idle to Active
BGP: 31.0.0.1 open active, delay 8928ms
BGP: 31.0.0.1 open active, local address 31.0.0.3
IP: tableid=0, s=31.0.0.3 (local), d=31.0.0.1 (Serial1/2),
routed via RIB
! R1 rejects the connection with ACK RST, it has no peering to
31.0.0.3
IP: tableid=0, s=31.0.0.1 (Serial1/2), d=31.0.0.3 (Serial1/2),
routed via RIB
IP: s=31.0.0.1 (Serial1/2), d=31.0.0.3 (Serial1/2), len 40,
rcvd 3
TCP src=179, dst=11009, seq=0, ack=3354450521, win=0 ACK
RST
BGP: 31.0.0.1 open failed: Connection refused by remote host
```

Breakdown

When establishing a BGP peering relationship, the source IP address used for BGP traffic by default is based on the IP address of the outgoing interface used to reach the destination. When a BGP speaker receives a BGP packet, it checks the configured remote-peer statements to see if a peering has been configured for this neighbor. If the BGP packet received has a source IP address that is different from a configured peer, it has no way to associate the packet with the peer in question, and hence the connection is refused.

In this scenario R1 is sending BGP packets to R3 using the source IP address of 13.0.0.1 (the IP address of the outgoing interface), while R3 is expecting a BGP peering to come from 31.0.0.1. When R1 attempts to initiate the TCP session to R3, R3 refuses it, as seen by the ACK RST packet sent from R3 to R1. Likewise

R3 is sending BGP packets to R1 sourced from the IP address 31.0.0.3 (the IP address of its outgoing interface), while R1 expects the BGP peering to come from 13.0.0.3. When R3 attempts to initiate the TCP session to R1, the connection is refused.

This exercise demonstrates that the TCP server (the peer receiving the connection attempt) must agree on what address the BGP peering will be accepted from. In the case that a mismatch occurs, the connection will be refused.

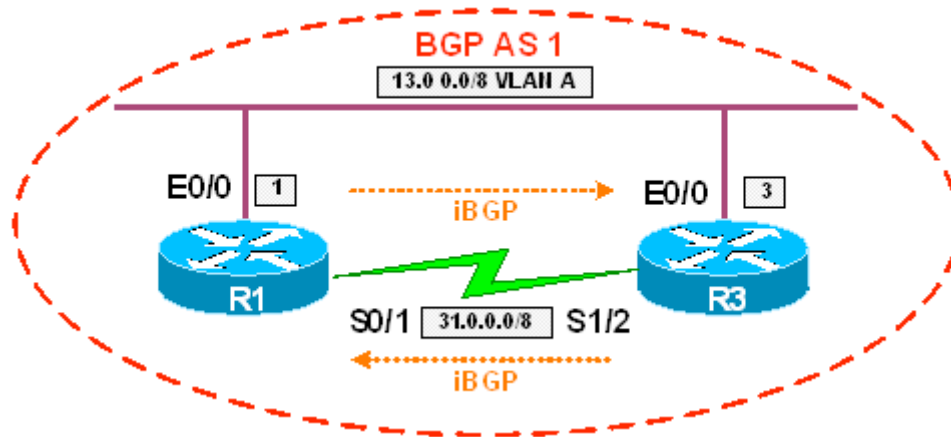


Recommended Reading

[Configuring BGP: Configuring BGP Neighbors](#)

BGP Update Source Modification

Objective: Configure a BGP peering relationship between R1 and R3. R1 should peer with R3's Ethernet interface, while R3 should peer with R1's Serial interface. R1 should use the source address 31.0.0.1 when sending BGP packets to R3



Directions

- Configure the IP addressing per the diagram
- Configure R1 and R3 in BGP AS 1
- Configure R1 to peer with R3's interface Ethernet0/0
- Configure R3 to peer with R1's interface Serial0/1
- Configure R1 to use the ip address 31.0.0.1 when sending BGP packets to R3

Ask Yourself

- What source IP address does a BGP speaker use for peering?
- How does this affect the establishment of a peering relationship?
- Can this address be modified? If so, how?
- What are the advantages of modifying this address?

Final Configuration

R1:

```
interface Ethernet0/0
 ip address 13.0.0.1 255.0.0.0
!
interface Serial0/1
 ip address 31.0.0.1 255.0.0.0
!
```

```
router bgp 1
  neighbor 13.0.0.3 remote-as 1
  neighbor 13.0.0.3 update-source Serial0/1
```

R3:

```
interface Ethernet0/0
  ip address 13.0.0.3 255.0.0.0
!
interface Serial1/2
  ip address 31.0.0.3 255.0.0.0
  clock rate 64000
!
router bgp 1
  neighbor 31.0.0.1 remote-as 1
```

Verification

```
R1#debug ip packet detail
```

```
IP packet debugging is on (detailed)
```

```
! R1 sends R3 TCP SYN to start the BGP session
```

```
! Source of the packet is 31.0.0.1 due to the update-source command
```

```
IP: tableid=0, s=31.0.0.1 (local), d=13.0.0.3 (Ethernet0/0), routed via RIB
```

```
! R3 was expecting it from this address, so it replies with ACK SYN
```

```
IP: s=13.0.0.3 (Serial0/1), d=31.0.0.1 (Serial0/1), len 44, rcvd 3
```

```
    TCP src=179, dst=11084, seq=2501470792, ack=2524207564, win=16384 ACK SYN
```

```
! R1 replies with ACK, the BGP session is established
```

```
IP: tableid=0, s=31.0.0.1 (local), d=13.0.0.3 (Ethernet0/0), routed via RIB
```

```
%BGP-5-ADJCHANGE: neighbor 13.0.0.3 Up
```

```
R3#debug ip packet detail
```

```
IP packet debugging is on (detailed)
```

```
! R3 sends TCP SYN to 31.0.0.1 to initiate BGP session with R1
```

```
BGP: 31.0.0.1 open active, local address 31.0.0.3
```

```
IP: tableid=0, s=31.0.0.3 (local), d=31.0.0.1 (Serial1/2),  
routed via RIB
```

```
! R1 denies the connection and responds with ACK RST
```

```
! R1 expected the connection from 13.0.0.3
```

```
IP: tableid=0, s=31.0.0.1 (Serial1/2), d=31.0.0.3  
(Serial1/2), routed via RIB
```

```
IP: s=31.0.0.1 (Serial1/2), d=31.0.0.3 (Serial1/2), len 40,  
rcvd 3
```

```
TCP src=179, dst=11073, seq=0, ack=2264277676, win=0  
ACK RST
```

```
BGP: 31.0.0.1 open failed: Connection refused by remote  
host
```

```
! R1 sends TCP SYN to 13.0.0.3 to initiate BGP session with R1
```

```
IP: s=31.0.0.1 (Ethernet0/0), d=13.0.0.3 (Ethernet0/0), len  
44, rcvd 3
```

```
TCP src=11084, dst=179, seq=2524207563, ack=0,  
win=16384 SYN
```

```
! Since it came from the address that R3 expected, R3  
responds with SYN ACK
```

```
IP: tableid=0, s=13.0.0.3 (local), d=31.0.0.1 (Serial1/2),  
routed via RIB
```

```
! R1 responds with ACK, BGP session is established
```

```
IP: tableid=0, s=31.0.0.1 (Ethernet0/0), d=13.0.0.3  
(Ethernet0/0), routed via RIB
```

```
IP: s=31.0.0.1 (Ethernet0/0), d=13.0.0.3 (Ethernet0/0), len  
40, rcvd 3
```

```
TCP src=11084, dst=179, seq=2524207564, ack=2501470793,  
win=16384 ACK
```

```
%BGP-5-ADJCHANGE: neighbor 31.0.0.1 Up
```

Breakdown

When establishing a BGP peering relationship, the source IP address used for BGP traffic by default is based on the IP address of the outgoing interface used to reach the destination. When a BGP speaker receives a BGP packet, it checks the configured remote-peer statements so see if a peering has been configured for this neighbor. If the BGP packet received has a source IP address that is different from a configured peer, it has no way to associate the packet with the peer in question, and hence the connection is refused.

In this scenario R1 is sending BGP packets to R3's address 13.0.0.3 from the modified source address 31.0.0.1. Since R3 is expecting a peering to be coming from 31.0.0.1, the connection is successful when established from R1. However, when R3 attempts to start a connection to R1, it uses the default source address of 31.0.0.3. Since R1 is expecting the peering to be initiated from 13.0.0.3, R1 replies to 31.0.0.3 with a TCP **ACK RST**, and the connection is refused. Note that when R1 initiates the session to R3, R3 responds from the address 31.0.0.3. Although R1 does not have a peering configured to that address the TCP session can continue, as R1 is the TCP client of R3.

This exercise demonstrates that the TCP server (the peer receiving the connection attempt) must agree on what address the peering will be accepted from, and how to modify the source of updates to meet this requirement. In the case that a mismatch occurs it is seen that the connection will be refused.

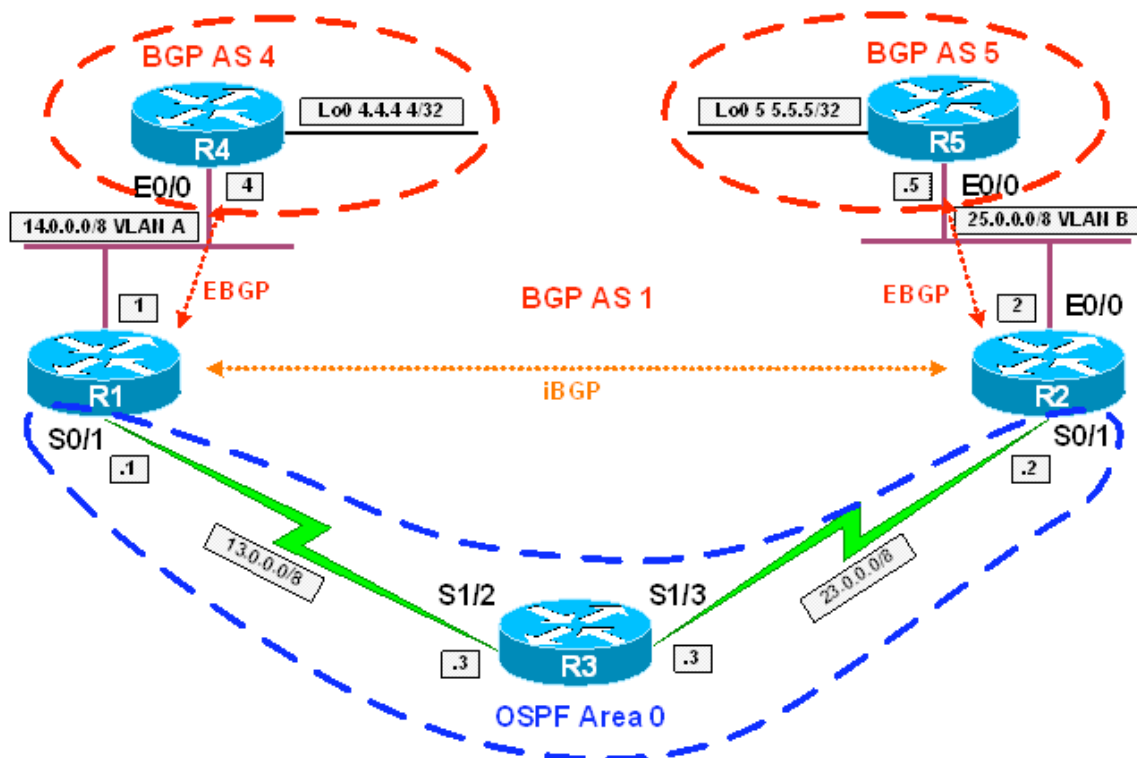


Recommended Reading

[Configuring BGP: Configuring BGP Neighbors](#)

iBGP Synchronization

Objective: Configure BGP per the diagram to obtain connectivity from AS 1 to R4 and R5's loopback interfaces. R4 and R5 should have static default routes pointing towards R1 and R2 respectively. BGP synchronization should be enabled on R1 and R2



Directions

- Configure the IP addressing on R1, R2, R3, R4, and R5 per the diagram
- Configure OSPF area 0 on the Serial links between R1 and R3 & R2 and R3
- Advertise VLAN A and VLAN B into OSPF on R1 and R2 respectively
- Configure static default routes on R4 and R5 pointing to R1 and R2 respectively
- Configure R1 and R2 in BGP AS 1
- Configure R4 in BGP AS 4
- Configure R5 in BGP AS 5
- Configure an iBGP peering between R1 and R2
- Configure an EBGP peering R1 and R4
- Configure an EBGP peering between R2 and R5
- Advertise R4's Loopback0 into BGP
- Advertise R5's Loopback0 into BGP
- Disable synchronization on R1 and R2, what happens?

- Redistribute R4 and R5's loopback interfaces into OSPF on R1 and R2 respectively, what happens?

Ask Yourself

- What is BGP synchronization?
- What problem is it designed to prevent?
- How does meeting the synchronization rule prevent this problem?
- When can you safely disable synchronization?
- Why would you want to disable synchronization?

Final Configuration

R1:

```
interface Ethernet0/0
 ip address 14.0.0.1 255.0.0.0
!
interface Serial0/1
 ip address 13.0.0.1 255.0.0.0
!
router ospf 1
 network 13.0.0.1 0.0.0.0 area 0
 network 14.0.0.1 0.0.0.0 area 0
!
router bgp 1
 synchronization
 neighbor 14.0.0.4 remote-as 4
 neighbor 23.0.0.2 remote-as 1
```

R2:

```
interface Ethernet0/0
 ip address 25.0.0.2 255.0.0.0
!
interface Serial0/1
 ip address 23.0.0.2 255.0.0.0
!
router ospf 1
 network 23.0.0.2 0.0.0.0 area 0
 network 25.0.0.2 0.0.0.0 area 0
!
router bgp 1
```

```
synchronization
neighbor 13.0.0.1 remote-as 1
neighbor 25.0.0.5 remote-as 5
```

R3:

```
interface Serial1/2
 ip address 13.0.0.3 255.0.0.0
 clock rate 64000
!
interface Serial1/3
 ip address 23.0.0.3 255.0.0.0
 clock rate 64000
!
router ospf 1
 network 13.0.0.3 0.0.0.0 area 0
 network 23.0.0.3 0.0.0.0 area 0
```

R4:

```
interface Loopback0
 ip address 4.4.4.4 255.255.255.255
!
interface Ethernet0/0
 ip address 14.0.0.4 255.0.0.0
!
router bgp 4
 network 4.4.4.4 mask 255.255.255.255
 neighbor 14.0.0.1 remote-as 1
!
ip route 0.0.0.0 0.0.0.0 14.0.0.1
```

R5:

```
interface Loopback0
 ip address 5.5.5.5 255.255.255.255
!
interface Ethernet0/0
 ip address 25.0.0.5 255.0.0.0
!
router bgp 5
 network 5.5.5.5 mask 255.255.255.255
```

```

neighbor 25.0.0.2 remote-as 1
!
ip route 0.0.0.0 0.0.0.0 25.0.0.2

```

Verification

Synchronization On, Before Redistribution

R1#**show ip bgp**

```

BGP table version is 4, local router ID is 14.0.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
*> 4.4.4.4/32 0 4 i	14.0.0.4	0	
* i5.5.5.5/32 0 5 i	25.0.0.5	0	100

R1#**show ip bgp 5.5.5.5**

```

BGP routing table entry for 5.5.5.5/32, version 4
Paths: (1 available, no best path)
Flag: 0x820
    Not advertised to any peer
    5
    25.0.0.5 (metric 855) from 23.0.0.2 (25.0.0.2)
    Origin IGP, metric 0, localpref 100, valid, internal,
    not synchronized

```

R2#**show ip bgp**

```

BGP table version is 4, local router ID is 25.0.0.2
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
------------------------	----------	--------	--------

```
* i4.4.4.4/32      14.0.0.4      0    100
0 4 i
*> 5.5.5.5/32     25.0.0.5      0
0 5 i
```

R2#**show ip bgp 4.4.4.4**

BGP routing table entry for 4.4.4.4/32, version 4

Paths: (1 available, no best path)

```
Not advertised to any peer
4
14.0.0.4 (metric 855) from 13.0.0.1 (14.0.0.1)
Origin IGP, metric 0, localpref 100, valid, internal,
not synchronized
```

Synchronization Off, Before Redistribution

R1#**conf t**

Enter configuration commands, one per line. End with
CNTL/Z.

R1(config)#**router bgp 1**

R1(config-router)#**no synchronization**

R1(config-router)#**end**

R1#

R1#**show ip bgp**

```
BGP table version is 5, local router ID is 14.0.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf
*> 4.4.4.4/32	14.0.0.4	0	
0 4 i			
*>i5.5.5.5/32	25.0.0.5	0	100
0 5 i			

R1#**show ip bgp neighbors 14.0.0.4 advertised-routes**

```
BGP table version is 5, local router ID is 14.0.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
```

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*>i5.5.5.5/32 0 5 i	25.0.0.5	0	100

R4#**show ip route 5.5.5.5**

Routing entry for 5.5.5.5/32

Known via "bgp 4", distance 20, metric 0

Tag 1, type external

Last update from 14.0.0.1 00:02:16 ago

Routing Descriptor Blocks:

* 14.0.0.1, from 14.0.0.1, 00:02:16 ago

Route metric is 0, traffic share count is 1

AS Hops 2

R4#**debug ip icmp**

ICMP packet debugging is on

R4#**ping 5.5.5.5**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:

U.U.U

Success rate is 0 percent (0/5)

ICMP: dst (14.0.0.4) host unreachable rcv from 13.0.0.3

R2#**conf t**

Enter configuration commands, one per line. End with CNTL/Z.

R2(config)#**router bgp 1**

R2(config-router)#**no synchronization**

R2#

R2#**show ip bgp**

BGP table version is 5, local router ID is 25.0.0.2

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*>i4.4.4.4/32 0 4 i	14.0.0.4	0	100
*> 5.5.5.5/32 0 5 i	25.0.0.5	0	

R2#show ip bgp neighbors 25.0.0.5 advertised-routes

BGP table version is 5, local router ID is 25.0.0.2
 Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
 r RIB-failure, S Stale
 Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*>i4.4.4.4/32 0 4 i	14.0.0.4	0	100

R5#show ip route 4.4.4.4

Routing entry for 4.4.4.4/32
 Known via "bgp 5", distance 20, metric 0
 Tag 1, type external
 Last update from 25.0.0.2 00:03:47 ago
 Routing Descriptor Blocks:
 * 25.0.0.2, from 25.0.0.2, 00:03:47 ago
 Route metric is 0, traffic share count is 1
 AS Hops 2

R5#debug ip icmp

ICMP packet debugging is on

R5#ping 4.4.4.4

Type escape sequence to abort.
 Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
 U.U.U
 Success rate is 0 percent (0/5)
 ICMP: dst (25.0.0.5) host unreachable rcv from 23.0.0.3

Synchronization On, After Redistribution

```
R1#conf t
Enter configuration commands, one per line. End with
CNTL/Z.
R1(config)#ip prefix-list R4_LOOPBACK permit 4.4.4.4/32
R1(config)#route-map R4_LOOPBACK permit 10
R1(config-route-map)#match ip address prefix-list
R4_LOOPBACK
R1(config-route-map)#router ospf 1
R1(config-router)#redistribute bgp 1 subnets route-map
R4_LOOPBACK
R1(config-router)#router bgp 1
R1(config-router)#synchronization
R1(config-router)#end
R1#
```

```
R2#conf t
Enter configuration commands, one per line. End with
CNTL/Z.
R2(config)#ip prefix-list R5_LOOPBACK permit 5.5.5.5/32
R2(config)#route-map R5_LOOPBACK permit 10
R2(config-route-map)#match ip address prefix-list
R5_LOOPBACK
R2(config-route-map)#router ospf 1
R2(config-router)#redistribute bgp 1 subnets route-map
R5_LOOPBACK
R2(config-router)#router bgp 1
R2(config-router)#synchronization
R2(config-router)#end
```

```
R1#show ip route 5.5.5.5
Routing entry for 5.5.5.5/32
  Known via "ospf 1", distance 110, metric 1
  Tag 5, type extern 2, forward metric 855
  Last update from 13.0.0.3 on Serial0/1, 00:01:43 ago
  Routing Descriptor Blocks:
    * 13.0.0.3, from 25.0.0.2, 00:01:43 ago, via Serial0/1
      Route metric is 1, traffic share count is 1
```

```
R1#show ip bgp
BGP table version is 8, local router ID is 14.0.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```


r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*> 4.4.4.4/32	14.0.0.4	0	
0 4 i			
r>i5.5.5.5/32	25.0.0.5	0	100
0 5 i			

R1#show ip bgp 5.5.5.5

BGP routing table entry for 5.5.5.5/32, version 8

Paths: (1 available, best #1, table Default-IP-Routing-Table, RIB-failure(17))

Advertised to non peer-group peers:

14.0.0.4

5

25.0.0.5 (metric 855) from 23.0.0.2 (25.0.0.2)

Origin IGP, metric 0, localpref 100, valid, internal, synchronized, best

R4#show ip route 5.5.5.5

Routing entry for 5.5.5.5/32

Known via "bgp 4", distance 20, metric 0

Tag 1, type external

Last update from 14.0.0.1 00:00:57 ago

Routing Descriptor Blocks:

* 14.0.0.1, from 14.0.0.1, 00:00:57 ago

Route metric is 0, traffic share count is 1

AS Hops 2

R4#ping 5.5.5.5

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 60/61/69 ms

R2#show ip route 4.4.4.4

Routing entry for 4.4.4.4/32

```

Known via "ospf 1", distance 110, metric 1
Tag 4, type extern 2, forward metric 855
Last update from 23.0.0.3 on Serial0/1, 00:03:23 ago
Routing Descriptor Blocks:
* 23.0.0.3, from 14.0.0.1, 00:03:23 ago, via Serial0/1
  Route metric is 1, traffic share count is 1

```

R2#**show ip bgp**

```

BGP table version is 7, local router ID is 25.0.0.2
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
r>i4.4.4.4/32 0 4 i	14.0.0.4	0	100
*> 5.5.5.5/32 0 5 i	25.0.0.5	0	

R2#**show ip bgp 4.4.4.4**

```

BGP routing table entry for 4.4.4.4/32, version 7
Paths: (1 available, best #1, table Default-IP-Routing-
Table, RIB-failure(17))
  Advertised to non peer-group peers:
    25.0.0.5
  4
    14.0.0.4 (metric 855) from 13.0.0.1 (14.0.0.1)
      Origin IGP, metric 0, localpref 100, valid, internal,
      synchronized, best

```

R5#**show ip route 4.4.4.4**

```

Routing entry for 4.4.4.4/32
  Known via "bgp 5", distance 20, metric 0
  Tag 1, type external
  Last update from 25.0.0.2 00:12:21 ago
  Routing Descriptor Blocks:
  * 25.0.0.2, from 25.0.0.2, 00:12:21 ago
    Route metric is 0, traffic share count is 1
    AS Hops 2

```

```
R5#ping 4.4.4.4
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/61/68 ms
```

Breakdown

In order to prevent non-BGP speaking routers from dropping traffic in the iBGP transit path, the BGP synchronization rule states that an iBGP learned route can not be candidate for best path selection use unless there is a matching IGP route installed. The logic behind this rule is that most likely all routers within the autonomous system run IGP. Therefore, if there is a matching IGP route for the BGP destination, all devices in the autonomous system, even non-BGP speaking routers, will be able to provide transport to the final destination.

Although BGP synchronization is considered a legacy rule, and is disabled by default as of IOS 12.2(8)T, it is important to understand the reason for its initial implementation. Regardless whether BGP synchronization is on or off, all routers in the BGP transit path must still be able to provide transport in the direction of the final destination. This is typically accomplished by ensuring that all routers in the transit path run BGP, and hence would know about the destination via BGP itself. Other methods of providing this transport include redistribution of BGP into IGP, as seen in the above scenario, and by hiding the final destination from the routers in the transit path through the implementation of a virtual private network.

In the above scenario R1 and R2 learn routes from their EBGP neighbors, R4 and R5 respectively, and advertise these routes on to each other. In the first case, when BGP synchronization is enabled, these routes are not seen as best paths on either R1 or R2. The reason why is verified by the `show ip bgp 5.5.5.5` output on R1, and the `show ip bgp 4.4.4.4` output on R2, as the routes are seen as **not synchronized**. This means that there is not a matching IGP route for these iBGP learned routes. Since the routes are not best paths, they are not advertised on to R4 and R5 respectively.

In the next case, synchronization is disabled on R1 and R2. Since the synchronization rule is bypassed, the routes go through the best path selection, and are advertised on to R4 and R5 respectively. From the perspective of R4 and R5 these routes are valid, and are therefore installed. However, when traffic is sent to the final destination, a non-BGP speaking router in the transit path (R3)

drops the traffic because it does not have a route to the final destination. This is verified by the ICMP host unreachable message received from R3. This case dictates that although the route is advertised because synchronization is disabled does not mean that the problem synchronization was designed to prevent was resolved.

In the last case, synchronization is enabled and BGP is redistributed into IGP on R1 and R2. When R1 and R2 learn the BGP routes originated by R4 and R5, matching routes do exist in the IGP table, and the synchronization rule is met. This is verified by the `synchronized` output seen in the `show ip bgp 5.5.5.5` and `show ip bgp 4.4.4.4` commands on R1 and R2 respectively. Since the non-BGP speaking router in the transit path now has an IGP route to the destination, end-to-end transport is achieved.

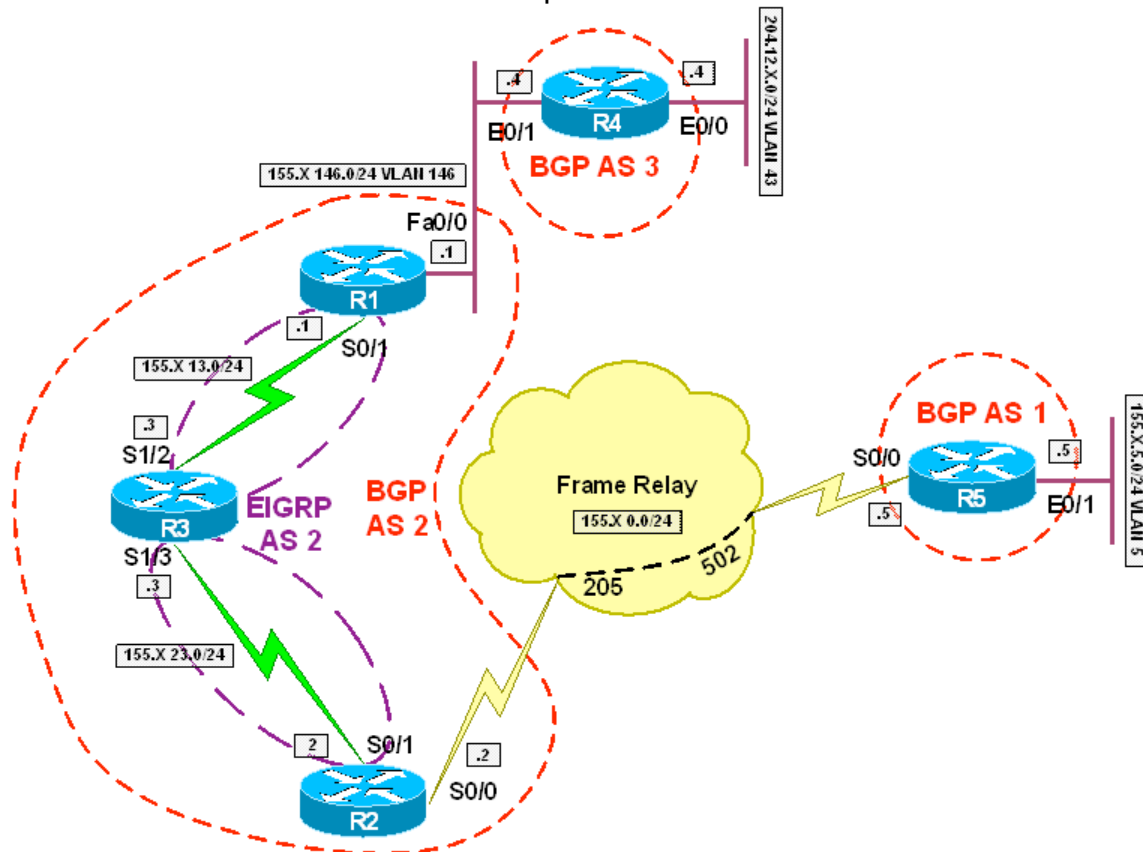


Recommended Reading

[Cisco IOS Command Reference: synchronization](#)

Transiting Non-BGP Speaking Devices - Redistribution

Objective: Configure the network so that hosts on VLAN 5 can reach hosts on VLAN 43. R3 will not participate in BGP routing. Redistribute BGP into IGP in AS 2 to accomplish this



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 2 on the links between R1 & R3 and R2 & R3
- Configure BGP on R1, R2, R4, and R5 per the diagram
- R1 should peer with R2 and R4
- R2 should peer with R5
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4
- Configure BGP to IGP redistribution on R1 and R2 to gain connectivity between R4 and VLAN 4

Final Configuration**R1:**

```
interface FastEthernet0/0
  ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
  ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
  redistribute bgp 2 metric 1 1 1 1 1 route-map BGP2IGP
  network 155.1.13.1 0.0.0.0
  no auto-summary
!
router bgp 2
  neighbor 155.1.23.2 remote-as 2
  neighbor 155.1.23.2 next-hop-self
  neighbor 155.1.146.4 remote-as 3
!
ip prefix-list VLAN46 seq 5 permit 204.12.1.0/24
!
route-map BGP2IGP permit 10
  match ip address prefix-list VLAN46
```

R2:

```
interface FastEthernet0/0
  ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.2 255.255.255.0
  frame-relay interface-dlci 205
!
interface Serial0/1
  ip address 155.1.23.2 255.255.255.0
!
```

```
router eigrp 2
 redistribute bgp 2 metric 1 1 1 1 1 route-map BGP2IGP
 network 155.1.23.2 0.0.0.0
 no auto-summary
!
router bgp 2
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
!
ip prefix-list VLAN5 seq 5 permit 155.1.5.0/24
!
route-map BGP2IGP permit 10
 match ip address prefix-list VLAN5
```

R3:

```
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
interface Serial1/3
 ip address 155.1.23.3 255.255.255.0
 clockrate 64000
!
router eigrp 2
 network 155.1.13.3 0.0.0.0
 network 155.1.23.3 0.0.0.0
 no auto-summary
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 3
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
```

R5:

```

interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2

```

Verification

```
Rack1R4#ping 155.1.5.5 source 204.12.1.4
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:

Packet sent with a source address of 204.12.1.4

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
88/88/92 ms
```

```
Rack1R1#show ip bgp
```

```
<output omitted>
```

Network Weight Path	Next Hop	Metric	LocPrf
r>i155.1.5.0/24 0 1 i	155.1.23.2	0	100
*> 204.12.1.0 0 3 i	155.1.146.4	0	

```
Rack1R2#show ip bgp
```

```
<output omitted>
```

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 0 1 i	155.1.0.5	0	


```
r>i204.12.1.0      155.1.13.1      0    100
0 3 i
```

```
Rack1R4#show ip bgp
```

```
<output omitted>
```

```
   Network          Next Hop          Metric LocPrf
Weight Path
*> 155.1.5.0/24     155.1.146.1
0 2 1 i
*> 204.12.1.0      0.0.0.0          0
32768 i
```

```
Rack1R5#show ip bgp
```

```
<output omitted>
```

```
   Network          Next Hop          Metric LocPrf
Weight Path
*> 155.1.5.0/24     0.0.0.0          0
32768 i
*> 204.12.1.0      155.1.0.2
0 2 3 i
```

```
Rack1R1#show ip route
```

```
<output omitted>
```

```
B    204.12.1.0/24 [20/0] via 155.1.146.4, 00:05:09
    155.1.0.0/24 is subnetted, 4 subnets
C    155.1.146.0 is directly connected, FastEthernet0/0
D    155.1.23.0 [90/21024000] via 155.1.13.3, 00:45:07,
Serial0/1
C    155.1.13.0 is directly connected, Serial0/1
D EX 155.1.5.0 [170/2561024256] via 155.1.13.3,
00:16:11, Serial0/1
```

```
Rack1R2#show ip route
```

```
<output omitted>
```

```
D EX 204.12.1.0/24 [170/2561024256] via 155.1.23.3,
00:04:57, Serial0/1
    155.1.0.0/24 is subnetted, 4 subnets
C    155.1.23.0 is directly connected, Serial0/1
D    155.1.13.0 [90/21024000] via 155.1.23.3, 00:45:11,
Serial0/1
C    155.1.0.0 is directly connected, Serial0/0.1
B    155.1.5.0 [20/0] via 155.1.0.5, 00:20:59
```

Rack1R3#**show ip route**

<output omitted>

D EX 204.12.1.0/24 [170/2560512256] via 155.1.13.1,
00:05:09, Serial1/2

155.1.0.0/24 is subnetted, 3 subnets

C 155.1.23.0 is directly connected, Serial1/3

C 155.1.13.0 is directly connected, Serial1/2

D EX 155.1.5.0 [170/2560512256] via 155.1.23.2,
00:16:35, Serial1/3

Rack1R4#**show ip route**

<output omitted>

C 204.12.1.0/24 is directly connected, Ethernet0/0

155.1.0.0/24 is subnetted, 2 subnets

C 155.1.146.0 is directly connected, Ethernet0/1

B 155.1.5.0 [20/0] via 155.1.146.1, 00:03:34

Rack1R5#**show ip route**

<output omitted>

B 204.12.1.0/24 [20/0] via 155.1.0.2, 00:04:12

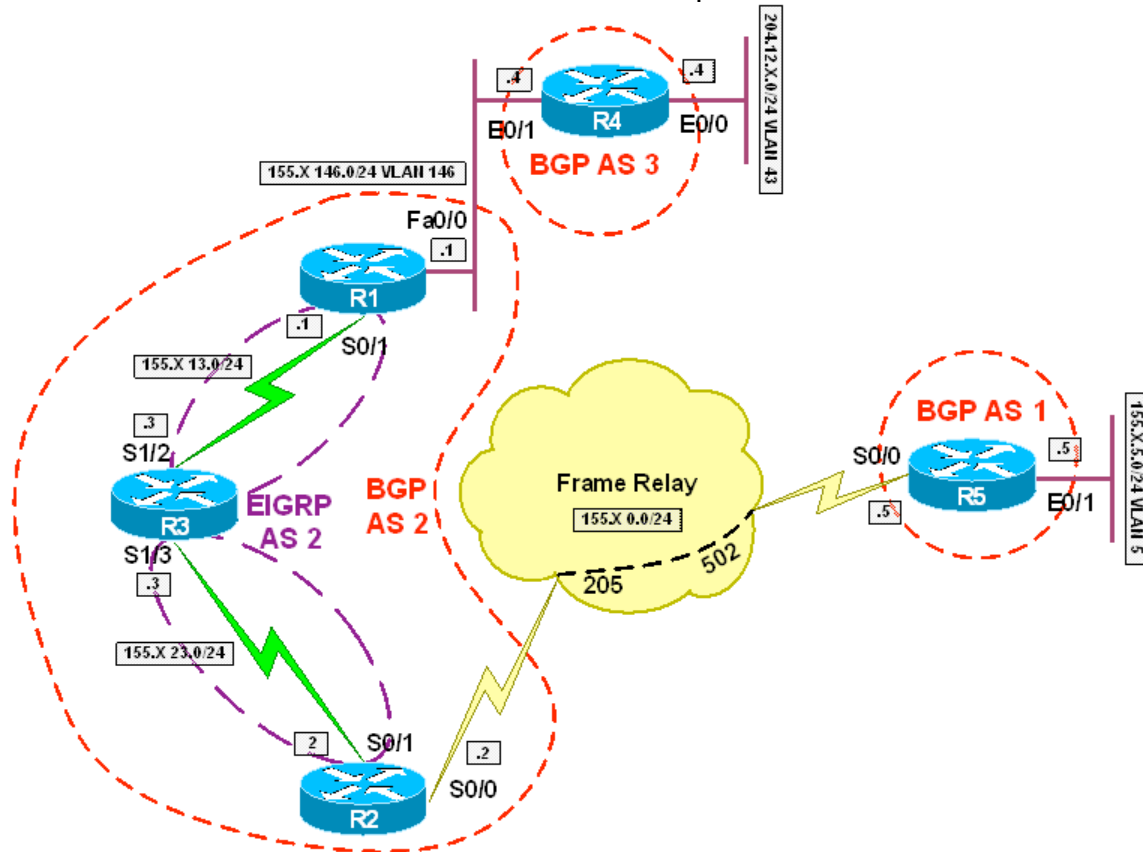
155.1.0.0/24 is subnetted, 2 subnets

C 155.1.0.0 is directly connected, Serial0/0

C 155.1.5.0 is directly connected, Ethernet0/1

Transiting Non-BGP Speaking Devices - Tunneling

Objective: Configure the network so that hosts on VLAN 5 can reach hosts on VLAN 43. R3 will not participate in BGP routing. Configure a GRE tunnel between R1 and R2 to accomplish this



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 2 on the links between R1 & R3 and R2 & R3
- Configure a tunnel between R1 and R2 using the subnet 155.X.12.0/24
- Configure BGP on R1, R2, R4, and R5 per the diagram
- R1 and R2 should peer with each other over the tunnel interface
- R1 should peer with R4
- R2 should peer with R5
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4

Final Configuration

```
R1:
interface Tunnel0
```

```
ip address 155.1.12.1 255.255.255.0
tunnel source 155.1.13.1
tunnel destination 155.1.23.2
!
interface FastEthernet0/0
ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
network 155.1.13.1 0.0.0.0
no auto-summary
!
router bgp 2
neighbor 155.1.12.2 remote-as 2
neighbor 155.1.12.2 next-hop-self
neighbor 155.1.146.4 remote-as 3
```

R2:

```
interface Tunnel0
ip address 155.1.12.2 255.255.255.0
tunnel source 155.1.23.2
tunnel destination 155.1.13.1
!
interface FastEthernet0/0
ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
ip address 155.1.0.2 255.255.255.0
frame-relay interface-dlci 205
!
interface Serial0/1
ip address 155.1.23.2 255.255.255.0
!
router eigrp 2
```

```
network 155.1.23.2 0.0.0.0
no auto-summary
!
router bgp 2
neighbor 155.1.0.5 remote-as 1
neighbor 155.1.12.1 remote-as 2
neighbor 155.1.12.1 next-hop-self
```

R3:

```
interface Serial1/2
ip address 155.1.13.3 255.255.255.0
clockrate 64000
!
interface Serial1/3
ip address 155.1.23.3 255.255.255.0
clockrate 64000
!
router eigrp 2
network 155.1.13.3 0.0.0.0
network 155.1.23.3 0.0.0.0
no auto-summary
```

Rack1R4#

```
interface Ethernet0/0
ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
ip address 155.1.146.4 255.255.255.0
!
router bgp 3
network 204.12.1.0
neighbor 155.1.146.1 remote-as 2
```

Rack1R5#

```
interface Serial0/0
ip address 155.1.0.5 255.255.255.0
encapsulation frame-relay
frame-relay map ip 155.1.0.2 502 broadcast
!
```

```

interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2

```

Verification

Rack1R4#ping 155.1.5.5 source 204.12.1.4

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:

Packet sent with a source address of 204.12.1.4

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 88/88/92 ms

Rack1R4#traceroute 155.1.5.5 source 204.12.1.4

Type escape sequence to abort.

Tracing the route to 155.1.5.5

```

 1 155.1.146.1 0 msec 4 msec 4 msec
 2 155.1.12.2 44 msec 40 msec 44 msec
 3 155.1.0.5 56 msec * 56 msec

```

Rack1R1#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24 0 1 i	155.1.12.2	0	100
*> 204.12.1.0 0 3 i	155.1.146.4	0	

Rack1R2#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
---------	----------	--------	--------

Weight Path

```
*> 155.1.5.0/24      155.1.0.5          0
0 1 i
*>i204.12.1.0      155.1.12.1        0   100
0 3 i
```

Rack1R4#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.146.1		
0 2 1 i			
*> 204.12.1.0	0.0.0.0	0	
32768 i			

Rack1R5#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*> 204.12.1.0	155.1.0.2		
0 2 3 i			

Rack1R1#show ip route

<output omitted>

```
B   204.12.1.0/24 [20/0] via 155.1.146.4, 00:05:09
    155.1.0.0/24 is subnetted, 4 subnets
C   155.1.146.0 is directly connected, FastEthernet0/0
D   155.1.23.0 [90/21024000] via 155.1.13.3, 00:45:07,
    Serial0/1
C   155.1.13.0 is directly connected, Serial0/1
D EX 155.1.5.0 [170/2561024256] via 155.1.13.3,
    00:16:11, Serial0/1
```

Rack1R2#show ip route

<output omitted>

```
D EX 204.12.1.0/24 [170/2561024256] via 155.1.23.3,
    00:04:57, Serial0/1
    155.1.0.0/24 is subnetted, 4 subnets
C   155.1.23.0 is directly connected, Serial0/1
D   155.1.13.0 [90/21024000] via 155.1.23.3, 00:45:11,
    Serial0/1
C   155.1.0.0 is directly connected, Serial0/0.1
```

B 155.1.5.0 [20/0] via 155.1.0.5, 00:20:59

Rack1R3#**show ip route**

<output omitted>

D EX 204.12.1.0/24 [170/2560512256] via 155.1.13.1,
00:05:09, Serial1/2

155.1.0.0/24 is subnetted, 3 subnets

C 155.1.23.0 is directly connected, Serial1/3

C 155.1.13.0 is directly connected, Serial1/2

D EX 155.1.5.0 [170/2560512256] via 155.1.23.2,
00:16:35, Serial1/3

Rack1R4#**show ip route**

<output omitted>

C 204.12.1.0/24 is directly connected, Ethernet0/0

155.1.0.0/24 is subnetted, 2 subnets

C 155.1.146.0 is directly connected, Ethernet0/1

B 155.1.5.0 [20/0] via 155.1.146.1, 00:03:34

Rack1R5#**show ip route**

<output omitted>

B 204.12.1.0/24 [20/0] via 155.1.0.2, 00:04:12

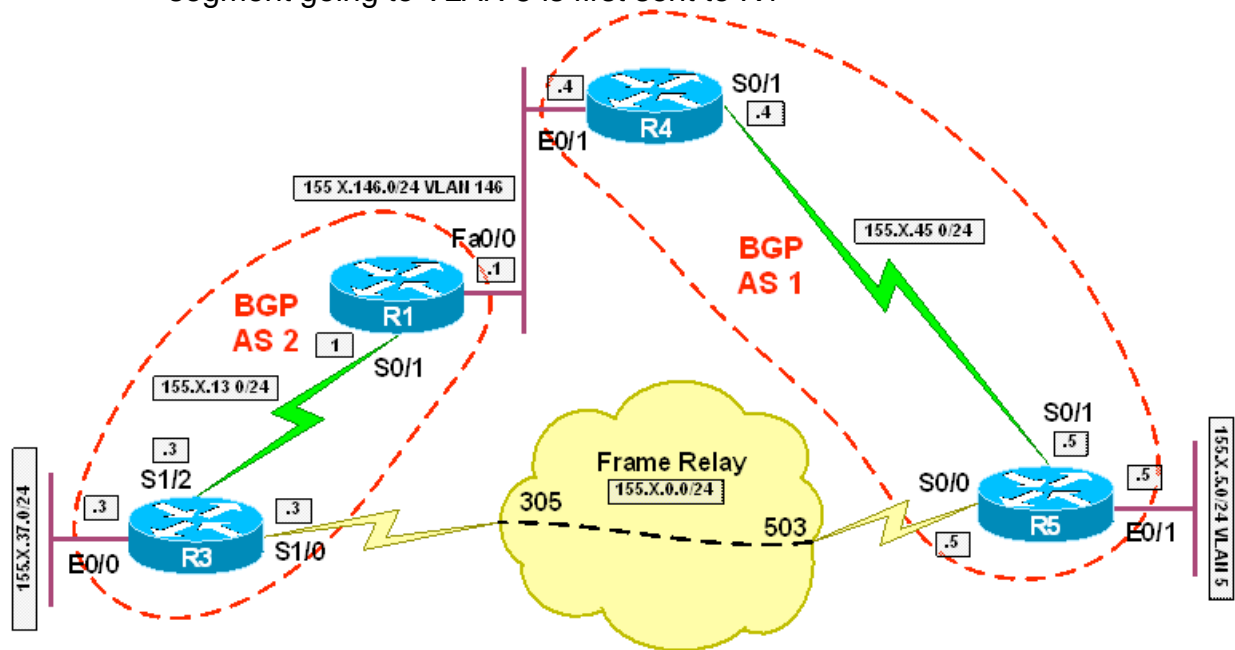
155.1.0.0/24 is subnetted, 2 subnets

C 155.1.0.0 is directly connected, Serial0/0

C 155.1.5.0 is directly connected, Ethernet0/1

BGP Bestpath Selection - Weight

Objective: Configure the BGP Weight attribute on R3 so that traffic from R3's Ethernet segment going to VLAN 5 is first sent to R1



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure BGP weight on R3 so that routes coming from R1 are preferred over those coming from R5

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 1
```

R3:

```
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
router bgp 2
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
 neighbor 155.1.13.1 route-map WEIGHT in
!
route-map WEIGHT permit 10
 set weight 100
```

R4:

```
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
 half-duplex
!
interface Serial0/1
 ip address 155.1.45.4 255.255.255.0
!
router bgp 1
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.3 503 broadcast
 no frame-relay inverse-arp
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.5 255.255.255.0
 clockrate 64000
!
router bgp 1
```

```

network 155.1.5.0 mask 255.255.255.0
neighbor 155.1.0.3 remote-as 2
neighbor 155.1.45.4 remote-as 1
neighbor 155.1.45.4 next-hop-self

```

Verification

```
Rack1R3#traceroute 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

Tracing the route to 155.1.5.5

```

 1 155.1.13.1 16 msec 16 msec 16 msec
 2 155.1.146.4 16 msec 16 msec 16 msec
 3 155.1.45.5 32 msec * 28 msec

```

```
Rack1R3#show ip bgp 155.1.5.0 255.255.255.0
```

BGP routing table entry for 155.1.5.0/24, version 6

Paths: (2 available, best #1, table Default-IP-Routing-Table)

Flag: 0x800

Advertised to update-groups:

2

1

155.1.13.1 from 155.1.13.1 (155.1.146.1)

Origin IGP, metric 0, localpref 100, weight 100, valid, internal, best

1

155.1.0.5 from 155.1.0.5 (155.1.45.5)

Origin IGP, metric 0, localpref 100, valid, external

```
Rack1R1#show ip bgp
```

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.146.4		
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

```
Rack1R3#show ip bgp
```

Network	Next Hop	Metric	LocPrf
Weight Path			
*>i155.1.5.0/24	155.1.13.1	0	100
100 1 i			

```
*          155.1.0.5          0
0 1 i
*> 155.1.37.0/24  0.0.0.0          0
32768 i
```

Rack1R4#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> i155.1.5.0/24 0 i	155.1.45.5	0	100
*> 155.1.37.0/24 0 2 i	155.1.146.1		
* i 0 2 i	155.1.45.5	0	100

Rack1R5#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 32768 i	0.0.0.0	0	
* i155.1.37.0/24 0 2 i	155.1.45.4	0	100
*> 0 2 i	155.1.0.3	0	

Rack1R1#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C    155.1.146.0 is directly connected, FastEthernet0/0
C    155.1.13.0 is directly connected, Serial0/1
B    155.1.5.0 [20/0] via 155.1.146.4, 00:02:39
B    155.1.37.0 [200/0] via 155.1.13.3, 00:02:39
```

Rack1R3#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C    155.1.13.0 is directly connected, Serial1/2
C    155.1.0.0 is directly connected, Serial1/0.1
B    155.1.5.0 [200/0] via 155.1.13.1, 00:02:16
C    155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R4#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
```

```
C      155.1.146.0 is directly connected, Ethernet0/1
B      155.1.5.0 [200/0] via 155.1.45.5, 00:09:03
C      155.1.45.0 is directly connected, Serial0/1
B      155.1.37.0 [20/0] via 155.1.146.1, 00:08:44
```

Rack1R5#**show ip route**

<output omitted>

```
      155.1.0.0/24 is subnetted, 4 subnets
C      155.1.0.0 is directly connected, Serial0/0
C      155.1.5.0 is directly connected, Ethernet0/1
C      155.1.45.0 is directly connected, Serial0/1
B      155.1.37.0 [20/0] via 155.1.0.3, 00:04:47
```

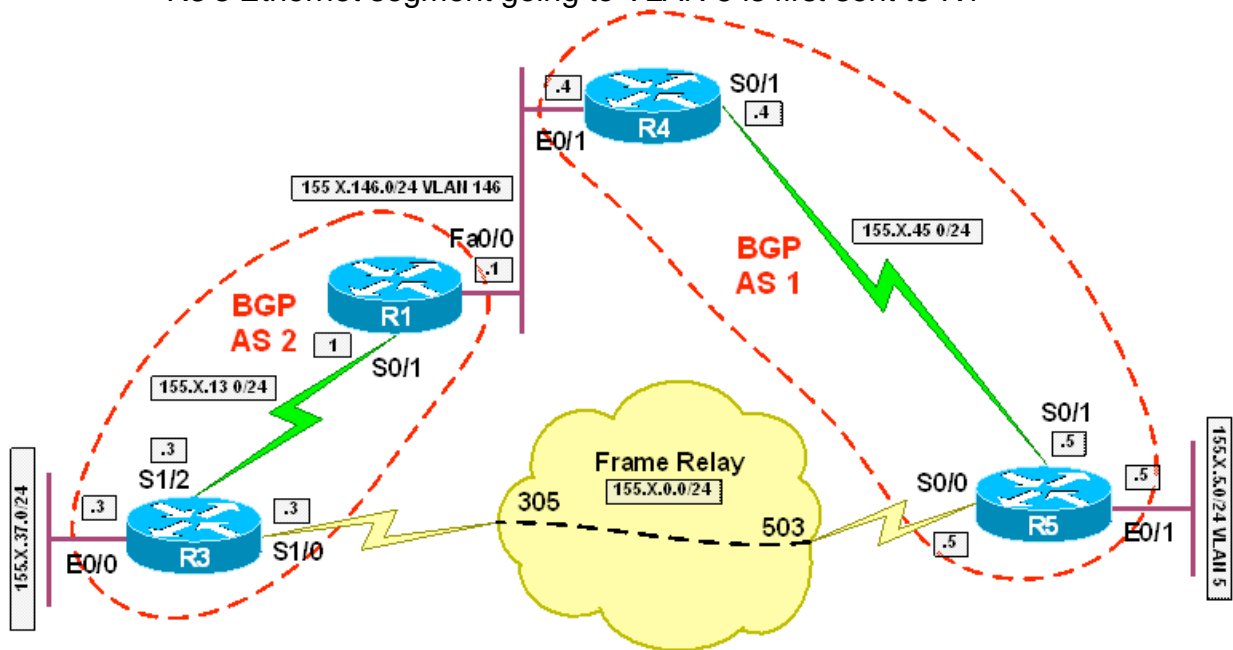


Recommended Reading

[BGP Best Path Selection Algorithm](#)

BGP Bestpath Selection – Local Preference

Objective: Configure the BGP Local Preference attribute in AS 2 so that traffic from R3's Ethernet segment going to VLAN 5 is first sent to R1



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure BGP Local Preference on R3 so that routes coming from R1 are preferred over those coming from R5

Final Configuration

```

R1:
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 1

```

R3:

```
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
router bgp 2
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
 neighbor 155.1.13.1 route-map LOCAL_PREFERENCE in
!
route-map LOCAL_PREFERENCE permit 10
 set local-preference 200
```

R4:

```
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.4 255.255.255.0
!
router bgp 1
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.3 503 broadcast
 no frame-relay inverse-arp
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.5 255.255.255.0
 clockrate 64000
!
router bgp 1
```

```

network 155.1.5.0 mask 255.255.255.0
neighbor 155.1.0.3 remote-as 2
neighbor 155.1.45.4 remote-as 1
neighbor 155.1.45.4 next-hop-self

```

Verification

```
Rack1R3#traceroute 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

Tracing the route to 155.1.5.5

```

 1 155.1.13.1 16 msec 16 msec 16 msec
 2 155.1.146.4 16 msec 16 msec 16 msec
 3 155.1.45.5 32 msec * 28 msec

```

```
Rack1R3#show ip bgp 155.1.5.0
```

BGP routing table entry for 155.1.5.0/24, version 5

Paths: (2 available, best #1, table Default-IP-Routing-Table)

Advertised to update-groups:

```

 2
 1
 155.1.13.1 from 155.1.13.1 (155.1.146.1)
   Origin IGP, metric 0, localpref 200, valid, internal,
  best
 1
 155.1.0.5 from 155.1.0.5 (155.1.45.5)
   Origin IGP, metric 0, localpref 100, valid, external

```

```
Rack1R1#show ip bgp
```

<output omitted>

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	155.1.146.4		
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

```
Rack1R3#show ip bgp
```

<output omitted>

Network	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.13.1	0	200
0 1 i			


```
*          155.1.0.5          0
0 1 i
*> 155.1.37.0/24    0.0.0.0          0
32768 i
```

Rack1R4#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> i155.1.5.0/24	155.1.45.5	0	100
0 1 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			
* i	155.1.45.5	0	100
0 2 i			

Rack1R5#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
* i155.1.37.0/24	155.1.45.4	0	100
0 2 i			
*>	155.1.0.3	0	
0 2 i			

Rack1R1#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C    155.1.146.0 is directly connected, FastEthernet0/0
C    155.1.13.0 is directly connected, Serial0/1
B    155.1.5.0 [20/0] via 155.1.146.4, 00:02:39
B    155.1.37.0 [200/0] via 155.1.13.3, 00:02:39
```

Rack1R3#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C    155.1.13.0 is directly connected, Serial1/2
C    155.1.0.0 is directly connected, Serial1/0.1
B    155.1.5.0 [200/0] via 155.1.13.1, 00:02:16
C    155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R4#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
```

```
C      155.1.13.0 is directly connected, Serial1/2
C      155.1.0.0 is directly connected, Serial1/0.1
B      155.1.5.0 [200/0] via 155.1.13.1, 00:02:16
C      155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R5#**show ip route**

<output omitted>

```
      155.1.0.0/24 is subnetted, 4 subnets
C      155.1.0.0 is directly connected, Serial0/0
C      155.1.5.0 is directly connected, Ethernet0/1
C      155.1.45.0 is directly connected, Serial0/1
B      155.1.37.0 [20/0] via 155.1.0.3, 00:04:47
```

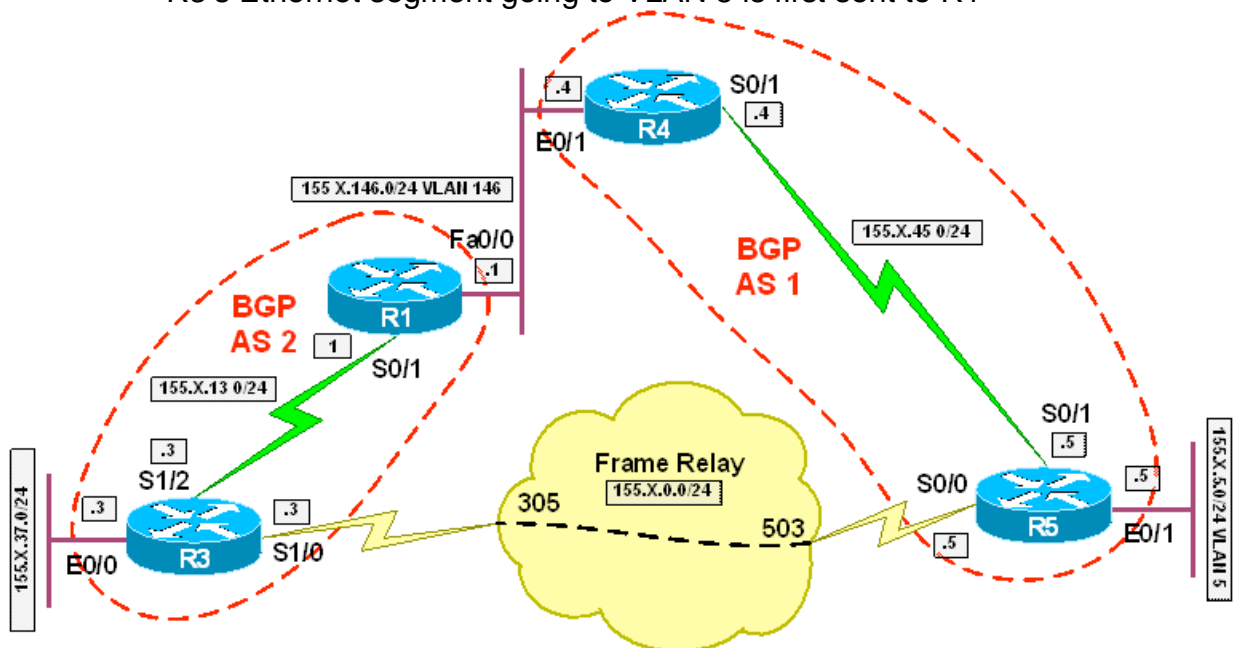


Recommended Reading

[BGP Best Path Selection Algorithm](#)

BGP Bestpath Selection – Local Preference

Objective: Configure the BGP Local Preference attribute in AS 2 so that traffic from R3's Ethernet segment going to VLAN 5 is first sent to R1



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure BGP Local Preference on R3 so that routes coming from R1 are preferred over those coming from R5

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 1
```

R3:

```
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
router bgp 2
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
 neighbor 155.1.13.1 route-map LOCAL_PREFERENCE in
!
route-map LOCAL_PREFERENCE permit 10
 set local-preference 200
```

R4:

```
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.4 255.255.255.0
!
router bgp 1
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.3 503 broadcast
 no frame-relay inverse-arp
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.5 255.255.255.0
 clockrate 64000
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
```

```
neighbor 155.1.0.3 remote-as 2
neighbor 155.1.45.4 remote-as 1
neighbor 155.1.45.4 next-hop-self
```

Verification

```
Rack1R3#traceroute 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

Tracing the route to 155.1.5.5

```
 1 155.1.13.1 16 msec 16 msec 16 msec
 2 155.1.146.4 16 msec 16 msec 16 msec
 3 155.1.45.5 32 msec * 28 msec
```

```
Rack1R3#show ip bgp 155.1.5.0
```

BGP routing table entry for 155.1.5.0/24, version 5

Paths: (2 available, best #1, table Default-IP-Routing-Table)

Advertised to update-groups:

2

1

155.1.13.1 from 155.1.13.1 (155.1.146.1)

Origin IGP, metric 0, localpref 200, valid, internal, best

1

155.1.0.5 from 155.1.0.5 (155.1.45.5)

Origin IGP, metric 0, localpref 100, valid, external

```
Rack1R1#show ip bgp
```

<output omitted>

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	155.1.146.4		
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

```
Rack1R3#show ip bgp
```

<output omitted>

Network	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.13.1	0	200
0 1 i			
*	155.1.0.5	0	

```
0 1 i
*> 155.1.37.0/24    0.0.0.0          0
32768 i
```

Rack1R4#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.45.5	0	100
0 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			
* i	155.1.45.5	0	100
0 2 i			

Rack1R5#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
* i155.1.37.0/24	155.1.45.4	0	100
0 2 i			
*>	155.1.0.3	0	
0 2 i			

Rack1R1#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C    155.1.146.0 is directly connected, FastEthernet0/0
C    155.1.13.0 is directly connected, Serial0/1
B    155.1.5.0 [20/0] via 155.1.146.4, 00:02:39
B    155.1.37.0 [200/0] via 155.1.13.3, 00:02:39
```

Rack1R3#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C    155.1.13.0 is directly connected, Serial1/2
C    155.1.0.0 is directly connected, Serial1/0.1
B    155.1.5.0 [200/0] via 155.1.13.1, 00:02:16
C    155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R4#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C    155.1.13.0 is directly connected, Serial1/2
```

```
C      155.1.0.0 is directly connected, Serial1/0.1
B      155.1.5.0 [200/0] via 155.1.13.1, 00:02:16
C      155.1.37.0 is directly connected, Ethernet0/0
```

```
Rack1R5#show ip route
```

```
<output omitted>
```

```
      155.1.0.0/24 is subnetted, 4 subnets
C      155.1.0.0 is directly connected, Serial0/0
C      155.1.5.0 is directly connected, Ethernet0/1
C      155.1.45.0 is directly connected, Serial0/1
B      155.1.37.0 [20/0] via 155.1.0.3, 00:04:47
```

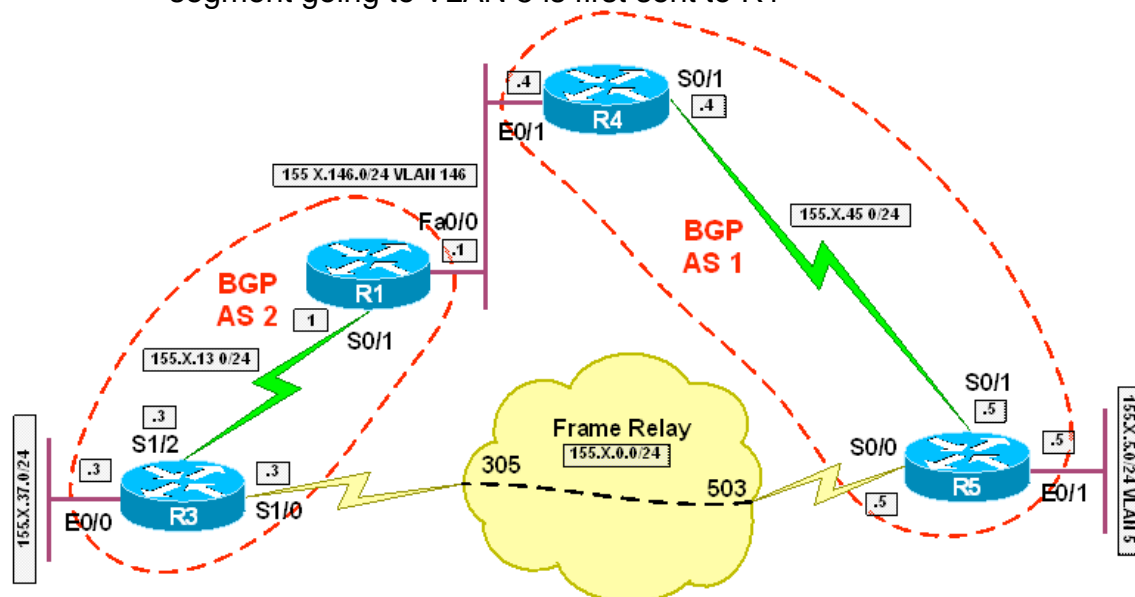


Recommended Reading

[BGP Best Path Selection Algorithm](#)

BGP Bestpath Selection – MED

Objective: Configure the BGP MED in AS 1 so that traffic from R3's Ethernet segment going to VLAN 5 is first sent to R1



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure BGP MED outbound on R4 and R5 towards AS 2

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 1
```


R3:

```
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
router bgp 2
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
```

R4:

```
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
 half-duplex
!
interface Serial0/1
 ip address 155.1.45.4 255.255.255.0
!
router bgp 1
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
 neighbor 155.1.146.1 remote-as 2
 neighbor 155.1.146.1 route-map MED out
!
route-map MED permit 10
 set metric 100
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.3 503 broadcast
 no frame-relay inverse-arp
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
```

```
interface Serial0/1
 ip address 155.1.45.5 255.255.255.0
 clockrate 64000
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.3 remote-as 2
 neighbor 155.1.0.3 route-map MED out
 neighbor 155.1.45.4 remote-as 1
 neighbor 155.1.45.4 next-hop-self
!
route-map MED permit 10
 set metric 200
```

Verification

```
Rack1R3#tracert 155.1.5.5 source 155.1.37.3
```

```
Type escape sequence to abort.
Tracing the route to 155.1.5.5
```

```
 1 155.1.13.1 16 msec 16 msec 16 msec
 2 155.1.146.4 16 msec 16 msec 16 msec
 3 155.1.45.5 32 msec * 28 msec
```

```
Rack1R3#show ip bgp 155.1.5.0 255.255.255.0
```

```
BGP routing table entry for 155.1.5.0/24, version 8
Paths: (2 available, best #1, table Default-IP-Routing-Table)
Flag: 0x800
   Advertised to update-groups:
     2
  1
    155.1.13.1 from 155.1.13.1 (155.1.146.1)
      Origin IGP, metric 100, localpref 100, valid,
      internal, best
  1
    155.1.0.5 from 155.1.0.5 (155.1.45.5)
      Origin IGP, metric 200, localpref 100, valid,
```

external

Rack1R1#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 0 1 i	155.1.146.4	100	
*>i155.1.37.0/24 0 i	155.1.13.3	0	100

Rack1R3#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24 0 1 i	155.1.13.1	100	100
* 0 1 i	155.1.0.5	200	
*> 155.1.37.0/24 32768 i	0.0.0.0	0	

Rack1R4#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24 0 i	155.1.45.5	0	100
*> 155.1.37.0/24 0 2 i	155.1.146.1		
* i 0 2 i	155.1.45.5	0	100

Rack1R5#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 32768 i	0.0.0.0	0	
* i155.1.37.0/24 0 2 i	155.1.45.4	0	100
*> 0 2 i	155.1.0.3	0	

Rack1R1#show ip route

<output omitted>

```
    155.1.0.0/24 is subnetted, 4 subnets
C       155.1.146.0 is directly connected, FastEthernet0/0
C       155.1.13.0 is directly connected, Serial0/1
B       155.1.5.0 [20/100] via 155.1.146.4, 00:05:49
B       155.1.37.0 [200/0] via 155.1.13.3, 02:26:23
```

Rack1R3#**show ip route**

<output omitted>

```
    155.1.0.0/24 is subnetted, 4 subnets
C       155.1.13.0 is directly connected, Serial1/2
C       155.1.0.0 is directly connected, Serial1/0.1
B       155.1.5.0 [200/100] via 155.1.13.1, 00:05:53
C       155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R4#**show ip route**

<output omitted>

```
    155.1.0.0/24 is subnetted, 4 subnets
C       155.1.13.0 is directly connected, Serial1/2
C       155.1.0.0 is directly connected, Serial1/0.1
B       155.1.5.0 [200/0] via 155.1.13.1, 00:02:16
C       155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R5#**show ip route**

<output omitted>

```
    155.1.0.0/24 is subnetted, 4 subnets
C       155.1.0.0 is directly connected, Serial0/0
C       155.1.5.0 is directly connected, Ethernet0/1
C       155.1.45.0 is directly connected, Serial0/1
B       155.1.37.0 [20/0] via 155.1.0.3, 00:04:47
```

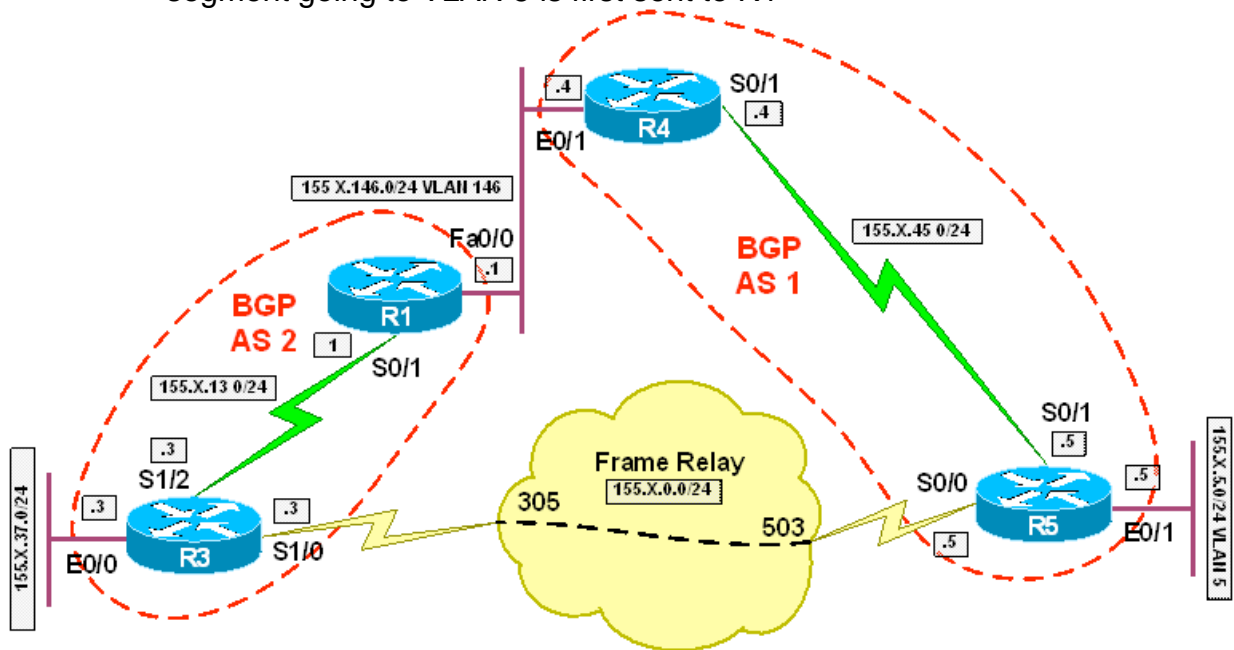


Recommended Reading

[BGP Best Path Selection Algorithm](#)

BGP Bestpath Selection – Origin

Objective: Modify the BGP Origin code in AS 2 so that traffic from R3's Ethernet segment going to VLAN 5 is first sent to R1



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure R3 so that the Origin of the route learned from R1 is preferred over the one learned from R5

Final Configuration

```
R1:
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 1
```

R3:

```
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
router bgp 2
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.0.5 route-map ORIGIN in
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
!
route-map ORIGIN permit 10
 set origin incomplete
```

R4:

```
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
 half-duplex
!
interface Serial0/1
 ip address 155.1.45.4 255.255.255.0
!
router bgp 1
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.3 503 broadcast
 no frame-relay inverse-arp
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.5 255.255.255.0
 clockrate 64000
!
```

```

router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.3 remote-as 2
 neighbor 155.1.45.4 remote-as 1
 neighbor 155.1.45.4 next-hop-self

```

Verification

```
Rack1R3#traceroute 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

Tracing the route to 155.1.5.5

```

 1 155.1.13.1 16 msec 16 msec 16 msec
 2 155.1.146.4 16 msec 16 msec 16 msec
 3 155.1.45.5 32 msec * 28 msec

```

```
Rack1R3#show ip bgp 155.1.5.0 255.255.255.0
```

BGP routing table entry for 155.1.5.0/24, version 9

Paths: (2 available, best #1, table Default-IP-Routing-Table)

Advertised to update-groups:

```

 2
 1
 155.1.13.1 from 155.1.13.1 (155.1.146.1)
  Origin IGP, metric 0, localpref 100, valid, internal,
 best
 1
 155.1.0.5 from 155.1.0.5 (155.1.45.5)
  Origin incomplete, metric 0, localpref 100, valid,
 external

```

```
Rack1R1#show ip bgp
```

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.146.4		
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

```
Rack1R3#show ip bgp
```

<output omitted>

Origin codes: i - IGP, e - EGP, ? - incomplete

```

      Network          Next Hop          Metric LocPrf
Weight Path
*>i155.1.5.0/24      155.1.13.1          0      100
0 1 i
*
155.1.0.5            0
0 1 ?
*> 155.1.37.0/24    0.0.0.0             0
32768 i

```

Rack1R4#show ip bgp

<output omitted>

```

      Network          Next Hop          Metric LocPrf
Weight Path
*>i155.1.5.0/24      155.1.45.5          0      100
0 i
*> 155.1.37.0/24    155.1.146.1         0
0 2 i
* i
155.1.45.5          0      100
0 2 i

```

Rack1R5#show ip bgp

<output omitted>

```

      Network          Next Hop          Metric LocPrf
Weight Path
*> 155.1.5.0/24      0.0.0.0             0
32768 i
* i155.1.37.0/24    155.1.45.4          0      100
0 2 i
*>
155.1.0.3           0
0 2 i

```

Rack1R1#show ip route

<output omitted>

```

      155.1.0.0/24 is subnetted, 4 subnets
C       155.1.146.0 is directly connected, FastEthernet0/0
C       155.1.13.0 is directly connected, Serial0/1
B       155.1.5.0 [20/0] via 155.1.146.4, 00:05:49
B       155.1.37.0 [200/0] via 155.1.13.3, 02:26:23

```

Rack1R3#show ip route

<output omitted>

```

      155.1.0.0/24 is subnetted, 4 subnets
C       155.1.13.0 is directly connected, Serial1/2
C       155.1.0.0 is directly connected, Serial1/0.1
B       155.1.5.0 [200/0] via 155.1.13.1, 00:05:53
C       155.1.37.0 is directly connected, Ethernet0/0

```


Rack1R4#show ip route

<output omitted>

```
    155.1.0.0/24 is subnetted, 4 subnets
C       155.1.13.0 is directly connected, Serial1/2
C       155.1.0.0 is directly connected, Serial1/0.1
B       155.1.5.0 [200/0] via 155.1.13.1, 00:02:16
C       155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R5#show ip route

<output omitted>

```
    155.1.0.0/24 is subnetted, 4 subnets
C       155.1.0.0 is directly connected, Serial0/0
C       155.1.5.0 is directly connected, Ethernet0/1
C       155.1.45.0 is directly connected, Serial0/1
B       155.1.37.0 [20/0] via 155.1.0.3, 00:04:47
```

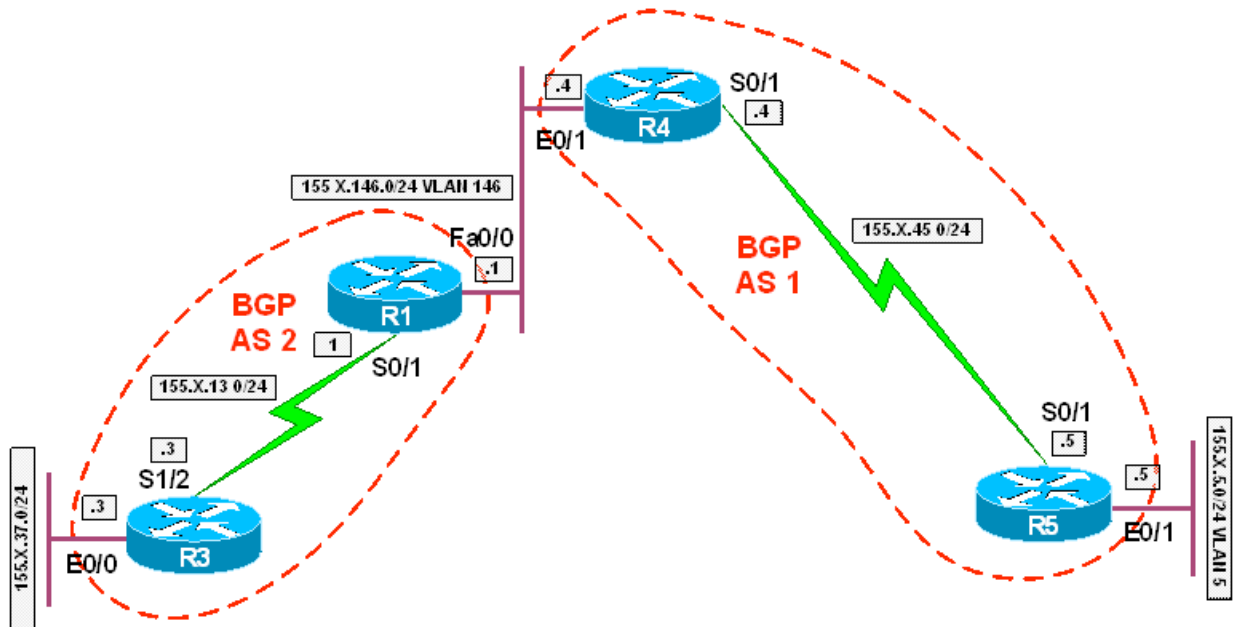


Recommended Reading

[BGP Best Path Selection Algorithm](#)

BGP Next-Hop Processing – Next-Hop-Self

Objective: Configure the next-hop-self command where necessary to gain reachability between R3's Ethernet segment and VLAN 5



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R4 should peer with R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure the next-hop-self command where necessary to gain reachability between R3's Ethernet segment and VLAN 5

Final Configuration

```
R1:
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 1
```

R3:

```
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
router bgp 2
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.13.1 remote-as 2
```

R4:

```
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.4 255.255.255.0
!
router bgp 1
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
interface Serial0/1
 ip address 155.1.45.5 255.255.255.0
 clockrate 64000
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.3 remote-as 2
 neighbor 155.1.45.4 remote-as 1
```

Verification

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2
seconds:
```

Packet sent with a source address of 155.1.37.3

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max =
56/60/72 ms

Rack1R1#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.146.4		
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

Rack1R3#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*>i155.1.5.0/24	155.1.13.1	0	100
0 1 i			
*> 155.1.37.0/24	0.0.0.0	0	
32768 i			

Rack1R4#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*>i155.1.5.0/24	155.1.45.5	0	100
0 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			

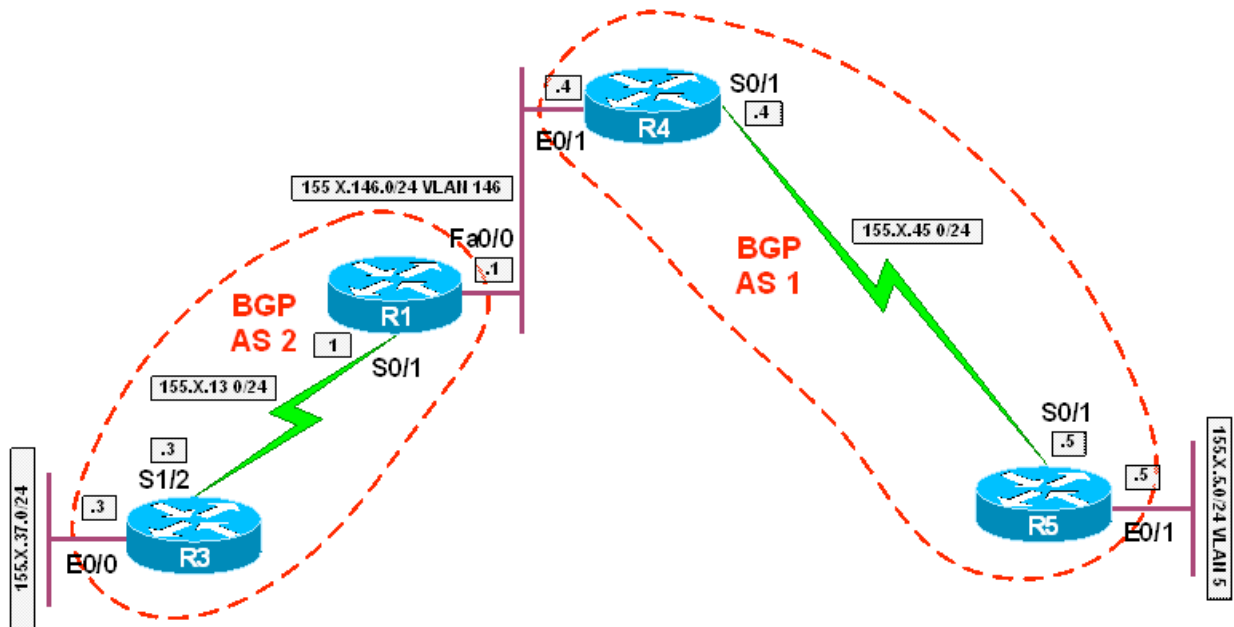
Rack1R5#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*>i155.1.37.0/24	155.1.45.4	0	100
0 2 i			

BGP Next-Hop Processing – Manual Modification

Objective: Configure manual next-hop modification via a route-map where necessary to gain reachability between R3's Ethernet segment and VLAN 5



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R4 should peer with R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure route-maps on R1 and R4 to manually modify the next-hop values advertised to R3 and R5 respectively

Final Configuration

```

R1:
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 route-map SET_NEXT_HOP out
 neighbor 155.1.146.4 remote-as 1

```

```
!  
route-map SET_NEXT_HOP permit 10  
  set ip next-hop 155.1.13.1
```

R3:

```
interface Serial1/2  
  ip address 155.1.13.3 255.255.255.0  
  clockrate 64000  
!  
router bgp 2  
  network 155.1.37.0 mask 255.255.255.0  
  neighbor 155.1.13.1 remote-as 2
```

R4:

```
interface Ethernet0/1  
  ip address 155.1.146.4 255.255.255.0  
!  
interface Serial0/1  
  ip address 155.1.45.4 255.255.255.0  
!  
router bgp 1  
  neighbor 155.1.45.5 remote-as 1  
  neighbor 155.1.45.5 route-map SET_NEXT_HOP out  
  neighbor 155.1.146.1 remote-as 2  
!  
route-map SET_NEXT_HOP permit 10  
  set ip next-hop 155.1.45.4
```

R5:

```
interface Ethernet0/1  
  ip address 155.1.5.5 255.255.255.0  
!  
interface Serial0/1  
  ip address 155.1.45.5 255.255.255.0  
  clockrate 64000  
!  
router bgp 1  
  network 155.1.5.0 mask 255.255.255.0  
  neighbor 155.1.0.3 remote-as 2  
  neighbor 155.1.45.4 remote-as 1
```

Verification

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/72 ms
```

```
Rack1R1#show ip bgp
```

```
<output omitted>
```

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.146.4		
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

```
Rack1R3#show ip bgp
```

```
<output omitted>
```

Network	Next Hop	Metric	LocPrf
Weight Path			
*>i155.1.5.0/24	155.1.13.1	0	100
0 1 i			
*> 155.1.37.0/24	0.0.0.0	0	
32768 i			

```
Rack1R4#show ip bgp
```

```
<output omitted>
```

Network	Next Hop	Metric	LocPrf
Weight Path			
*>i155.1.5.0/24	155.1.45.5	0	100
0 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			

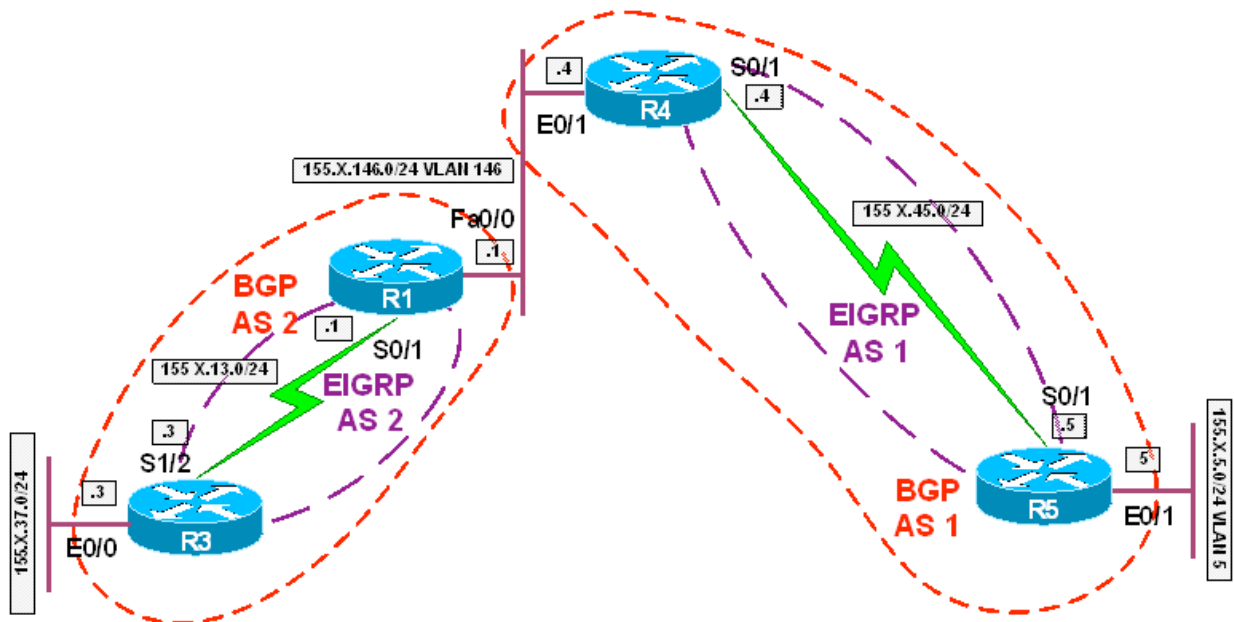
```
Rack1R5#show ip bgp
```

```
<output omitted>
```

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*>i155.1.37.0/24	155.1.45.4	0	100
0 2 i			

BGP Next-Hop Processing – IGP Redistribution

Objective: Configure redistribution on R1 and R4 to allow IGP next-hop lookup in order to gain reachability between R3's Ethernet segment and VLAN 5



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 1 between R4 and R5
- Configure EIGRP AS 2 between R1 and R3
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R4 should peer with R5
- Advertise R3's Ethernet segment into BGP
- Advertise R5's Ethernet segment into BGP
- Configure redistribution on R1 and R4 to allow IGP next-hop lookup in order to gain reachability between R3's Ethernet segment and VLAN 5

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 redistribute connected metric 1 1 1 1 1
 network 155.1.13.1 0.0.0.0
 no auto-summary
```



```
!  
router bgp 2  
  neighbor 155.1.13.3 remote-as 2  
  neighbor 155.1.146.4 remote-as 1  
  
R3:  
interface Serial1/2  
  ip address 155.1.13.3 255.255.255.0  
  clockrate 64000  
!  
router eigrp 2  
  network 155.1.13.3 0.0.0.0  
  no auto-summary  
!  
router bgp 2  
  network 155.1.37.0 mask 255.255.255.0  
  neighbor 155.1.13.1 remote-as 2
```

```
R4:  
interface Ethernet0/1  
  ip address 155.1.146.4 255.255.255.0  
!  
interface Serial0/1  
  ip address 155.1.45.4 255.255.255.0  
!  
router eigrp 1  
  redistribute connected metric 1 1 1 1 1  
  network 155.1.45.4 0.0.0.0  
  no auto-summary  
!  
router bgp 1  
  neighbor 155.1.45.5 remote-as 1  
  neighbor 155.1.146.1 remote-as 2
```

```
R5:  
interface Ethernet0/1  
  ip address 155.1.5.5 255.255.255.0  
!  
interface Serial0/1  
  ip address 155.1.45.5 255.255.255.0  
  clockrate 64000  
!  
router eigrp 1
```

```

network 155.1.45.5 0.0.0.0
no auto-summary
!
router bgp 1
network 155.1.5.0 mask 255.255.255.0
neighbor 155.1.0.3 remote-as 2
neighbor 155.1.45.4 remote-as 1

```

Verification

Rack1R3#ping 155.1.5.5 source 155.1.37.3

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:

Packet sent with a source address of 155.1.37.3

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/72 ms

Rack1R1#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	155.1.146.4		
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

Rack1R1#show ip route

<output omitted>

```

155.1.0.0/24 is subnetted, 4 subnets
C    155.1.146.0 is directly connected, FastEthernet0/0
C    155.1.13.0 is directly connected, Serial0/1
B    155.1.5.0 [20/0] via 155.1.146.4, 01:25:02
B    155.1.37.0 [200/0] via 155.1.13.3, 04:04:26

```

Rack1R3#show ip bgp

<output omitted>

Network	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.146.4	0	100
0 1 i			
*> 155.1.37.0/24	0.0.0.0	0	
32768 i			

Rack1R3#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
D EX    155.1.146.0 [170/2560512256] via 155.1.13.1,
00:01:55, Serial1/2
C       155.1.13.0 is directly connected, Serial1/2
B       155.1.5.0 [200/0] via 155.1.146.4, 00:01:41
C       155.1.37.0 is directly connected, Ethernet0/0
```

Rack1R4#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.45.5	0	100
0 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			

Rack1R4#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
C       155.1.146.0 is directly connected, Ethernet0/1
B       155.1.5.0 [200/0] via 155.1.45.5, 04:05:03
C       155.1.45.0 is directly connected, Serial0/1
B       155.1.37.0 [20/0] via 155.1.146.1, 04:05:02
```

Rack1R5#show ip bgp

<output omitted>

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*>i155.1.37.0/24	155.1.146.1	0	100
0 2 i			

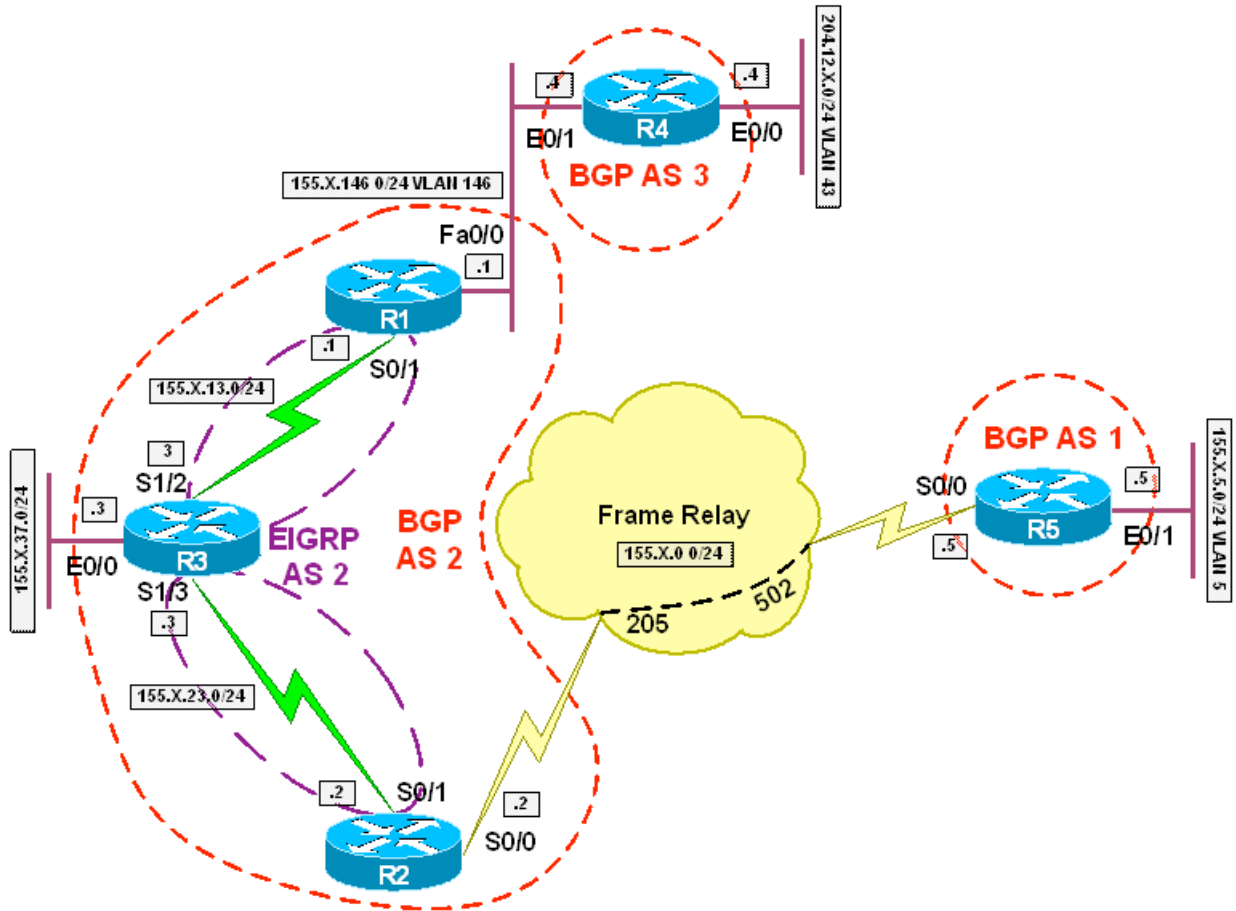
Rack1R5#show ip route

<output omitted>

```
155.1.0.0/24 is subnetted, 4 subnets
D EX    155.1.146.0 [170/2560512256] via 155.1.45.4,
00:04:43, Serial0/1
C       155.1.5.0 is directly connected, Ethernet0/1
C       155.1.45.0 is directly connected, Serial0/1
B       155.1.37.0 [200/0] via 155.1.146.1, 00:04:37
```

BGP Communities – No-Export

Objective: Configure AS 2 using the community No-Export so that hosts on R3's Ethernet have access to VLANs 5 and 43 but AS 1 and AS 3 cannot reach VLANs 43 and 5 respectively



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 2 on the links between R1 & R3 and R2 & R3
- Configure BGP on R1, R2, R3, R4, and R5 per the diagram
- R1 should peer with R4
- R2 should peer with R5
- R1, R2, and R3 should all peer with each other
- Advertise R3's Ethernet into BGP on R3
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4
- Configure the community No-Export on R1 and R2 so that routes coming from AS 1 are not passed to AS 3 and vice-versa

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 network 155.1.13.1 0.0.0.0
 no auto-summary
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.23.2 remote-as 2
 neighbor 155.1.23.2 next-hop-self
 neighbor 155.1.23.2 send-community
 neighbor 155.1.146.4 remote-as 3
 neighbor 155.1.146.4 route-map NO_EXPORT in
!
route-map NO_EXPORT permit 10
 set community no-export
```

R2:

```
interface FastEthernet0/0
 ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
```

```
!  
interface Serial0/0.1 point-to-point  
  ip address 155.1.0.2 255.255.255.0  
  frame-relay interface-dlci 205  
!  
interface Serial0/1  
  ip address 155.1.23.2 255.255.255.0  
!  
router eigrp 2  
  network 155.1.23.2 0.0.0.0  
  no auto-summary  
!  
router bgp 2  
  neighbor 155.1.0.5 remote-as 1  
  neighbor 155.1.0.5 route-map NO_EXPORT in  
  neighbor 155.1.13.1 remote-as 2  
  neighbor 155.1.13.1 next-hop-self  
  neighbor 155.1.13.1 send-community  
  neighbor 155.1.23.3 remote-as 2  
  neighbor 155.1.23.3 next-hop-self  
!  
route-map NO_EXPORT permit 10  
  set community no-export
```

R3:

```
interface Ethernet0/0  
  ip address 155.1.37.3 255.255.255.0  
!  
interface Serial1/2  
  ip address 155.1.13.3 255.255.255.0  
  clockrate 64000  
!  
interface Serial1/3  
  ip address 155.1.23.3 255.255.255.0  
  clockrate 64000  
!  
router eigrp 2  
  network 155.1.13.3 0.0.0.0  
  network 155.1.23.3 0.0.0.0  
  no auto-summary  
!  
router bgp 2  
  network 155.1.37.0 mask 255.255.255.0
```

```
neighbor 155.1.13.1 remote-as 2
neighbor 155.1.23.2 remote-as 2
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 3
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2
```

Verification

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2
seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
84/86/88 ms
```

```
Rack1R3#ping 204.12.1.4 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 204.12.1.4, timeout is 2
```

seconds:

Packet sent with a source address of 155.1.37.3

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max =
28/31/32 ms

Rack1R4#show ip bgp

BGP table version is 3, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			
*> 204.12.1.0	0.0.0.0	0	
32768 i			

Rack1R5#show ip bgp

BGP table version is 3, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*> 155.1.37.0/24	155.1.0.2		
0 2 i			

Rack1R1#show ip bgp 155.1.5.0

BGP routing table entry for 155.1.5.0/24, version 3

Paths: (1 available, best #1, table Default-IP-Routing-
Table, not advertised to EBGP peer)

Not advertised to any peer

1

155.1.23.2 (metric 21024000) from 155.1.23.2
(150.1.2.2)

Origin IGP, metric 0, localpref 100, valid, internal,
best

Community: no-export

Rack1R2#show ip bgp 204.12.1.0

BGP routing table entry for 204.12.1.0/24, version 2


```
Paths: (1 available, best #1, table Default-IP-Routing-
Table, not advertised to EBGP peer)

  Not advertised to any peer

    3

      155.1.13.1 (metric 21024000) from 155.1.13.1
      (150.1.1.1)

        Origin IGP, metric 0, localpref 100, valid, internal,
best
        Community: no-export
```

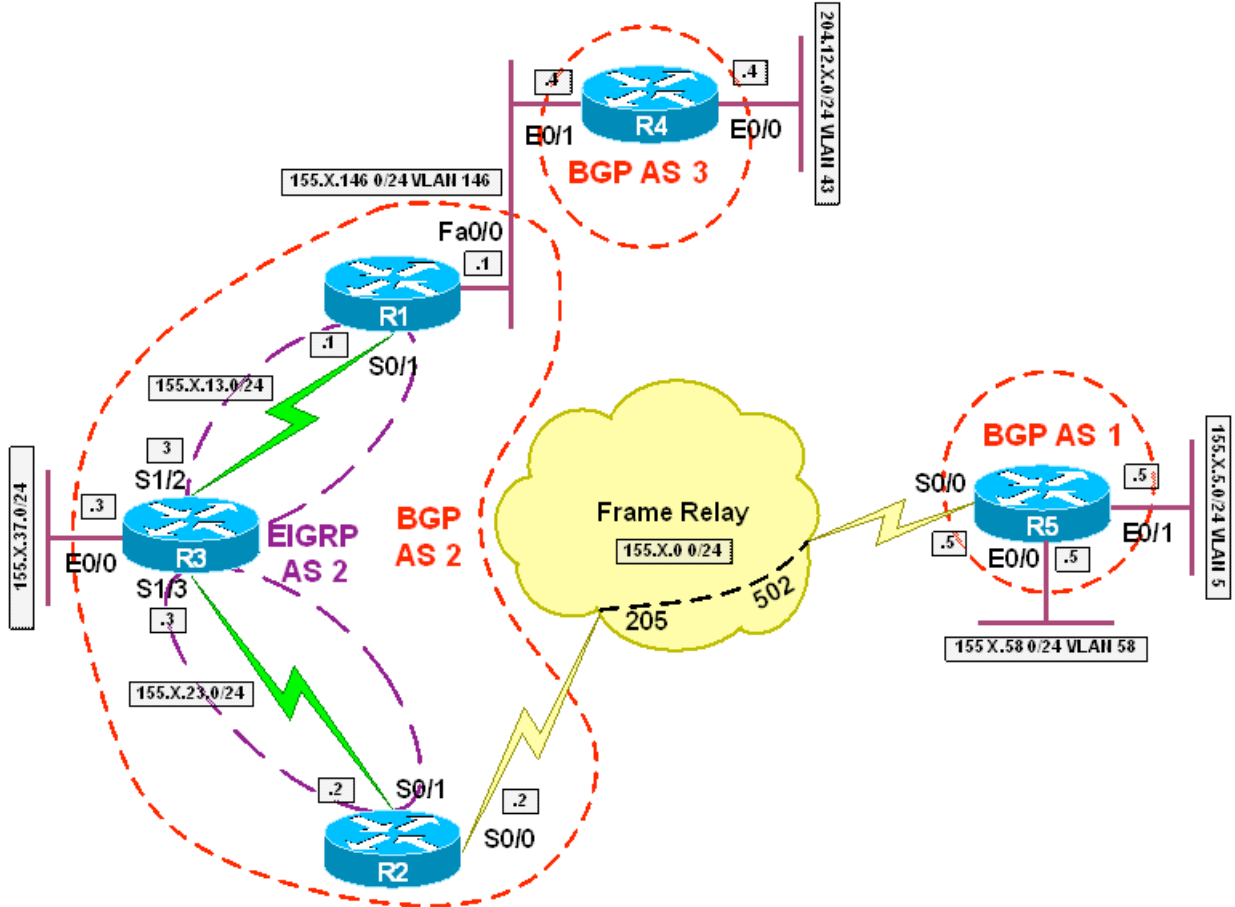


Recommended Reading

[RFC 1997 - BGP Communities Attribute](#)

BGP Communities – No-Advertise

Objective: Configure R2 using the community No-Advertise so that hosts on R3's Ethernet, VLAN 5, and VLAN 43 all have access to each other but only R2 has access to VLAN 58



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 2 on the links between R1 & R3 and R2 & R3
- Configure BGP on R1, R2, R3, R4, and R5 per the diagram
- R1 should peer with R4
- R2 should peer with R5
- R1, R2, and R3 should all peer with each other
- Advertise R3's Ethernet into BGP on R3
- Advertise VLANs 5 and 58 into BGP on R5
- Advertise VLAN 43 into BGP on R4
- Configure the community No-Advertise on R2 so that VLAN 58 is not advertised to any neighbor

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 network 155.1.13.1 0.0.0.0
 no auto-summary
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.23.2 remote-as 2
 neighbor 155.1.23.2 next-hop-self
 neighbor 155.1.146.4 remote-as 3
```

R2:

```
interface FastEthernet0/0
 ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 155.1.0.2 255.255.255.0
 frame-relay interface-dlci 205
!
```

```
interface Serial0/1
 ip address 155.1.23.2 255.255.255.0
!
router eigrp 2
 network 155.1.23.2 0.0.0.0
 no auto-summary
!
router bgp 2
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.0.5 route-map NO_ADVERTISE in
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
 neighbor 155.1.23.3 remote-as 2
 neighbor 155.1.23.3 next-hop-self
!
ip prefix-list VLAN58 permit 155.1.58.0/24
!
route-map NO_ADVERTISE permit 10
 match ip address prefix-list VLAN58
 set community no-advertise
!
route-map NO_ADVERTISE permit 20
```

R3:

```
interface Ethernet0/0
 ip address 155.1.37.3 255.255.255.0
!
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
interface Serial1/3
 ip address 155.1.23.3 255.255.255.0
 clockrate 64000
!
router eigrp 2
 network 155.1.13.3 0.0.0.0
 network 155.1.23.3 0.0.0.0
 no auto-summary
!
router bgp 2
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.13.1 remote-as 2
```

```
neighbor 155.1.23.2 remote-as 2
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 3
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/0
 ip address 155.1.58.5 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 network 155.1.58.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2
```

Verification

```
Rack1R2#show ip bgp 155.1.58.0
```

```
BGP routing table entry for 155.1.58.0/24, version 4
```

```
Paths: (1 available, best #1, table Default-IP-Routing-Table, not advertised to any peer)
```

```
Not advertised to any peer
```

```
1
```

```
155.1.0.5 from 155.1.0.5 (150.1.5.5)
```

```
Origin IGP, metric 0, localpref 100, valid, external, best
```

```
Community: no-advertise
```

```
Rack1R2#ping 155.1.58.5
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 155.1.58.5, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/59/60 ms
```

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 84/87/88 ms
```

```
Rack1R3#ping 155.1.58.8 source 155.1.37.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 155.1.58.8, timeout is 2 seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
.....
```

```
Success rate is 0 percent (0/5)
```

```
Rack1R4#ping 155.1.5.5 source 204.12.1.4
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:
```

```
Packet sent with a source address of 204.12.1.4
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 112/115/120 ms
```

```
Rack1R3#ping 204.12.1.4 source 155.1.37.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 204.12.1.4, timeout is 2 seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
```

28/30/32 ms

Rack1R1#show ip bgp

BGP table version is 6, local router ID is 150.1.1.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*>i155.1.5.0/24	155.1.23.2	0	100
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			
*> 204.12.1.0	155.1.146.4	0	
0 3 i			

Rack1R2#show ip bgp

BGP table version is 5, local router ID is 150.1.2.2

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.0.5	0	
0 1 i			
*>i155.1.37.0/24	155.1.23.3	0	100
0 i			
*> 155.1.58.0/24	155.1.0.5	0	
0 1 i			
*>i204.12.1.0	155.1.13.1	0	100
0 3 i			

Rack1R3#show ip bgp

BGP table version is 8, local router ID is 150.1.3.3

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*>i155.1.5.0/24	155.1.23.2	0	100
0 1 i			
*> 155.1.37.0/24	0.0.0.0	0	
32768 i			

```
*>i204.12.1.0      155.1.13.1      0      100
0 3 i
```

Rack1R4#show ip bgp

BGP table version is 6, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 0 2 1 i	155.1.146.1		
*> 155.1.37.0/24 0 2 i	155.1.146.1		
*> 204.12.1.0 32768 i	0.0.0.0	0	

Rack1R5#show ip bgp

BGP table version is 9, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 32768 i	0.0.0.0	0	
*> 155.1.37.0/24 0 2 i	155.1.0.2		
*> 155.1.58.0/24 32768 i	0.0.0.0	0	
*> 204.12.1.0 0 2 3 i	155.1.0.2		

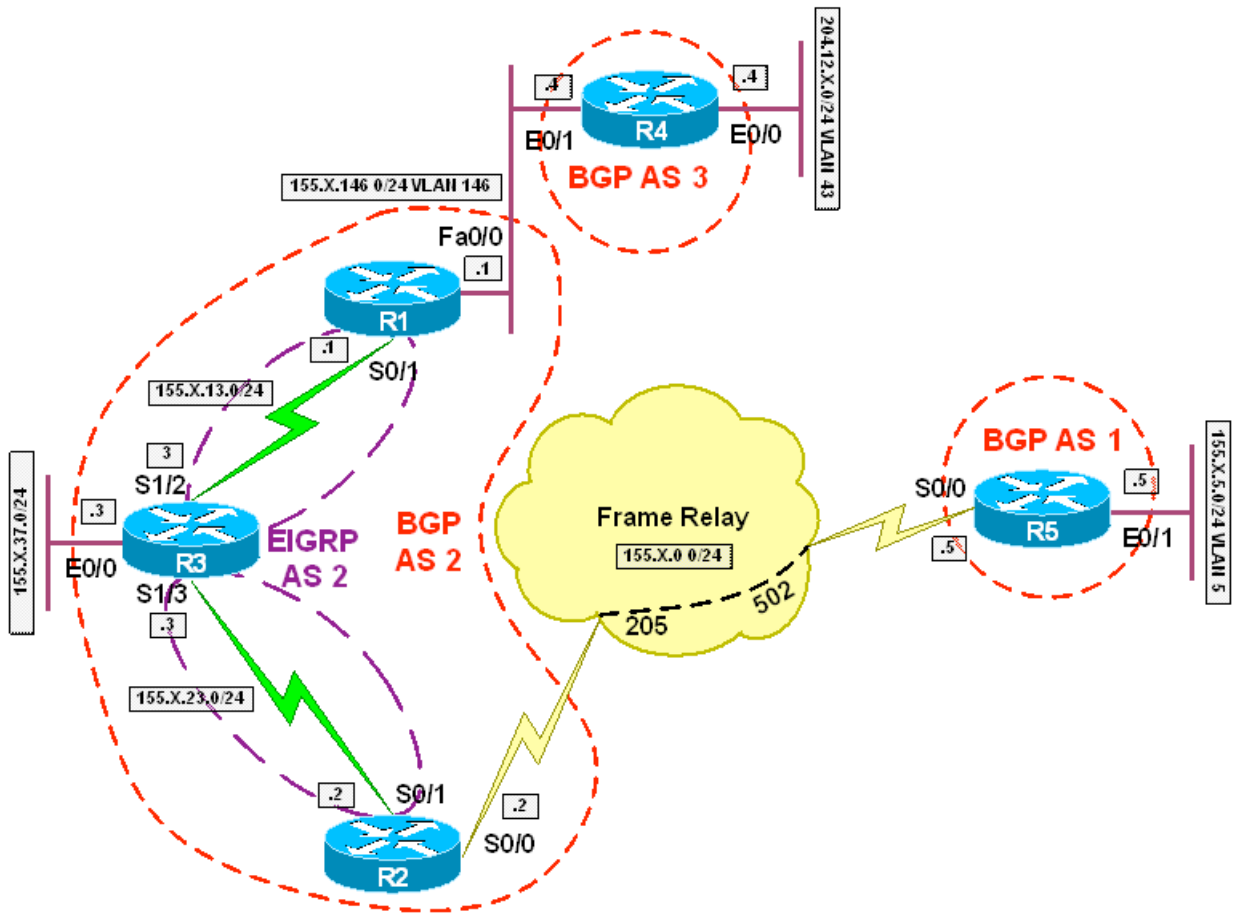


Recommended Reading

[RFC 1997 - BGP Communities Attribute](#)

BGP Route Reflection

Objective: Configure R3 as a route reflector for R1 and R2 so that hosts on R3's Ethernet, VLAN 5, and VLAN 43 all have access to each other



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 2 on the links between R1 & R3 and R2 & R3
- Configure BGP on R1, R2, R3, R4, and R5 per the diagram
- R1 should peer with R4
- R2 should peer with R5
- R3 should peer with and be a route reflector for R1 and R2
- Advertise R3's Ethernet into BGP on R3
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 network 155.1.13.1 0.0.0.0
 no auto-summary
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 3
```

R2:

```
interface FastEthernet0/0
 ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 155.1.0.2 255.255.255.0
 frame-relay interface-dlci 205
!
interface Serial0/1
 ip address 155.1.23.2 255.255.255.0
!
router eigrp 2
```

```
network 155.1.23.2 0.0.0.0
no auto-summary
!
router bgp 2
neighbor 155.1.0.5 remote-as 1
neighbor 155.1.23.3 remote-as 2
neighbor 155.1.23.3 next-hop-self
```

R3:

```
interface Ethernet0/0
ip address 155.1.37.3 255.255.255.0
!
interface Serial1/2
ip address 155.1.13.3 255.255.255.0
clockrate 64000
!
interface Serial1/3
ip address 155.1.23.3 255.255.255.0
clockrate 64000
!
router eigrp 2
network 155.1.13.3 0.0.0.0
network 155.1.23.3 0.0.0.0
no auto-summary
!
router bgp 2
network 155.1.37.0 mask 255.255.255.0
neighbor 155.1.13.1 remote-as 2
neighbor 155.1.13.1 route-reflector-client
neighbor 155.1.23.2 remote-as 2
neighbor 155.1.23.2 route-reflector-client
```

R4:

```
interface Ethernet0/0
ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
ip address 155.1.146.4 255.255.255.0
!
router bgp 3
network 204.12.1.0
neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/0
 ip address 155.1.58.5 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2
```

Verification

Rack1R3#ping 155.1.5.5 source 155.1.37.3

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:

Packet sent with a source address of 155.1.37.3

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 84/87/92 ms

Rack1R3#ping 204.12.1.4 source 155.1.37.3

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 204.12.1.4, timeout is 2 seconds:

Packet sent with a source address of 155.1.37.3

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 28/32/36 ms

Rack1R4#ping 155.1.5.5 source 204.12.1.4

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:

Packet sent with a source address of 204.12.1.4

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =  
112/115/116 ms
```

```
Rack1R1#show ip bgp
```

```
BGP table version is 4, local router ID is 150.1.1.1
```

```
Status codes: s suppressed, d damped, h history, * valid, >  
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24 0 1 i	155.1.23.2	0	100
*>i155.1.37.0/24 0 i	155.1.13.3	0	100
*> 204.12.1.0 0 3 i	155.1.146.4	0	

```
Rack1R2#show ip bgp
```

```
BGP table version is 4, local router ID is 150.1.2.2
```

```
Status codes: s suppressed, d damped, h history, * valid, >  
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 0 1 i	155.1.0.5	0	
*>i155.1.37.0/24 0 i	155.1.23.3	0	100
*>i204.12.1.0 0 3 i	155.1.13.1	0	100

```
Rack1R3#show ip bgp
```

```
BGP table version is 4, local router ID is 150.1.3.3
```

```
Status codes: s suppressed, d damped, h history, * valid, >  
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24 0 1 i	155.1.23.2	0	100

```
*> 155.1.1.37.0/24    0.0.0.0          0
32768 i
*>i204.12.1.0        155.1.13.1      0    100
0 3 i
```

Rack1R4#**show ip bgp**

BGP table version is 10, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.146.1		
0 2 1 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			
*> 204.12.1.0	0.0.0.0	0	
32768 i			

Rack1R5#**show ip bgp**

BGP table version is 4, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*> 155.1.37.0/24	155.1.0.2		
0 2 i			
*> 204.12.1.0	155.1.0.2		
0 2 3 i			

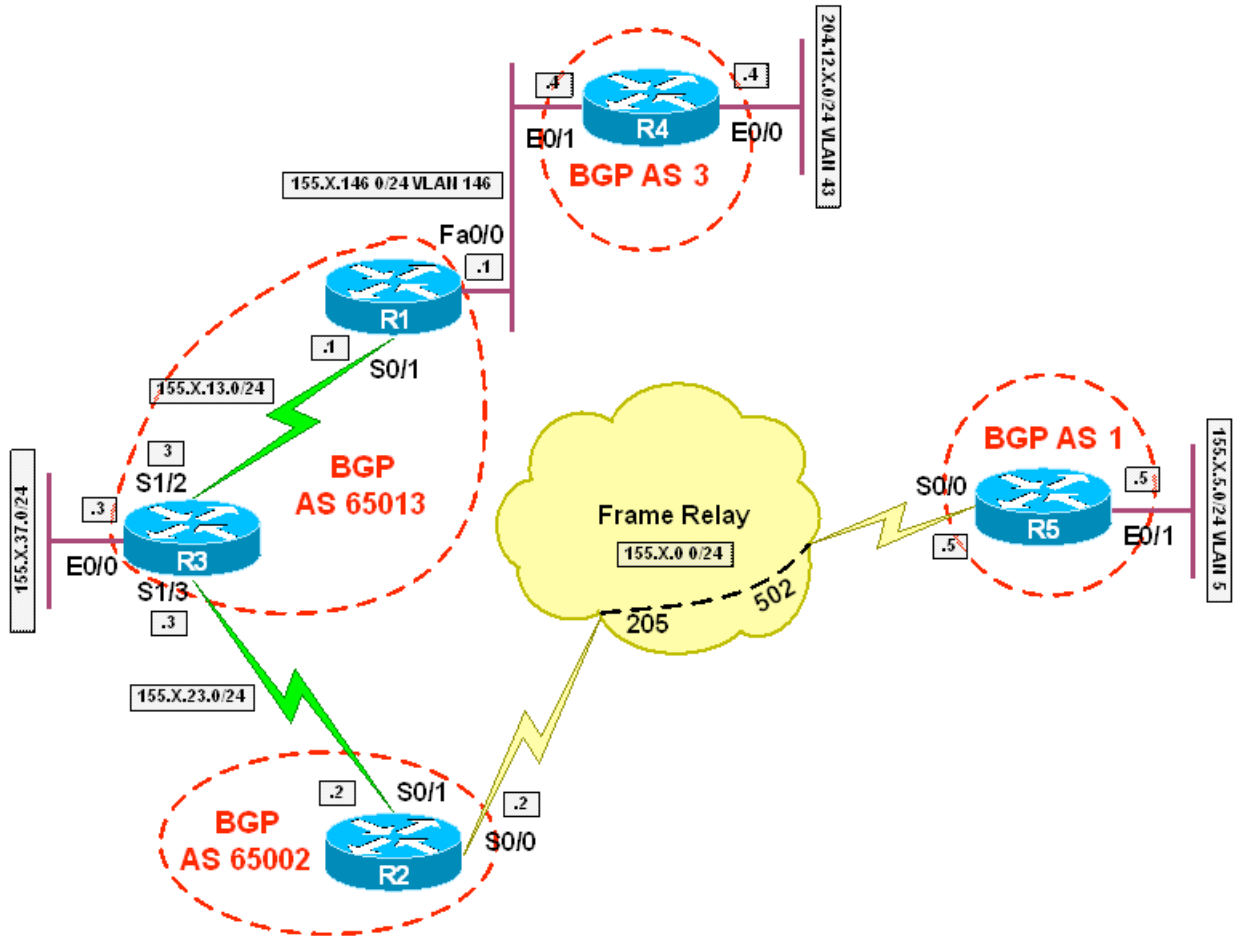


Recommended Reading

[RFC 1966 - BGP Route Reflection An alternative to full mesh IBGP](#)

BGP Confederation

Objective: Configure R1, R2, and R3 in confederation so that AS 1 and AS 3 see them as all belonging to AS 2



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R2, R3, R4, and R5 per the diagram
- R1 and R3 should use the private AS 65013 and the public AS 2
- R2 should use the private AS 65002 and the public AS 2
- R1 should peer with R3 and R4
- R2 should peer with R3 and R5
- Advertise R3's Ethernet into BGP on R3
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 network 155.1.13.1 0.0.0.0
 no auto-summary
!
router bgp 65013
 bgp confederation identifier 2
 neighbor 155.1.13.3 remote-as 65013
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 3
```

R2:

```
interface FastEthernet0/0
 ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 155.1.0.2 255.255.255.0
 frame-relay interface-dlci 205
!
interface Serial0/1
 ip address 155.1.23.2 255.255.255.0
!
```



```
router eigrp 2
 network 155.1.23.2 0.0.0.0
 no auto-summary
!
router bgp 65002
 bgp confederation identifier 2
 bgp confederation peers 65013
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.23.3 remote-as 65013
```

R3:

```
interface Ethernet0/0
 ip address 155.1.37.3 255.255.255.0
!
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
interface Serial1/3
 ip address 155.1.23.3 255.255.255.0
 clockrate 64000
!
router eigrp 2
 network 155.1.13.3 0.0.0.0
 network 155.1.23.3 0.0.0.0
 no auto-summary
!
router bgp 65013
 bgp confederation identifier 2
 bgp confederation peers 65002
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.13.1 remote-as 65013
 neighbor 155.1.13.1 next-hop-self
 neighbor 155.1.23.2 remote-as 65002
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 3
```

```
network 204.12.1.0
neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/0
 ip address 155.1.58.5 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2
```

Verification

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:

Packet sent with a source address of 155.1.37.3

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 72/82/120 ms

```
Rack1R3#ping 204.12.1.4 source 155.1.37.3
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 204.12.1.4, timeout is 2 seconds:

Packet sent with a source address of 155.1.37.3

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/32 ms

```
Rack1R4#ping 155.1.5.5 source 204.12.1.4
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2 seconds:

Packet sent with a source address of 204.12.1.4

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 100/102/104 ms

Rack1R1#show ip bgp

BGP table version is 4, local router ID is 150.1.1.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.13.3	0	100
0 (65002) 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			
*> 204.12.1.0	155.1.146.4	0	
0 3 i			

Rack1R2#show ip bgp

BGP table version is 4, local router ID is 150.1.2.2

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	155.1.0.5	0	
0 1 i			
*> 155.1.37.0/24	155.1.23.3	0	100
0 (65013) i			
*> 204.12.1.0	155.1.13.1	0	100
0 (65013) 3 i			

Rack1R3#show ip bgp

BGP table version is 4, local router ID is 150.1.3.3

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
---------	----------	--------	--------

Weight Path

```
*> 155.1.5.0/24      155.1.0.5          0    100
0 (65002) 1 i
*> 155.1.37.0/24    0.0.0.0            0
32768 i
*>i204.12.1.0        155.1.13.1         0    100
0 3 i
```

Rack1R4#show ip bgp

BGP table version is 14, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	155.1.146.1		
0 2 1 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			
*> 204.12.1.0	0.0.0.0	0	
32768 i			

Rack1R5#show ip bgp

BGP table version is 8, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*> 155.1.37.0/24	155.1.0.2		
0 2 i			
*> 204.12.1.0	155.1.0.2		
0 2 3 i			

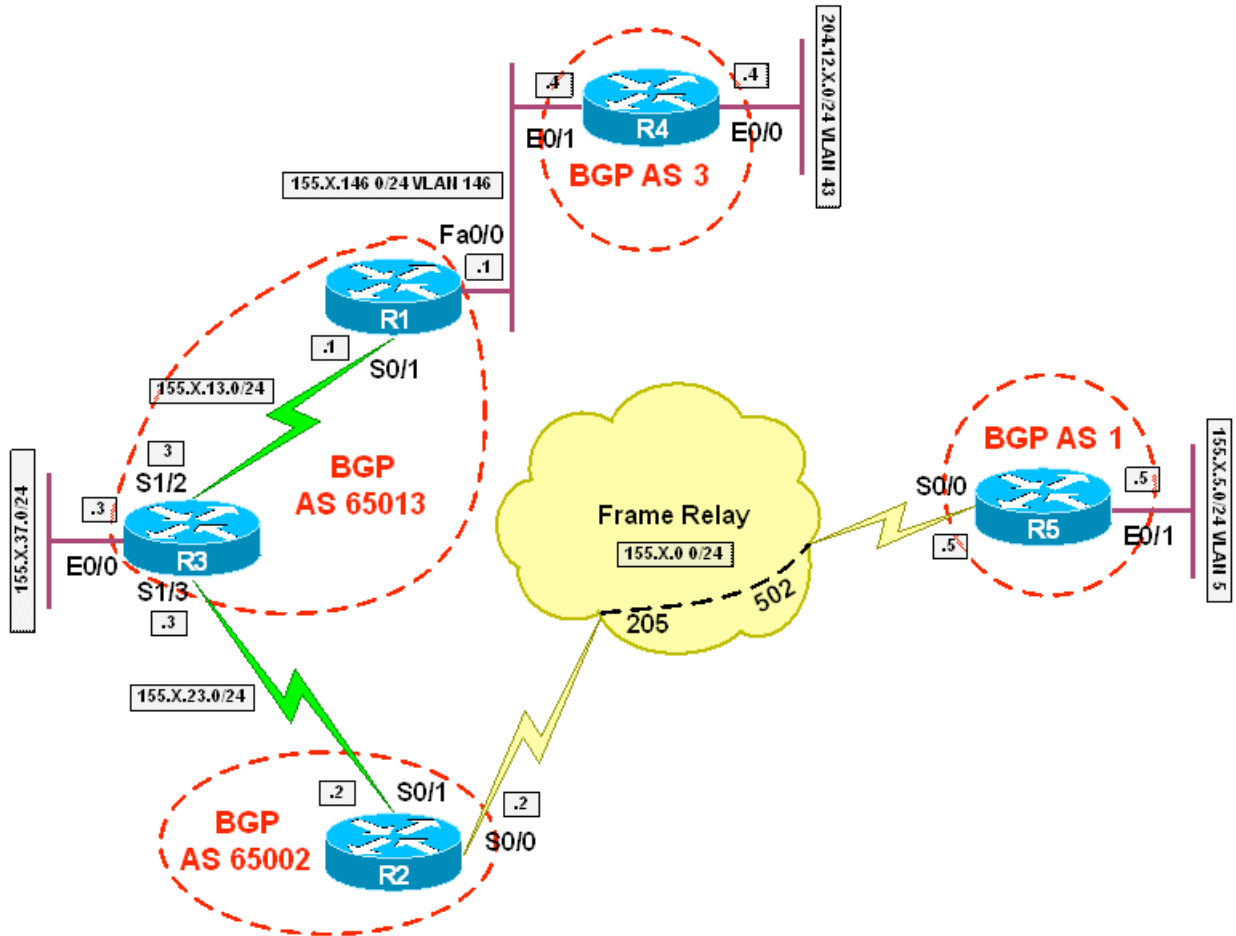


Recommended Reading

[RFC 1965 - Autonomous System Confederations for BGP](#)

BGP Communities – Local AS

Objective: Configure the community Local-AS on R1 so that only R3's Ethernet segment has reachability to VLAN 43



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R2, R3, R4, and R5 per the diagram
- R1 and R3 should use the private AS 65013 and the public AS 2
- R2 should use the private AS 65002 and the public AS 2
- R1 should peer with R3 and R4
- R2 should peer with R3 and R5
- Advertise R3's Ethernet into BGP on R3
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4
- Configure R1 to set VLAN 43 to the community Local-AS as it is received from R4

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 network 155.1.13.1 0.0.0.0
 no auto-summary
!
router bgp 65013
 bgp confederation identifier 2
 neighbor 155.1.13.3 remote-as 65013
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.13.3 send-community
 neighbor 155.1.146.4 remote-as 3
 neighbor 155.1.146.4 route-map LOCAL_AS in
!
route-map LOCAL_AS permit 10
 set community local-as
```

R2:

```
interface FastEthernet0/0
 ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
!
```

```
interface Serial0/0.1 point-to-point
 ip address 155.1.0.2 255.255.255.0
 frame-relay interface-dlci 205
!
interface Serial0/1
 ip address 155.1.23.2 255.255.255.0
!
router eigrp 2
 network 155.1.23.2 0.0.0.0
 no auto-summary
!
router bgp 65002
 bgp confederation identifier 2
 bgp confederation peers 65013
 neighbor 155.1.0.5 remote-as 1
 neighbor 155.1.23.3 remote-as 65013
```

R3:

```
interface Ethernet0/0
 ip address 155.1.37.3 255.255.255.0
!
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
interface Serial1/3
 ip address 155.1.23.3 255.255.255.0
 clockrate 64000
!
router eigrp 2
 network 155.1.13.3 0.0.0.0
 network 155.1.23.3 0.0.0.0
 no auto-summary
!
router bgp 65013
 bgp confederation identifier 2
 bgp confederation peers 65002
 network 155.1.37.0 mask 255.255.255.0
 neighbor 155.1.13.1 remote-as 65013
 neighbor 155.1.13.1 next-hop-self
 neighbor 155.1.23.2 remote-as 65002
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 3
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/0
 ip address 155.1.58.5 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2
```

Verification

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2
seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
72/73/76 ms
```

```
Rack1R3#ping 204.12.1.4 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 204.12.1.4, timeout is 2
```


seconds:

Packet sent with a source address of 155.1.37.3

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max =
28/30/32 ms

Rack1R1#show ip bgp 204.12.1.0

BGP routing table entry for 204.12.1.0/24, version 5

Paths: (1 available, best #1, table Default-IP-Routing-
Table, not advertised outside local AS)

Advertised to non peer-group peers:

155.1.13.3

3

155.1.146.4 from 155.1.146.4 (150.1.4.4)

Origin IGP, metric 0, localpref 100, valid, external,
best

Community: local-AS

Rack1R3#show ip bgp 204.12.1.0

BGP routing table entry for 204.12.1.0/24, version 5

Paths: (1 available, best #1, table Default-IP-Routing-
Table, not advertised outside local AS)

Not advertised to any peer

3

155.1.13.1 from 155.1.13.1 (150.1.1.1)

Origin IGP, metric 0, localpref 100, valid, confed-
internal, best

Community: local-AS

Rack1R1#show ip bgp

BGP table version is 5, local router ID is 150.1.1.1

Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.13.3	0	100
0 (65002) 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			
*> 204.12.1.0	155.1.146.4	0	
0 3 i			

Rack1R2#show ip bgp

BGP table version is 5, local router ID is 150.1.2.2

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	155.1.0.5	0	
0 1 i			
*> 155.1.37.0/24	155.1.23.3	0	100
0 (65013) i			

Rack1R3#show ip bgp

BGP table version is 5, local router ID is 150.1.3.3

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	155.1.0.5	0	100
0 (65002) 1 i			
*> 155.1.37.0/24	0.0.0.0	0	
32768 i			
*> 204.12.1.0	155.1.13.1	0	100
0 3 i			

Rack1R4#show ip bgp

BGP table version is 14, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	155.1.146.1		
0 2 1 i			
*> 155.1.37.0/24	155.1.146.1		
0 2 i			
*> 204.12.1.0	0.0.0.0	0	
32768 i			

Rack1R5#show ip bgp

BGP table version is 9, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric LocPrf
*> 155.1.1.5.0/24 32768 i	0.0.0.0	0
*> 155.1.1.37.0/24 0 2 i	155.1.0.2	

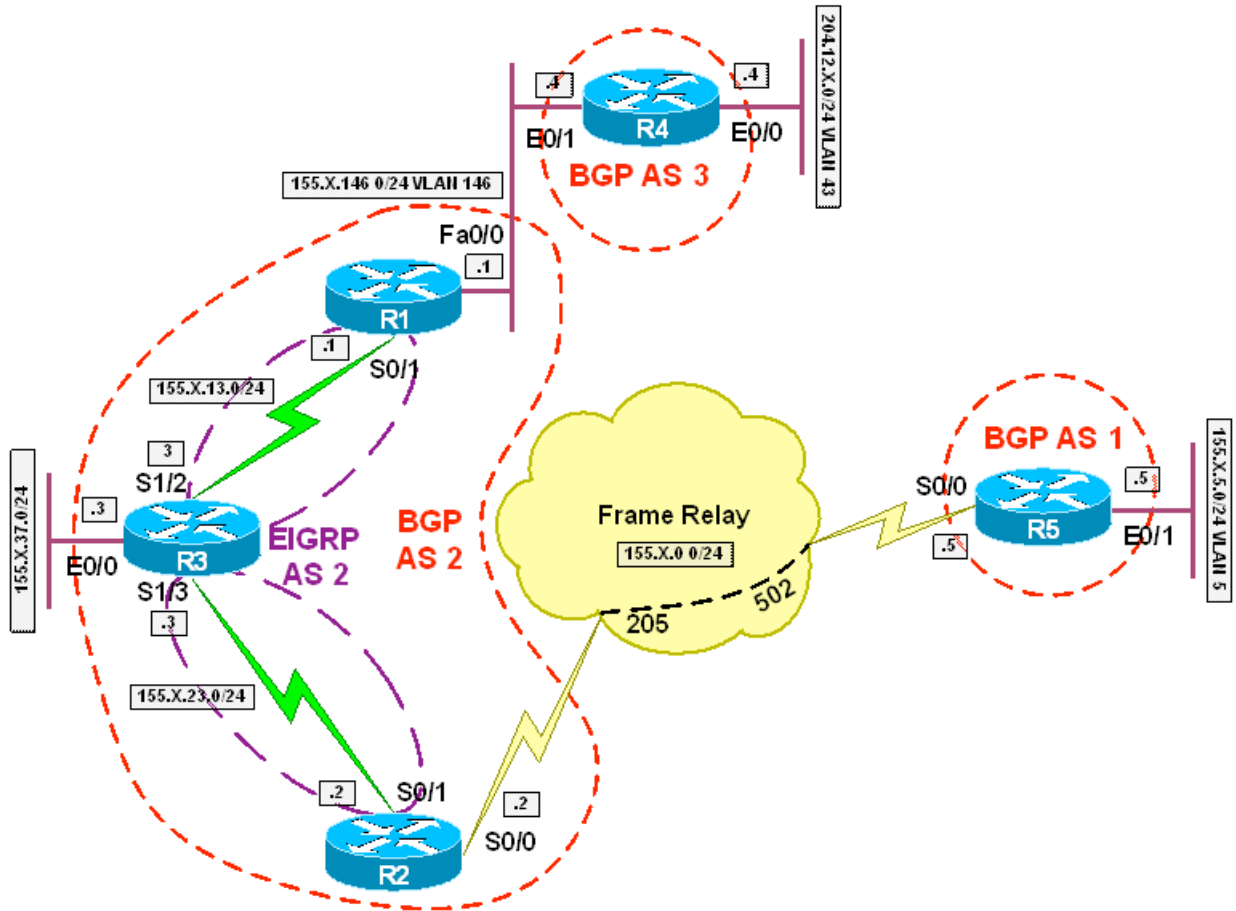


Recommended Reading

[RFC 1997 - BGP Communities Attribute](#)

BGP Regular Expressions

Objective: Configure AS-Path access-list filtering on R1 and R2 in such a way that hosts on R3's Ethernet have access to VLAN 5 and VLAN 43 but hosts on VLANs 5 and 43 do not have access to each other



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 2 on the links between R1 & R3 and R2 & R3
- Configure BGP on R1, R2, R3, R4, and R5 per the diagram
- R1 should peer with R4
- R2 should peer with R5
- R1, R2, and R3 should all peer with each other
- Advertise R3's Ethernet into BGP on R3
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4
- Configure an AS-Path access-list on R1 and R2 to only advertise routes originated in AS 2 out to AS 1 and AS 3

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 network 155.1.13.1 0.0.0.0
 no auto-summary
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.23.2 remote-as 2
 neighbor 155.1.23.2 next-hop-self
 neighbor 155.1.146.4 remote-as 3
 neighbor 155.1.146.4 filter-list 1 out
!
ip as-path access-list 1 permit ^$
```

R2:

```
interface FastEthernet0/0
 ip address 192.10.1.2 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
```

```
ip address 155.1.0.2 255.255.255.0
frame-relay interface-dlci 205
!
interface Serial0/1
ip address 155.1.23.2 255.255.255.0
!
router eigrp 2
network 155.1.23.2 0.0.0.0
no auto-summary
!
router bgp 2
neighbor 155.1.0.5 remote-as 1
neighbor 155.1.0.5 filter-list 1 out
neighbor 155.1.13.1 remote-as 2
neighbor 155.1.13.1 next-hop-self
neighbor 155.1.23.3 remote-as 2
neighbor 155.1.23.3 next-hop-self
!
ip as-path access-list 1 permit ^$
```

R3:

```
interface Ethernet0/0
ip address 155.1.37.3 255.255.255.0
!
interface Serial1/2
ip address 155.1.13.3 255.255.255.0
clockrate 64000
!
interface Serial1/3
ip address 155.1.23.3 255.255.255.0
clockrate 64000
!
router eigrp 2
network 155.1.13.3 0.0.0.0
network 155.1.23.3 0.0.0.0
no auto-summary
!
router bgp 2
network 155.1.37.0 mask 255.255.255.0
neighbor 155.1.13.1 remote-as 2
neighbor 155.1.23.2 remote-as 2
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 3
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2
```

Verification

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2
seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
84/86/88 ms
```

```
Rack1R3#ping 204.12.1.4 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 204.12.1.4, timeout is 2
seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
28/30/32 ms
```

```
Rack1R4#ping 155.1.5.5 source 204.12.1.4
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2
seconds:
```

```
Packet sent with a source address of 204.12.1.4
```

```
.....
```

```
Success rate is 0 percent (0/5)
```

```
Rack1R1#show ip bgp neighbors 155.1.146.4 advertised-routes
```

```
BGP table version is 4, local router ID is 150.1.1.1
```

```
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

```
Rack1R2#show ip bgp neighbors 155.1.0.5 advertised-routes
```

```
BGP table version is 4, local router ID is 150.1.2.2
```

```
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf
*>i155.1.37.0/24	155.1.23.3	0	100
0 i			

```
Rack1R1#show ip bgp
```

```
BGP table version is 4, local router ID is 150.1.1.1
```

```
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.23.2	0	100
0 1 i			


```
*>i155.1.37.0/24    155.1.13.3          0    100
0 i
*> 204.12.1.0      155.1.146.4         0
0 3 i
```

Rack1R2#show ip bgp

BGP table version is 4, local router ID is 150.1.2.2

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 0 1 i	155.1.0.5	0	
*>i155.1.37.0/24 0 i	155.1.23.3	0	100
*>i204.12.1.0 0 3 i	155.1.13.1	0	100

Rack1R3#show ip bgp

BGP table version is 4, local router ID is 150.1.3.3

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24 0 1 i	155.1.23.2	0	100
*> 155.1.37.0/24 32768 i	0.0.0.0	0	
*>i204.12.1.0 0 3 i	155.1.13.1	0	100

Rack1R4#show ip bgp

BGP table version is 17, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.37.0/24 0 2 i	155.1.146.1		

```
*> 204.12.1.0      0.0.0.0      0
32768 i
```

Rack1R5#**show ip bgp**

BGP table version is 11, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

 r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric LocPrf
*> 155.1.5.0/24 32768 i	0.0.0.0	0
*> 155.1.37.0/24 0 2 i	155.1.0.2	

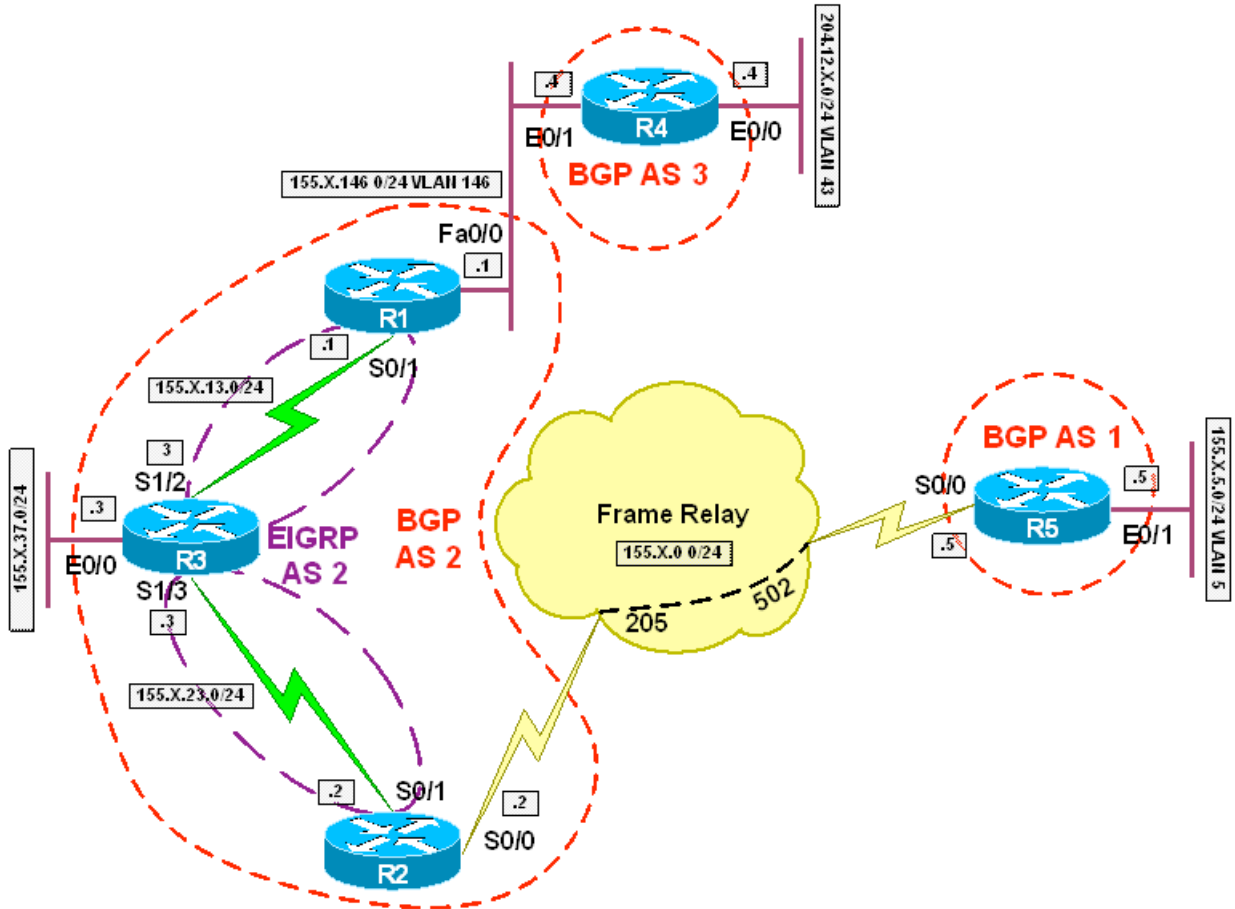


Recommended Reading

[Using Regular Expressions in BGP](#)

BGP Outbound Route Filtering (ORF)

Objective: Configure BGP ORF between R1 and R4 so that R1 does not advertise VLAN 5 to R4



Directions

- Configure the topology per the diagram
- Configure EIGRP AS 2 on the links between R1 & R3 and R2 & R3
- Configure BGP on R1, R2, R3, R4, and R5 per the diagram
- R1 should peer with R4
- R2 should peer with R5
- R1, R2, and R3 should all peer with each other
- Advertise R3's Ethernet into BGP on R3
- Advertise VLAN 5 into BGP on R5
- Advertise VLAN 43 into BGP on R4
- Configure BGP ORF between R1 and R4
- R4 should send the BGP ORF prefix-list to R1
- R1 should use the list received for outbound filtering towards R4

Final Configuration

R1:

```
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router eigrp 2
 network 155.1.13.1 0.0.0.0
 no auto-summary
!
router bgp 2
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.23.2 remote-as 2
 neighbor 155.1.146.4 remote-as 3
!
 address-family ipv4
  neighbor 155.1.13.3 activate
  neighbor 155.1.13.3 next-hop-self
  neighbor 155.1.23.2 activate
  neighbor 155.1.23.2 next-hop-self
  neighbor 155.1.146.4 activate
  neighbor 155.1.146.4 capability orf prefix-list receive
```

R2:

```
interface FastEthernet0/0
 ip address 192.10.1.2 255.255.255.0
!
```

```
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.2 255.255.255.0
  frame-relay interface-dlci 205
!
interface Serial0/1
  ip address 155.1.23.2 255.255.255.0
!
router eigrp 2
  network 155.1.23.2 0.0.0.0
  no auto-summary
!
router bgp 2
  neighbor 155.1.0.5 remote-as 1
  neighbor 155.1.13.1 remote-as 2
  neighbor 155.1.13.1 next-hop-self
  neighbor 155.1.23.3 remote-as 2
  neighbor 155.1.23.3 next-hop-self
```

R3:

```
interface Ethernet0/0
  ip address 155.1.37.3 255.255.255.0
!
interface Serial1/2
  ip address 155.1.13.3 255.255.255.0
  clockrate 64000
!
interface Serial1/3
  ip address 155.1.23.3 255.255.255.0
  clockrate 64000
!
router eigrp 2
  network 155.1.13.3 0.0.0.0
  network 155.1.23.3 0.0.0.0
  no auto-summary
!
router bgp 2
  network 155.1.37.0 mask 255.255.255.0
  neighbor 155.1.13.1 remote-as 2
  neighbor 155.1.23.2 remote-as 2
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 3
 neighbor 155.1.146.1 remote-as 2
!
 address-family ipv4
 neighbor 155.1.146.1 activate
 neighbor 155.1.146.1 capability orf prefix-list send
 neighbor 155.1.146.1 prefix-list DENY_VLAN5 in
 network 204.12.1.0
 exit-address-family
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.2 remote-as 2
```

Verification

```
Rack1R3#ping 155.1.5.5 source 155.1.37.3
```

Type escape sequence to abort.

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2
seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
84/86/88 ms
```

```
Rack1R3#ping 204.12.1.4 source 155.1.37.3
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 204.12.1.4, timeout is 2
seconds:
```

```
Packet sent with a source address of 155.1.37.3
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max =
28/30/32 ms
```

```
Rack1R4#ping 155.1.5.5 source 204.12.1.4
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 155.1.5.5, timeout is 2
seconds:
```

```
Packet sent with a source address of 204.12.1.4
```

```
.....
```

```
Success rate is 0 percent (0/5)
```

```
Rack1R1#show ip bgp neighbors 155.1.146.4 advertised-routes
```

```
BGP table version is 4, local router ID is 150.1.1.1
```

```
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			

```
Rack1R1#show ip bgp
```

```
BGP table version is 4, local router ID is 150.1.1.1
```

```
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```

```
          r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf
*>i155.1.5.0/24	155.1.23.2	0	100
0 1 i			
*>i155.1.37.0/24	155.1.13.3	0	100
0 i			
*> 204.12.1.0	155.1.146.4	0	
0 3 i			

Rack1R2#show ip bgp

BGP table version is 4, local router ID is 150.1.2.2

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.5.0/24 0 1 i	155.1.0.5	0	
*>i155.1.37.0/24 0 i	155.1.23.3	0	100
*>i204.12.1.0 0 3 i	155.1.13.1	0	100

Rack1R3#show ip bgp

BGP table version is 4, local router ID is 150.1.3.3

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*>i155.1.5.0/24 0 1 i	155.1.23.2	0	100
*> 155.1.37.0/24 32768 i	0.0.0.0	0	
*>i204.12.1.0 0 3 i	155.1.13.1	0	100

Rack1R4#show ip bgp

BGP table version is 17, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 155.1.37.0/24 0 2 i	155.1.146.1		
*> 204.12.1.0 32768 i	0.0.0.0	0	

Rack1R5#show ip bgp

BGP table version is 14, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*> 155.1.37.0/24	155.1.0.2		
0 2 i			
*> 204.12.1.0	155.1.0.2		
0 2 3 i			

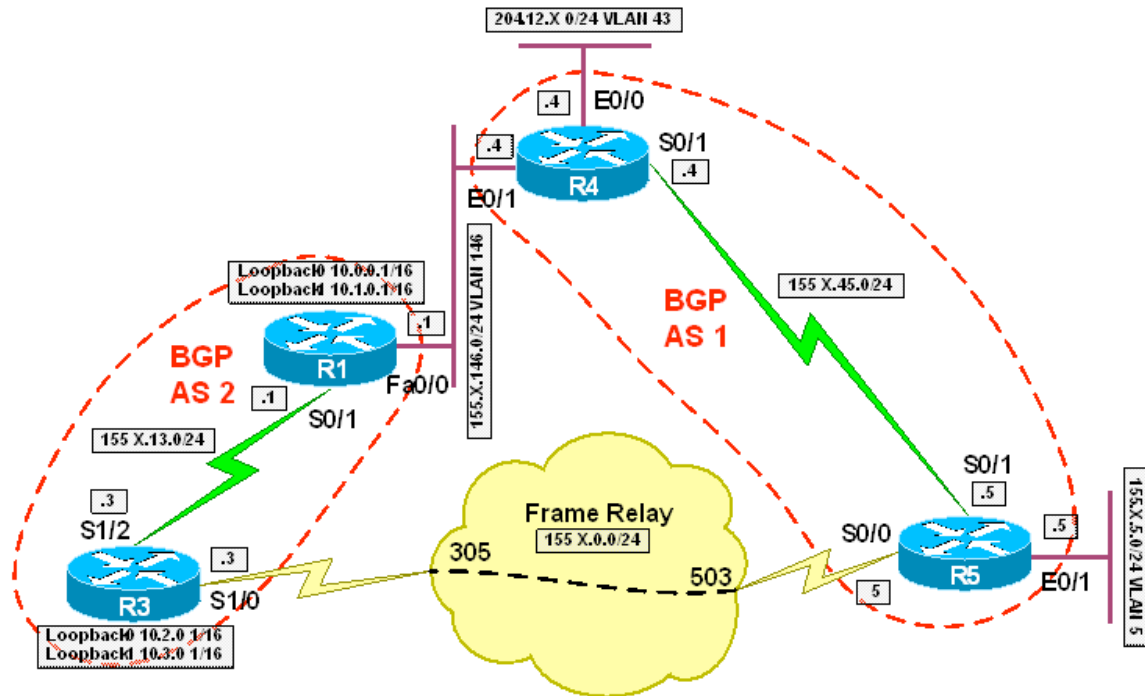


Recommended Reading

[BGP Prefix-Based Outbound Route Filtering](#)

BGP Aggregation

Objective: Configure AS 2 so that AS 1 sees an aggregate route representing the 10.0.0.0/16, 10.1.0.0/16, 10.2.0.0/16, and 10.3.0.0/16 networks



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R4
- Advertise VLAN 5 and 43 into BGP on R5 and R4 respectively
- Create the Loopback networks 10.0.0.1/16 and 10.1.0.1/16 on R1 and advertise them into BGP
- Create the Loopback networks 10.2.0.1/16 and 10.3.0.1/16 on R3 and advertise them into BGP
- Configure BGP aggregation on R1 for all four of these networks

Final Configuration

R1:

```
interface Loopback0
  ip address 10.0.0.1 255.255.0.0
!
interface Loopback1
  ip address 10.1.0.1 255.255.0.0
!
interface FastEthernet0/0
  ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
  ip address 155.1.13.1 255.255.255.0
!
router bgp 2
  network 10.0.0.0 mask 255.255.0.0
  network 10.1.0.0 mask 255.255.0.0
  aggregate-address 10.0.0.0 255.252.0.0
  neighbor 155.1.13.3 remote-as 2
  neighbor 155.1.13.3 next-hop-self
  neighbor 155.1.146.4 remote-as 1
```

R3:

```
interface Loopback0
  ip address 10.2.0.1 255.255.0.0
!
interface Loopback1
```

```
ip address 10.3.0.1 255.255.0.0
!
interface Serial1/0
  encapsulation frame-relay
!
interface Serial1/0.1 point-to-point
  ip address 155.1.0.3 255.255.255.0
  frame-relay interface-dlci 305
!
interface Serial1/2
  ip address 155.1.13.3 255.255.255.0
  clockrate 64000
!
router bgp 2
  network 10.2.0.0 mask 255.255.0.0
  network 10.3.0.0 mask 255.255.0.0
  neighbor 155.1.13.1 remote-as 2
  neighbor 155.1.13.1 next-hop-self
  neighbor 155.1.0.5 remote-as 1
```

R4:

```
interface Ethernet0/0
  ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
  ip address 155.1.146.4 255.255.255.0
!
router bgp 1
  network 204.12.1.0
  neighbor 155.1.146.1 remote-as 2
  neighbor 155.1.45.5 remote-as 1
  neighbor 155.1.45.5 next-hop-self
```

R5:

```
interface Serial0/0
  ip address 155.1.0.5 255.255.255.0
  encapsulation frame-relay
  frame-relay map ip 155.1.0.2 502 broadcast
!
```

```

interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.3 remote-as 2
 neighbor 155.1.45.4 remote-as 1
 neighbor 155.1.45.4 next-hop-self

```

Verification

Rack1R1#**show ip bgp**

```

BGP table version is 8, local router ID is 10.1.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
*> 10.0.0.0/16 32768 i	0.0.0.0	0	
*> 10.0.0.0/14 32768 i	0.0.0.0		
*> 10.1.0.0/16 32768 i	0.0.0.0	0	
*>i10.2.0.0/16 0 i	155.1.13.3	0	100
*>i10.3.0.0/16 0 i	155.1.13.3	0	100
* i155.1.5.0/24 0 1 i	155.1.13.3	0	100
*> 0 1 i	155.1.146.4		
* i204.12.1.0 0 1 i	155.1.13.3	0	100
*> 0 1 i	155.1.146.4	0	

Rack1R3#**show ip bgp**

```

BGP table version is 10, local router ID is 10.3.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,

```

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*>i10.0.0.0/16 0 i	155.1.13.1	0	100
*>i10.0.0.0/14 0 i	155.1.13.1	0	100
*>i10.1.0.0/16 0 i	155.1.13.1	0	100
*> 10.2.0.0/16 32768 i	0.0.0.0	0	
*> 10.3.0.0/16 32768 i	0.0.0.0	0	
*> 155.1.5.0/24 0 1 i	155.1.0.5	0	
* i 0 1 i	155.1.13.1	0	100
*> 204.12.1.0 0 1 i	155.1.0.5		
* i 0 1 i	155.1.13.1	0	100

Rack1R4#show ip bgp

BGP table version is 8, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
* i10.0.0.0/16 0 2 i	155.1.145.5	0	100
*> 0 2 i	155.1.146.1	0	
* i10.0.0.0/14 0 2 i	155.1.145.5	0	100
*> 0 2 i	155.1.146.1	0	
* i10.1.0.0/16 0 2 i	155.1.145.5	0	100
*> 0 2 i	155.1.146.1	0	
* i10.2.0.0/16	155.1.145.5	0	100

```

0 2 i
*> 155.1.146.1
0 2 i
* i10.3.0.0/16 155.1.45.5 0 100
0 2 i
*> 155.1.146.1
0 2 i
*>i155.1.5.0/24 155.1.45.5 0 100
0 i
*> 204.12.1.0 0.0.0.0 0
32768 i

```

Rack1R5#**show ip bgp**

BGP table version is 13, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

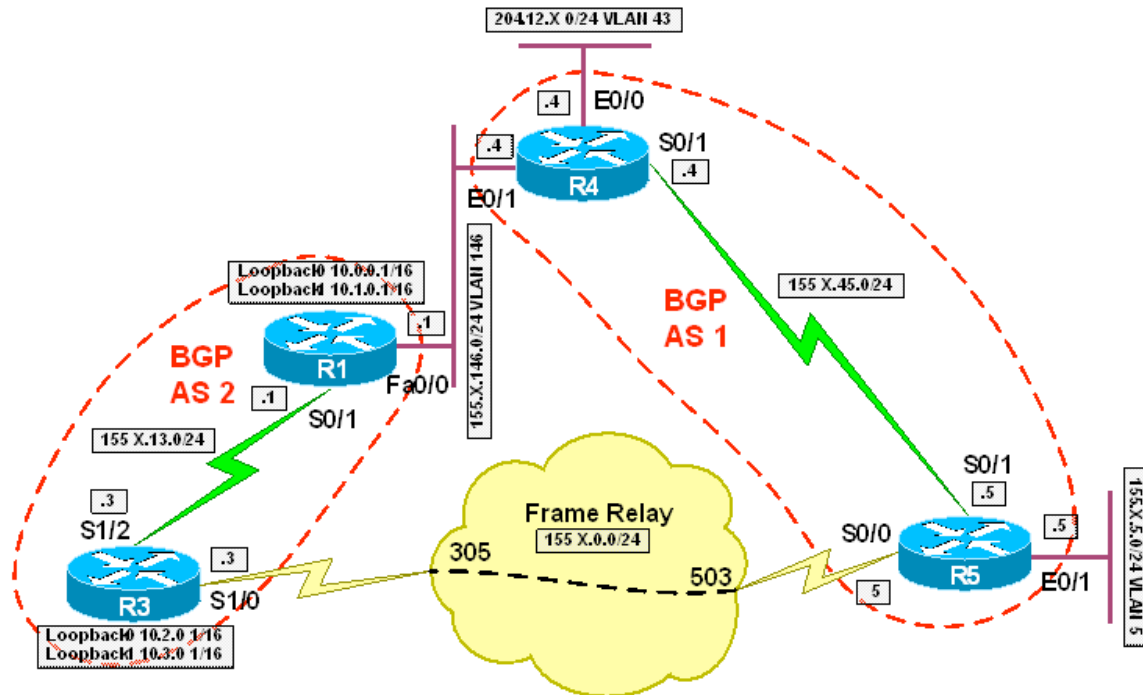
r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
*> 10.0.0.0/16	155.1.0.3		
* i	155.1.45.4	0	100
*> 10.0.0.0/14	155.1.0.3		
* i	155.1.45.4	0	100
*> 10.1.0.0/16	155.1.0.3		
* i	155.1.45.4	0	100
*> 10.2.0.0/16	155.1.0.3	0	
* i	155.1.45.4	0	100
*> 10.3.0.0/16	155.1.0.3	0	
* i	155.1.45.4	0	100
*> 155.1.5.0/24	0.0.0.0	0	
*>i204.12.1.0	155.1.45.4	0	100

BGP Aggregation – Summary Only

Objective: Configure AS 2 so that AS 1 sees an aggregate route representing the 10.0.0.0/16, 10.1.0.0/16, 10.2.0.0/16, and 10.3.0.0/16 networks but does not see the subnets that make up the aggregate



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R4
- Advertise VLAN 5 and 43 into BGP on R5 and R4 respectively
- Create the Loopback networks 10.0.0.1/16 and 10.1.0.1/16 on R1 and advertise them into BGP
- Create the Loopback networks 10.2.0.1/16 and 10.3.0.1/16 on R3 and advertise them into BGP
- Configure BGP aggregation on R1 and R3 for all four of these networks using the summary-only keyword

Final Configuration

```
R1:
interface Loopback0
 ip address 10.0.0.1 255.255.0.0
!
```



```
interface Loopback1
  ip address 10.1.0.1 255.255.0.0
!
interface FastEthernet0/0
  ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
  ip address 155.1.13.1 255.255.255.0
!
router bgp 2
  network 10.0.0.0 mask 255.255.0.0
  network 10.1.0.0 mask 255.255.0.0
  aggregate-address 10.0.0.0 255.252.0.0 summary-only
  neighbor 155.1.13.3 remote-as 2
  neighbor 155.1.13.3 next-hop-self
  neighbor 155.1.146.4 remote-as 1
```

R3:

```
interface Loopback0
  ip address 10.2.0.1 255.255.0.0
!
interface Loopback1
  ip address 10.3.0.1 255.255.0.0
!
interface Serial1/0
  encapsulation frame-relay
!
interface Serial1/0.1 point-to-point
  ip address 155.1.0.3 255.255.255.0
  frame-relay interface-dlci 305
!
interface Serial1/2
  ip address 155.1.13.3 255.255.255.0
  clockrate 64000
!
router bgp 2
  network 10.2.0.0 mask 255.255.0.0
  network 10.3.0.0 mask 255.255.0.0
  aggregate-address 10.0.0.0 255.252.0.0 summary-only
```

```
neighbor 155.1.13.1 remote-as 2
neighbor 155.1.13.1 next-hop-self
neighbor 155.1.0.5 remote-as 1
```

R3:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 1
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.3 remote-as 2
 neighbor 155.1.45.4 remote-as 1
 neighbor 155.1.45.4 next-hop-self
```

Verification

```
Rack1R1#show ip bgp
```

```
BGP table version is 14, local router ID is 10.1.0.1
```

```
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```

```
          r RIB-failure, S Stale
```

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
s> 10.0.0.0/16 32768 i	0.0.0.0	0	
* i10.0.0.0/14 0 i	155.1.13.3	0	100
*> 32768 i	0.0.0.0		
s> 10.1.0.0/16 32768 i	0.0.0.0	0	
* i155.1.5.0/24 0 1 i	155.1.13.3	0	100
*> 0 1 i	155.1.146.4		
* i204.12.1.0 0 1 i	155.1.13.3	0	100
*> 0 1 i	155.1.146.4	0	

Rack1R3#show ip bgp

BGP table version is 15, local router ID is 10.3.0.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 10.0.0.0/14 32768 i	0.0.0.0		
* i 0 i	155.1.13.1	0	100
s> 10.2.0.0/16 32768 i	0.0.0.0	0	
s> 10.3.0.0/16 32768 i	0.0.0.0	0	
*> 155.1.5.0/24 0 1 i	155.1.0.5	0	
* i 0 1 i	155.1.13.1	0	100
*> 204.12.1.0 0 1 i	155.1.0.5		
* i 0 1 i	155.1.13.1	0	100

Rack1R4#show ip bgp

BGP table version is 16, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
* i10.0.0.0/14	155.1.45.5	0	100
0 2 i			
*>	155.1.146.1	0	
0 2 i			
*>i155.1.5.0/24	155.1.45.5	0	100
0 i			
*> 204.12.1.0	0.0.0.0	0	
32768 i			

Rack1R5#show ip bgp

BGP table version is 18, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

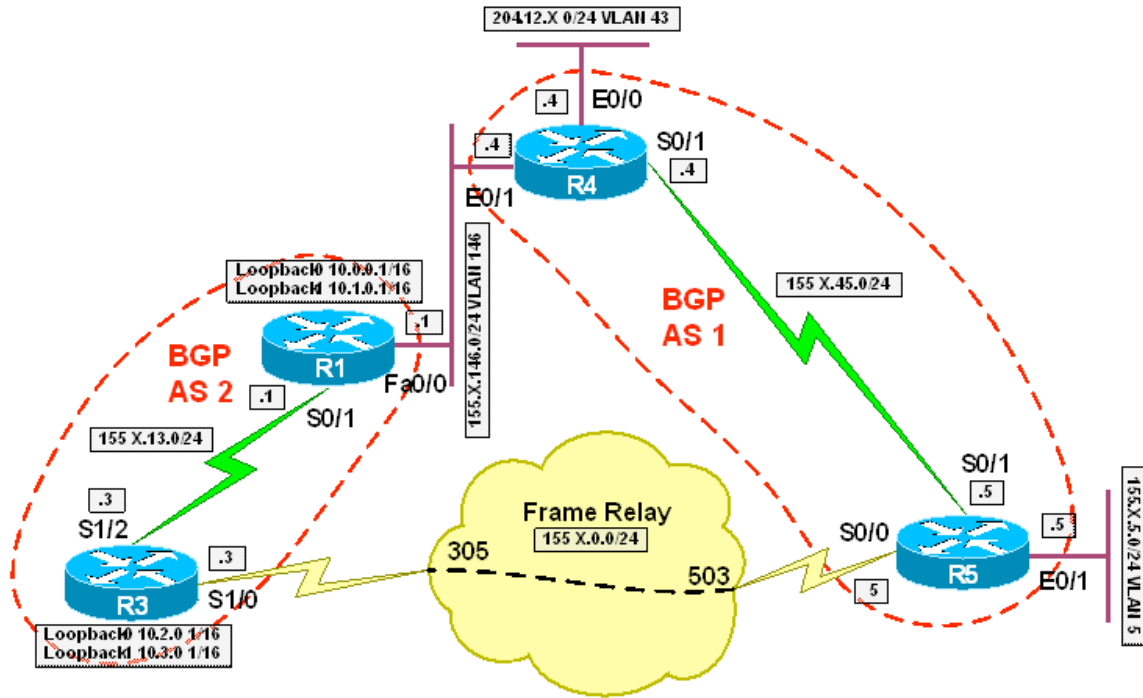
r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf
Weight Path			
*> 10.0.0.0/14	155.1.0.3	0	
0 2 i			
* i	155.1.45.4	0	100
0 2 i			
*> 155.1.5.0/24	0.0.0.0	0	
32768 i			
*>i204.12.1.0	155.1.45.4	0	100
0 i			

BGP Aggregation – Suppress Map

Objective: Configure AS 2 so that AS 1 sees an aggregate route representing the 10.0.0.0/16, 10.1.0.0/16, 10.2.0.0/16, and 10.3.0.0/16 networks along with the subnets 10.0.0.0/16 and 10.3.0.0/16



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R4
- Advertise VLAN 5 and 43 into BGP on R5 and R4 respectively
- Create the Loopback networks 10.0.0.1/16 and 10.1.0.1/16 on R1 and advertise them into BGP
- Create the Loopback networks 10.2.0.1/16 and 10.3.0.1/16 on R3 and advertise them into BGP
- Configure BGP aggregation on R1 and R3 for all four of these networks
- R1 should suppress only the 10.1.0.0/16 network
- R3 should suppress only the 10.2.0.0/16 network

Final Configuration

R1:

```
interface Loopback0
 ip address 10.0.0.1 255.255.0.0
!
interface Loopback1
 ip address 10.1.0.1 255.255.0.0
!
interface FastEthernet0/0
 ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
 ip address 155.1.13.1 255.255.255.0
!
router bgp 2
 network 10.0.0.0 mask 255.255.0.0
 network 10.1.0.0 mask 255.255.0.0
 aggregate-address 10.0.0.0 255.252.0.0 suppress-map
 SUPPRESS
 neighbor 155.1.13.3 remote-as 2
 neighbor 155.1.13.3 next-hop-self
 neighbor 155.1.146.4 remote-as 1
!
ip prefix-list 10.1.0.0 seq 5 permit 10.1.0.0/16
!
route-map SUPPRESS permit 10
```

```
match ip address prefix-list 10.1.0.0
```

R3:

```
interface Loopback0
 ip address 10.2.0.1 255.255.0.0
!
interface Loopback1
 ip address 10.3.0.1 255.255.0.0
!
interface Serial1/0
 encapsulation frame-relay
!
interface Serial1/0.1 point-to-point
 ip address 155.1.0.3 255.255.255.0
 frame-relay interface-dlci 305
!
interface Serial1/2
 ip address 155.1.13.3 255.255.255.0
 clockrate 64000
!
router bgp 2
 network 10.2.0.0 mask 255.255.0.0
 network 10.3.0.0 mask 255.255.0.0
 aggregate-address 10.0.0.0 255.252.0.0 suppress-map
 SUPPRESS
 neighbor 155.1.13.1 remote-as 2
 neighbor 155.1.13.1 next-hop-self
 neighbor 155.1.0.5 remote-as 1
!
ip prefix-list 10.2.0.0 seq 5 permit 10.2.0.0/16
!
route-map SUPPRESS permit 10
 match ip address prefix-list 10.2.0.0
```

R4:

```
interface Ethernet0/0
 ip address 204.12.1.4 255.255.255.0
!
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
```

```

!
router bgp 1
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self

```

R5:

```

interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.3 remote-as 2
 neighbor 155.1.45.4 remote-as 1
 neighbor 155.1.45.4 next-hop-self

```

Verification

```
Rack1R1#show ip bgp
```

```

BGP table version is 9, local router ID is 10.1.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
*> 10.0.0.0/16 32768 i	0.0.0.0	0	
* i10.0.0.0/14 0 i	155.1.13.3	0	100
*> 32768 i	0.0.0.0		
s> 10.1.0.0/16	0.0.0.0	0	


```

32768 i
*>i10.3.0.0/16      155.1.13.3      0    100
0 i
* i155.1.5.0/24    155.1.13.3      0    100
0 1 i
*>                  155.1.146.4
0 1 i
* i204.12.1.0      155.1.13.3      0    100
0 1 i
*>                  155.1.146.4      0
0 1 i

```

Rack1R3#show ip bgp

```

BGP table version is 9, local router ID is 10.3.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network	Next Hop	Metric	LocPrf
*>i10.0.0.0/16	155.1.13.1	0	100
0 i			
*> 10.0.0.0/14	0.0.0.0		
32768 i			
* i	155.1.13.1	0	100
0 i			
s> 10.2.0.0/16	0.0.0.0	0	
32768 i			
*> 10.3.0.0/16	0.0.0.0	0	
32768 i			
* i155.1.5.0/24	155.1.13.1	0	100
0 1 i			
*>	155.1.0.5	0	
0 1 i			
* i204.12.1.0	155.1.13.1	0	100
0 1 i			
*>	155.1.0.5		
0 1 i			

Rack1R4#show ip bgp

```

BGP table version is 28, local router ID is 150.1.4.4
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
* i10.0.0.0/16 0 2 i	155.1.145.5	0	100
*> 0 2 i	155.1.146.1	0	
* i10.0.0.0/14 0 2 i	155.1.145.5	0	100
*> 0 2 i	155.1.146.1	0	
*> 10.3.0.0/16 0 2 i	155.1.146.1		
* i 0 2 i	155.1.145.5	0	100
*>i155.1.5.0/24 0 i	155.1.145.5	0	100
*> 204.12.1.0 32768 i	0.0.0.0	0	

Rack1R5#show ip bgp

BGP table version is 27, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 10.0.0.0/16 0 2 i	155.1.1.0.3		
* i 0 2 i	155.1.145.4	0	100
*> 10.0.0.0/14 0 2 i	155.1.1.0.3	0	
* i 0 2 i	155.1.145.4	0	100
* i10.3.0.0/16 0 2 i	155.1.145.4	0	100
*> 0 2 i	155.1.1.0.3	0	
*> 155.1.5.0/24 32768 i	0.0.0.0	0	
*>i204.12.1.0 0 i	155.1.145.4	0	100

Rack1R4#**show ip route bgp**

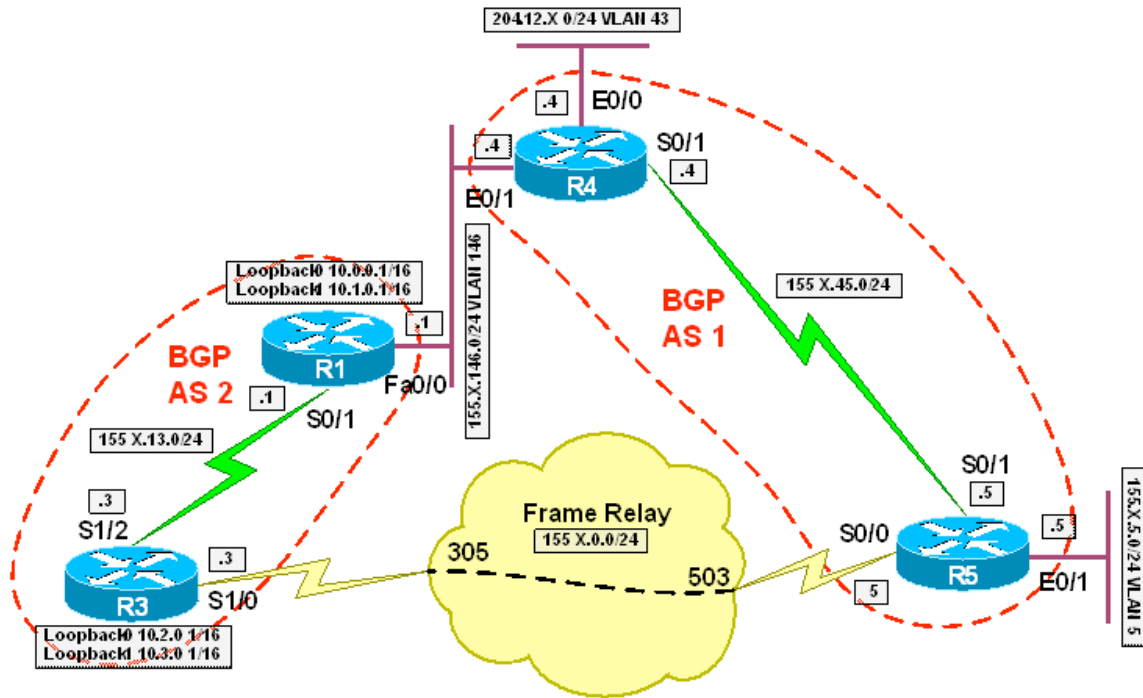
```
    155.1.0.0/24 is subnetted, 3 subnets
B       155.1.5.0 [200/0] via 155.1.45.5, 01:01:24
    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
B       10.3.0.0/16 [20/0] via 155.1.146.1, 00:03:51
B       10.0.0.0/16 [20/0] via 155.1.146.1, 00:05:04
B       10.0.0.0/14 [20/0] via 155.1.146.1, 00:05:04
```

Rack1R5#**show ip route bgp**

```
B    204.12.1.0/24 [200/0] via 155.1.45.4, 01:01:30
    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
B    10.3.0.0/16 [20/0] via 155.1.0.3, 00:03:57
B    10.0.0.0/16 [20/0] via 155.1.0.3, 00:03:57
B    10.0.0.0/14 [20/0] via 155.1.0.3, 00:03:57
```

BGP Aggregation – Unsuppress Map

Objective: Configure AS 2 so that AS 1 sees an aggregate route representing the 10.0.0.0/16, 10.1.0.0/16, 10.2.0.0/16, and 10.3.0.0/16 networks. Traffic for 10.0.0.1 should use the link between R1 and R4 while traffic for 10.3.0.1 should use the link between R3 and R5



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R3, R4, and R5 per the diagram
- R1 should peer with R3 and R4
- R5 should peer with R3 and R4
- Advertise VLAN 5 and 43 into BGP on R5 and R4 respectively
- Create the Loopback networks 10.0.0.1/16 and 10.1.0.1/16 on R1 and advertise them into BGP
- Create the Loopback networks 10.2.0.1/16 and 10.3.0.1/16 on R3 and advertise them into BGP
- Configure BGP aggregation on R1 and R3 for all four of these networks using the summary-only keyword
- R1 should unsuppress the 10.0.0.0/16 network to R4
- R3 should unsuppress the 10.3.0.0/16 network to R5

Final Configuration

R1:

```
interface Loopback0
  ip address 10.0.0.1 255.255.0.0
!
interface Loopback1
  ip address 10.1.0.1 255.255.0.0
!
interface FastEthernet0/0
  ip address 155.1.146.1 255.255.255.0
!
interface Serial0/1
  ip address 155.1.13.1 255.255.255.0
!
router bgp 2
  network 10.0.0.0 mask 255.255.0.0
  network 10.1.0.0 mask 255.255.0.0
  aggregate-address 10.0.0.0 255.252.0.0 summary-only
  neighbor 155.1.13.3 remote-as 2
  neighbor 155.1.13.3 next-hop-self
  neighbor 155.1.146.4 remote-as 1
  neighbor 155.1.146.4 unsuppress-map UNSUPPRESS
!
ip prefix-list 10.0.0.0 seq 5 permit 10.0.0.0/16
!
```

```
route-map UNSUPPRESS permit 10
  match ip address prefix-list 10.0.0.0
```

R3:

```
interface Loopback0
  ip address 10.2.0.1 255.255.0.0
!
interface Loopback1
  ip address 10.3.0.1 255.255.0.0
!
interface Serial1/0
  encapsulation frame-relay
!
interface Serial1/0.1 point-to-point
  ip address 155.1.0.3 255.255.255.0
  frame-relay interface-dlci 305
!
interface Serial1/2
  ip address 155.1.13.3 255.255.255.0
  clockrate 64000
!
router bgp 2
  network 10.2.0.0 mask 255.255.0.0
  network 10.3.0.0 mask 255.255.0.0
  aggregate-address 10.0.0.0 255.252.0.0 summary-only
  neighbor 155.1.13.1 remote-as 2
  neighbor 155.1.13.1 next-hop-self
  neighbor 155.1.0.5 remote-as 1
  neighbor 155.1.0.5 unsuppress-map UNSUPPRESS
!
ip prefix-list 10.3.0.0 seq 5 permit 10.3.0.0/16
!
route-map UNSUPPRESS permit 10
  match ip address prefix-list 10.3.0.0
```

R4:

```
interface Ethernet0/0
  ip address 204.12.1.4 255.255.255.0
!
```

```
interface Ethernet0/1
 ip address 155.1.146.4 255.255.255.0
!
router bgp 1
 network 204.12.1.0
 neighbor 155.1.146.1 remote-as 2
 neighbor 155.1.45.5 remote-as 1
 neighbor 155.1.45.5 next-hop-self
```

R5:

```
interface Serial0/0
 ip address 155.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 155.1.0.2 502 broadcast
!
interface Ethernet0/1
 ip address 155.1.5.5 255.255.255.0
!
router bgp 1
 network 155.1.5.0 mask 255.255.255.0
 neighbor 155.1.0.3 remote-as 2
 neighbor 155.1.45.4 remote-as 1
 neighbor 155.1.45.4 next-hop-self
```

Verification

```
Rack1R5#trace 10.0.0.1 source 155.1.5.5
```

Type escape sequence to abort.

Tracing the route to 10.0.0.1

```
 1 155.1.45.4 16 msec 12 msec 16 msec
 2 155.1.146.1 16 msec * 16 msec
```

```
Rack1R5#trace 10.3.0.1 source 155.1.5.5
```

Type escape sequence to abort.

Tracing the route to 10.3.0.1

```
1 155.1.0.3 32 msec * 28 msec
```

```
Rack1R4#trace 10.0.0.1 source 204.12.1.4
```

Type escape sequence to abort.

Tracing the route to 10.0.0.1

```
1 155.1.146.1 4 msec * 0 msec
```

```
Rack1R4#trace 10.3.0.1 source 204.12.1.4
```

Type escape sequence to abort.

Tracing the route to 10.3.0.1

```
1 155.1.45.5 16 msec 16 msec 16 msec
```

```
2 155.1.0.3 40 msec * 40 msec
```

```
Rack1R1#show ip bgp
```

BGP table version is 9, local router ID is 10.1.0.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
s> 10.0.0.0/16 32768 i	0.0.0.0	0	
*> 10.0.0.0/14 32768 i	0.0.0.0		
* i 0 i	155.1.13.3	0	100
s> 10.1.0.0/16 32768 i	0.0.0.0	0	
* i155.1.5.0/24 0 1 i	155.1.13.3	0	100
*> 0 1 i	155.1.146.4		
* i204.12.1.0 0 1 i	155.1.13.3	0	100
*> 0 1 i	155.1.146.4	0	

Rack1R1#show ip bgp neighbors 155.1.146.4 advertised-routes

BGP table version is 9, local router ID is 10.1.0.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
s> 10.0.0.0/16 32768 i	0.0.0.0	0	
*> 10.0.0.0/14 32768 i	0.0.0.0		

Rack1R3#show ip bgp

BGP table version is 14, local router ID is 10.3.0.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
* i10.0.0.0/14 0 i	155.1.13.1	0	100
*> 32768 i	0.0.0.0		
s> 10.2.0.0/16 32768 i	0.0.0.0	0	
s> 10.3.0.0/16 32768 i	0.0.0.0	0	
* i155.1.5.0/24 0 1 i	155.1.13.1	0	100
*> 0 1 i	155.1.0.5	0	
* i204.12.1.0 0 1 i	155.1.13.1	0	100
*> 0 1 i	155.1.0.5		

Rack1R3#show ip bgp neighbors 155.1.0.5 advertised-routes

BGP table version is 14, local router ID is 10.3.0.1

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 10.0.0.0/14 32768 i	0.0.0.0		
s> 10.3.0.0/16 32768 i	0.0.0.0	0	

Rack1R4#show ip bgp

BGP table version is 6, local router ID is 150.1.4.4

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 10.0.0.0/16 0 2 i	155.1.146.1	0	
* i10.0.0.0/14 0 2 i	155.1.45.5	0	100
*> 0 2 i	155.1.146.1	0	
*>i10.3.0.0/16 0 2 i	155.1.45.5	0	100
*>i155.1.5.0/24 0 i	155.1.45.5	0	100
*> 204.12.1.0 32768 i	0.0.0.0	0	

Rack1R5#show ip bgp

BGP table version is 6, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

r RIB-failure, S Stale

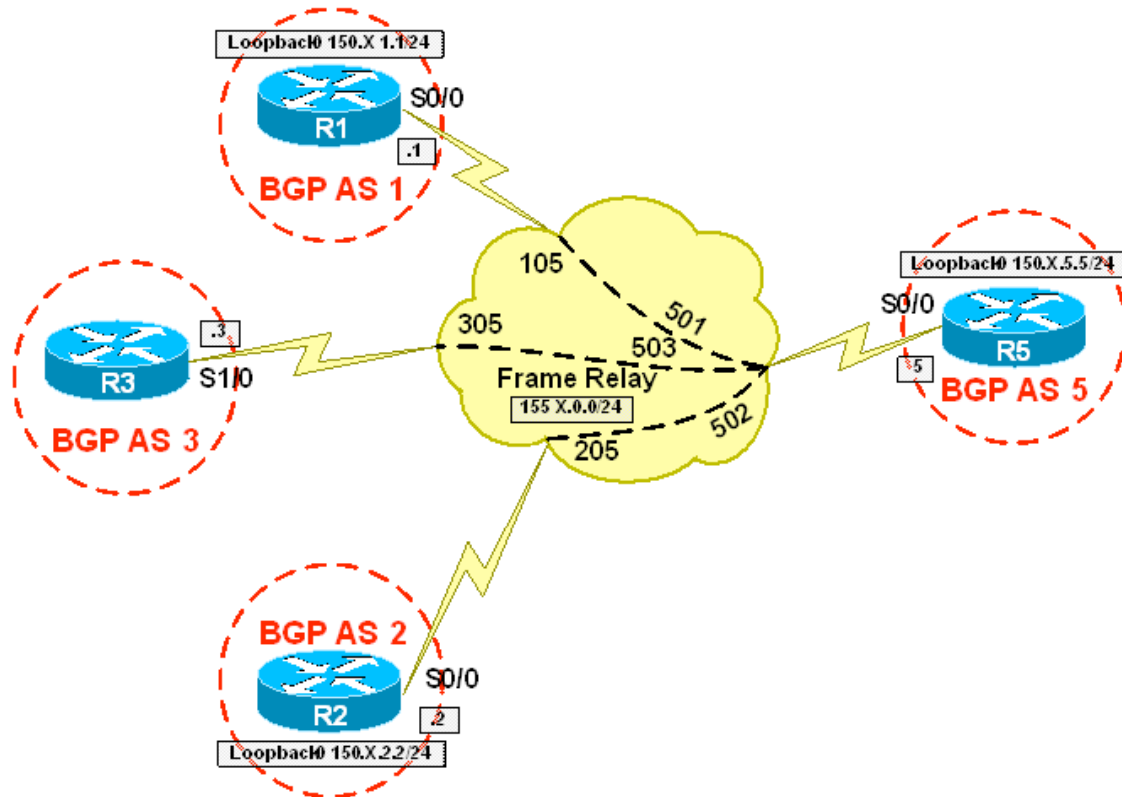
Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*>i10.0.0.0/16 0 2 i	155.1.45.4	0	100
* i10.0.0.0/14 0 2 i	155.1.45.4	0	100

```
*> 155.1.0.3 0
0 2 i
*> 10.3.0.0/16 155.1.0.3 0
0 2 i
*> 155.1.5.0/24 0.0.0.0 0
32768 i
*>i204.12.1.0 155.1.45.4 0 100
0 i
```

BGP Aggregation – AS-Set

Objective: Configure R5 to advertise the aggregate 150.X.0.0/21 to R3 without any specific subnet information. R3 should know that this aggregate is comprised of prefixes that passed through ASs 1, 2, and 5



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R2, R3, and R5 per the diagram
- R5 should peer with R1, R2, and R3
- Create the Loopback 150.X.1.1/24 on R1 and advertise it into BGP
- Create the Loopback 150.X.2.2/24 on R2 and advertise it into BGP
- Create the Loopback 150.X.5.5/24 on R5 and advertise it into BGP
- Configure the BGP aggregate 150.X.0.0/21 on R5
- Include the originating AS-Path information with this aggregate

Final Configuration**R1:**

```
interface Loopback0
  ip address 150.1.1.1 255.255.0.0
!
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.1 255.255.255.0
  frame-relay interface-dlci 105
!
router bgp 1
  network 150.1.1.0 mask 255.255.255.0
  neighbor 155.1.0.5 remote-as 5
```

R2:

```
interface Loopback0
  ip address 150.1.2.2 255.255.0.0
!
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.2 255.255.255.0
  frame-relay interface-dlci 205
!
router bgp 2
  network 150.1.2.0 mask 255.255.255.0
```

```
neighbor 155.1.0.5 remote-as 5
```

R3:

```
interface Serial1/0
  encapsulation frame-relay
!
interface Serial1/0.1 point-to-point
  ip address 155.1.0.3 255.255.255.0
  frame-relay interface-dlci 305
!
router bgp 3
  neighbor 155.1.0.5 remote-as 5
```

R5:

```
interface Loopback0
  ip address 150.1.5.5 255.255.0.0
!
interface Serial0/0
  ip address 155.1.0.5 255.255.255.0
  encapsulation frame-relay
  frame-relay map ip 155.1.0.1 501 broadcast
  frame-relay map ip 155.1.0.2 502 broadcast
  frame-relay map ip 155.1.0.3 503 broadcast
!
router bgp 5
  network 150.1.5.0 mask 255.255.255.0
  aggregate-address 150.1.0.0 255.255.248.0 as-set summary-
  only
  neighbor 155.1.0.1 remote-as 1
  neighbor 155.1.0.2 remote-as 2
  neighbor 155.1.0.3 remote-as 3
```

Verification

```
Rack1R3#show ip bgp
```

```
BGP table version is 8, local router ID is 10.3.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
```

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 150.1.0.0/21 0 5 {1,2} i	155.1.0.5		0

Rack1R5#show ip bgp

BGP table version is 8, local router ID is 150.1.5.5

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,

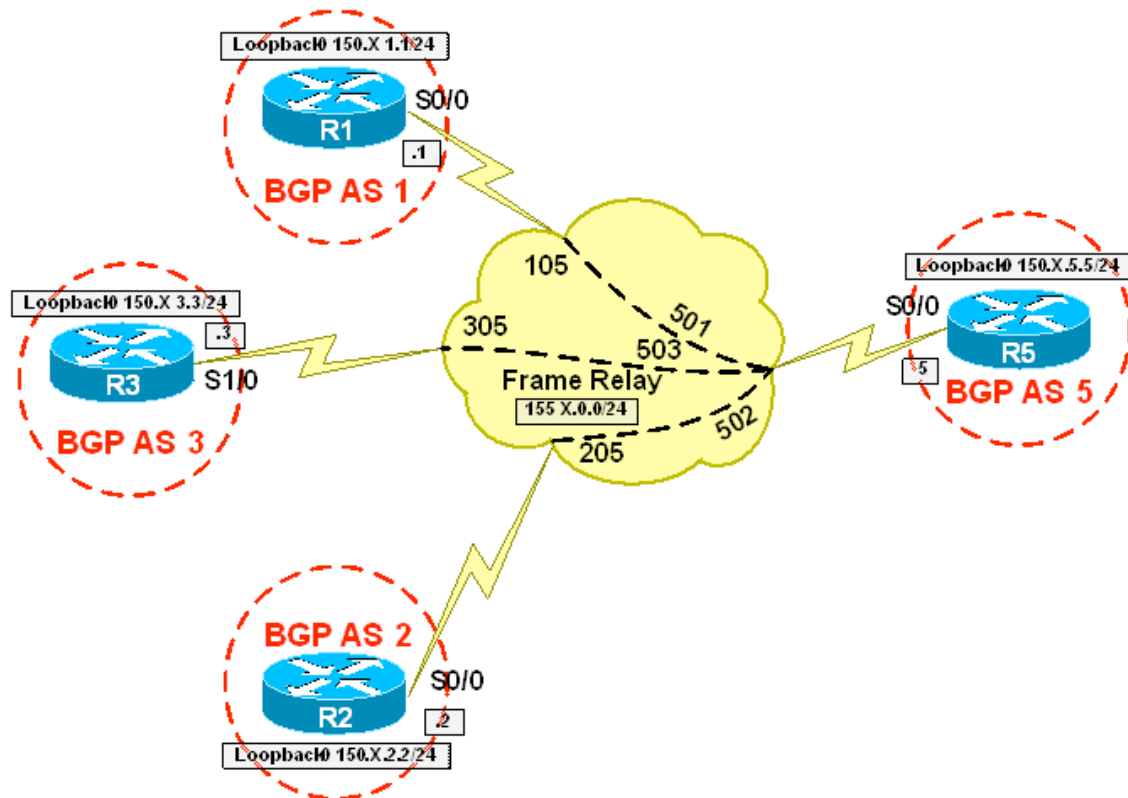
r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Weight Path	Next Hop	Metric	LocPrf
*> 150.1.0.0/21 32768 {1,2} i	0.0.0.0		100
s> 150.1.1.0/24 0 1 i	155.1.0.1		0
s> 150.1.2.0/24 0 2 i	155.1.0.2		0
s> 150.1.5.0/24 32768 i	0.0.0.0		0

BGP Aggregation – Advertise Map

Objective: Configure R5 to advertise the aggregate 150.X.0.0/21 to R3 without any specific subnet information. This aggregate should not include the prefix 150.X.3.0/24, and R3 should know that the aggregate is comprised of prefixes that passed through ASs 1, 2, and 5



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R2, R3, and R5 per the diagram
- R5 should peer with R1, R2, and R3
- Create the Loopback 150.X.1.1/24 on R1 and advertise it into BGP
- Create the Loopback 150.X.2.2/24 on R2 and advertise it into BGP
- Create the Loopback 150.X.3.3/24 on R3 and advertise it into BGP
- Create the Loopback 150.X.5.5/24 on R5 and advertise it into BGP
- Configure the BGP aggregate 150.X.0.0/21 on R5
- Use the advertise-map option to exclude the prefix 150.X.3.0/24 from this aggregate
- Include the originating AS-Path information with this aggregate

Final Configuration

R1:

```
interface Loopback0
  ip address 150.1.1.1 255.255.0.0
!
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.1 255.255.255.0
  frame-relay interface-dlci 105
!
router bgp 1
  network 150.1.1.0 mask 255.255.255.0
  neighbor 155.1.0.5 remote-as 5
```

R2:

```
interface Loopback0
  ip address 150.1.2.2 255.255.0.0
!
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.2 255.255.255.0
  frame-relay interface-dlci 205
```

```
!  
router bgp 2  
  network 150.1.2.0 mask 255.255.255.0  
  neighbor 155.1.0.5 remote-as 5  
  
R3:  
interface Loopback0  
  ip address 150.1.3.3 255.255.255.0  
!  
interface Serial1/0  
  encapsulation frame-relay  
!  
interface Serial1/0.1 point-to-point  
  ip address 155.1.0.3 255.255.255.0  
  frame-relay interface-dlci 305  
!  
router bgp 3  
  network 150.1.3.0 mask 255.255.255.0  
  neighbor 155.1.0.5 remote-as 5  
  
R5:  
interface Loopback0  
  ip address 150.1.5.5 255.255.0.0  
!  
interface Serial0/0  
  ip address 155.1.0.5 255.255.255.0  
  encapsulation frame-relay  
  frame-relay map ip 155.1.0.1 501 broadcast  
  frame-relay map ip 155.1.0.2 502 broadcast  
  frame-relay map ip 155.1.0.3 503 broadcast  
!  
router bgp 5  
  network 150.1.5.0 mask 255.255.255.0  
  aggregate-address 150.1.0.0 255.255.248.0 as-set summary-  
  only advertise-map ADVERTISE-MAP  
  neighbor 155.1.0.1 remote-as 1  
  neighbor 155.1.0.2 remote-as 2  
  neighbor 155.1.0.3 remote-as 3  
!  
ip prefix-list R3_LOOPBACK seq 5 permit 150.1.3.0/24
```

```

!
route-map ADVERTISE-MAP deny 10
  match ip address prefix-list R3_LOOPBACK
!
route-map ADVERTISE-MAP permit 20

```

Verification

Rack1R3#**show ip bgp**

```

BGP table version is 10, local router ID is 10.3.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
*> 150.1.0.0/21 0 5 {1,2} i	155.1.0.5	0	
*> 150.1.3.0/24 32768 i	0.0.0.0	0	

Rack1R5#**show ip bgp**

```

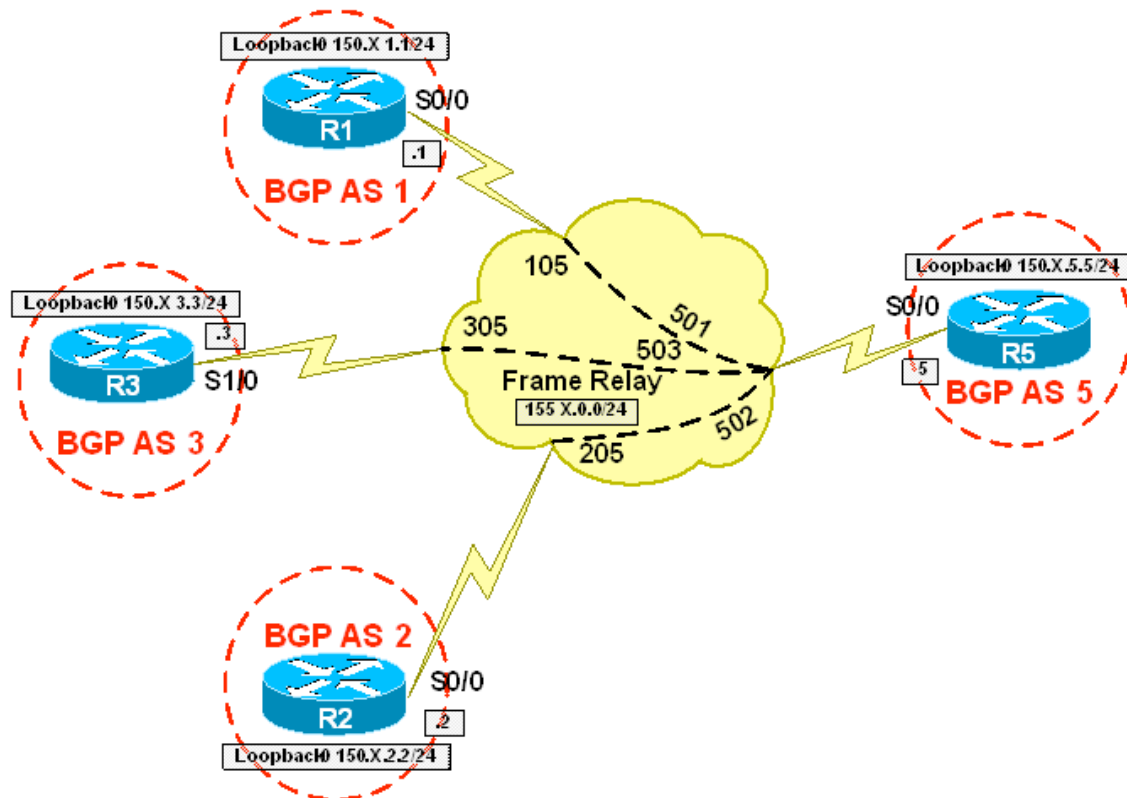
BGP table version is 11, local router ID is 150.1.5.5
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

```

Network Weight Path	Next Hop	Metric	LocPrf
*> 150.1.0.0/21 32768 {1,2} i	0.0.0.0	100	
s> 150.1.1.0/24 0 1 i	155.1.0.1	0	
s> 150.1.2.0/24 0 2 i	155.1.0.2	0	
s> 150.1.3.0/24 0 3 i	155.1.0.3	0	
s> 150.1.5.0/24 32768 i	0.0.0.0	0	

BGP Allow AS In

Objective: Configure R5 to advertise the aggregate 150.X.0.0/21 without any specific subnet information. Devices receiving the aggregate should know that it is comprised of prefixes that passed through ASs 1, 2, 3, and 5. Ensure that R1, R2, and R3 are able to install this aggregate in their BGP tables



Directions

- Configure the topology per the diagram
- Configure BGP on R1, R2, R3, and R5 per the diagram
- R5 should peer with R1, R2, and R3
- Create the Loopback 150.X.1.1/24 on R1 and advertise it into BGP
- Create the Loopback 150.X.2.2/24 on R2 and advertise it into BGP
- Create the Loopback 150.X.3.3/24 on R3 and advertise it into BGP
- Create the Loopback 150.X.5.5/24 on R5 and advertise it into BGP
- Configure the BGP aggregate 150.X.0.0/21 on R5
- Include the originating AS-Path information with this aggregate
- Configure R1, R2, and R3 to accept prefixes with their own AS in the path in order to receive the aggregate

Final Configuration

R1:

```
interface Loopback0
  ip address 150.1.1.1 255.255.0.0
!
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.1 255.255.255.0
  frame-relay interface-dlci 105
!
router bgp 1
  network 150.1.1.0 mask 255.255.255.0
  neighbor 155.1.0.5 remote-as 5
  neighbor 155.1.0.5 allowas-in 1
```

R2:

```
interface Loopback0
  ip address 150.1.2.2 255.255.0.0
!
interface Serial0/0
  encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
  ip address 155.1.0.2 255.255.255.0
```

```
frame-relay interface-dlci 205
!  
router bgp 2  
network 150.1.2.0 mask 255.255.255.0  
neighbor 155.1.0.5 remote-as 5  
neighbor 155.1.0.5 allowas-in 1
```

R3:

```
interface Loopback0  
ip address 150.1.3.3 255.255.255.0  
!  
interface Serial11/0  
encapsulation frame-relay  
!  
interface Serial11/0.1 point-to-point  
ip address 155.1.0.3 255.255.255.0  
frame-relay interface-dlci 305  
!  
router bgp 3  
network 150.1.3.0 mask 255.255.255.0  
neighbor 155.1.0.5 remote-as 5  
neighbor 155.1.0.5 allowas-in 1
```

R5:

```
interface Loopback0  
ip address 150.1.5.5 255.255.0.0  
!  
interface Serial10/0  
ip address 155.1.0.5 255.255.255.0  
encapsulation frame-relay  
frame-relay map ip 155.1.0.1 501 broadcast  
frame-relay map ip 155.1.0.2 502 broadcast  
frame-relay map ip 155.1.0.3 503 broadcast  
!  
router bgp 5  
network 150.1.5.0 mask 255.255.255.0  
aggregate-address 150.1.0.0 255.255.248.0 as-set summary-  
only  
neighbor 155.1.0.1 remote-as 1  
neighbor 155.1.0.2 remote-as 2
```

```
neighbor 155.1.0.3 remote-as 3
```

Verification

```
Rack1R1#show ip bgp
```

```
BGP table version is 8, local router ID is 150.1.1.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network Weight Path	Next Hop	Metric	LocPrf
*> 150.1.0.0/21 0 5 {1,2,3} i	155.1.0.5	0	
*> 150.1.1.0/24 32768 i	0.0.0.0	0	

```
Rack1R2#show ip bgp
```

```
BGP table version is 7, local router ID is 150.1.2.2
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network Weight Path	Next Hop	Metric	LocPrf
*> 150.1.0.0/21 0 5 {1,2,3} i	155.1.0.5	0	
*> 150.1.2.0/24 32768 i	0.0.0.0	0	

```
Rack1R3#show ip bgp
```

```
BGP table version is 11, local router ID is 10.3.0.1
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
                r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network Weight Path	Next Hop	Metric	LocPrf
*> 150.1.0.0/21	155.1.0.5	0	

```
0 5 {1,2,3} i
```

```
*> 150.1.3.0/24      0.0.0.0          0
32768 i
```

```
Rack1R5#show ip bgp
```

```
BGP table version is 22, local router ID is 150.1.5.5
```

```
Status codes: s suppressed, d damped, h history, * valid, >
best, i - internal,
```

```
                r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network Weight Path	Next Hop	Metric LocPrf
*> 150.1.0.0/21 32768 {1,2,3} i	0.0.0.0	100
s> 150.1.1.0/24 0 1 i	155.1.0.1	0
s> 150.1.2.0/24 0 2 i	155.1.0.2	0
s> 150.1.3.0/24 0 3 i	155.1.0.3	0
s> 150.1.5.0/24 32768 i	0.0.0.0	0

