Configuring IBGP and EBGP Sessions, Local Preference, and MED

Aim: To configure IBGP, EBGP and set the local preference and MED

Theory:
Border Gateway Protocol (BGP) Overview

BGP (Border Gateway Protocol) is a routing protocol used to exchange routing information between different networks on the internet. It is classified into two types:

- **External BGP (EBGP)** – Used between different Autonomous Systems (AS).
- **Internal BGP (IBGP)** – Used within the same Autonomous System.

External BGP (EBGP)

- EBGP is used to exchange routes between different Autonomous Systems (ASes).
- It is commonly used by Internet Service Providers (ISPs) and large enterprises to communicate with external networks.
- The default Time-To-Live (TTL) value is 1, meaning that EBGP peers must be directly connected unless explicitly configured otherwise.
- AS-path attribute is used in EBGP to prevent routing loops.
- It prefers shorter AS paths when selecting the best route.
- **Example Scenario:**
  If AS100 wants to exchange routes with AS200, they establish an EBGP connection between their routers.

Internal BGP (IBGP)

- IBGP is used for routing within the same Autonomous System.
- It ensures that all routers in an AS have a consistent view of external routes learned via EBGP.
- Unlike EBGP, IBGP does not modify the AS-path attribute.
- IBGP requires a full mesh of connections (or Route Reflectors/Confederations to reduce overhead).
- Next-hop attribute must be reachable within the AS for proper routing.
- **Example Scenario:**
  If AS100 has multiple routers, they must use IBGP to share routes learned from EBGP peers.

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Key Differences Between EBGP and IBGP

Feature	EBGP	IBGP
Used for	Between different ASes	Within the same AS
AS-Path Modification	Yes	No
Next-Hop Change	Yes	No (next-hop must be reachable)
Default TTL	1	255
Full Mesh Required?	No	Yes (or use Route Reflectors)

MED and Local Preference in BGP

BGP (Border Gateway Protocol) uses several attributes to influence routing decisions. Two important attributes that help in path selection are **MED (Multi-Exit Discriminator)** and **Local Preference**.

Multi-Exit Discriminator (MED)

Purpose: MED is used to influence the incoming traffic from an external AS by suggesting the preferred entry point into an AS when multiple links exist.

Characteristics:

- It is an **optional, non-transitive** attribute.
- A **lower MED value** is preferred.
- MED is shared only with **directly connected external neighbors** (not propagated beyond the next AS).
- It is commonly used between ISPs or between enterprise networks and ISPs.
- **Example Scenario:**
  If AS100 has two links to AS200, it can set a lower MED on one link to tell AS200 to prefer that path for incoming traffic.

Local Preference

Purpose: Local Preference is used within an AS to influence the outgoing traffic by selecting the preferred exit point when multiple paths to the same destination exist.

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Characteristics:

- It is a **well-known, discretionary** attribute.
- A **higher Local Preference value** is preferred.
- It is propagated within the AS to all IBGP peers.
- Used mainly by ISPs and large networks to control outbound traffic flow.
- **Example Scenario:**
  If AS100 has two exit points (R1 and R2) to AS200, setting a higher Local Preference on R1 will make all routers in AS100 prefer R1 for outgoing traffic.

Key Differences Between MED and Local Preference

Feature	MED (Multi-Exit Discriminator)	Local Preference
Function	Controls **incoming traffic** from another AS	Controls **outgoing traffic** within an AS
Preference Rule	Lower value preferred	Higher value preferred
Scope	Shared with EBGP peers but not propagated further	Propagated to all IBGP peers
Attribute Type	Optional, non-transitive	Well-known, discretionary
Used By	External ASes to choose entry points	Internal AS to choose exit points

Both attributes play a crucial role in BGP traffic engineering by influencing how traffic enters and exits an autonomous system.

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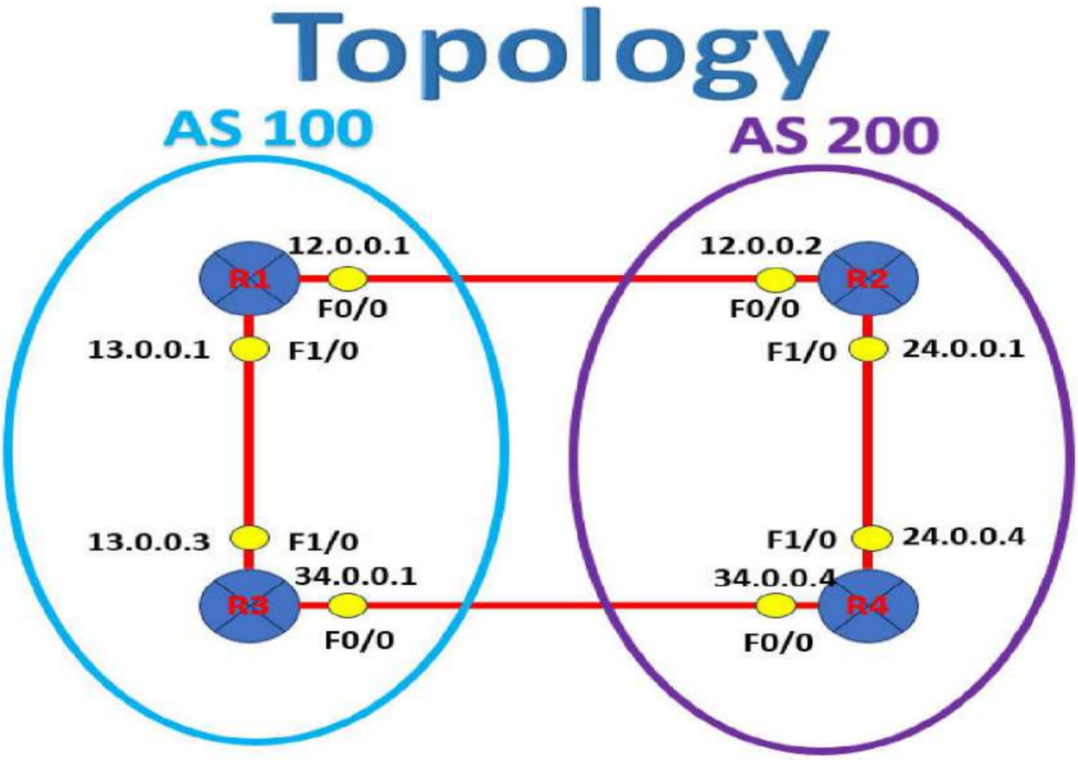
We use the following topology



We do the configuration using the following steps

Step 1: Configure the IP addresses on all the Routers

Router 1

```
R1#
R1#configure terminal
R1(config)#
R1(config)#interface fastEthernet 0/0
R1(config-if)#
R1(config-if)#ip address 12.0.0.1 255.255.255.0
R1(config-if)#
R1(config-if)#no shutdown
R1(config-if)#
R1(config-if)#exit
R1(config)#
R1(config)#interface fastEthernet 1/0
R1(config-if)#ip address 13.0.0.1 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#
```

R1(config-if)#exit
R1(config)

Router 2

R2#
R2#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#
R2(config)#interface fastEthernet 0/0
R2(config-if)#
R2(config-if)#ip address 12.0.0.2 255.255.255.0
R2(config-if)#no shutdown
R2(config-if)#exit
R2(config)#
R2(config)#interface fastEthernet 1/0
R2(config-if)#
R2(config-if)#ip address 24.0.0.1 255.255.255.0
R2(config-if)#no shutdown
R2(config-if)#exit
R2(config)#

Router 3

R3#
R3#configure terminal
R3(config)#i
R3(config)#interface fastEthernet 0/0
R3(config-if)#
R3(config-if)#ip address 34.0.0.1 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#
R3(config-if)#exit
R3(config)#
R3(config)#interface fastEthernet 1/0
R3(config-if)#
R3(config-if)#ip address 13.0.0.3 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#exit
R3(config)#

Router4

R4#
R4#configure terminal
R4(config)#

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R4(config)#interface fastEthernet 0/0
R4(config-if)#
R4(config-if)#ip address 34.0.0.4 255.255.255.0
R4(config-if)#no shutdown
R4(config-if)#exit
R4(config)#
R4(config)#interface fastEthernet 1/0
R4(config-if)#
R4(config-if)#ip address 24.0.0.4 255.255.255.0
R4(config-if)#no shutdown
R4(config-if)#exit
R4(config)#

Step 2: Set IBGP and EBGP on each router

Router 1

R1(config)#router bgp 100
R1(config-router)#
R1(config-router)#neighbor 13.0.0.3 remote-as 100
R1(config-router)#neighbor 13.0.0.3 update-source fastEthernet 1/0
R1(config-router)# network 12.0.0.0 mask 255.255.255.0
R1(config-router)#neighbor 12.0.0.2 remote-as 200
R1(config-router)#network 13.0.0.0 mask 255.255.255.0
R1(config-router)#
R1(config-router)#exit
R1(config)#exit
R1#

Router 2

R2(config)#router bgp 200
R2(config-router)#
R2(config-router)#neighbor 24.0.0.4 remote-as 200
R2(config-router)#neighbor 24.0.0.4 update-source fastEthernet 1/0
R2(config-router)#network 12.0.0.0 mask 255.255.255.0
R2(config-router)#neighbor 12.0.0.1 remote-as 100
R2(config-router)#network 24.0.0.0 mask 255.255.255.0
R2(config-router)#exit
R2(config)#

Router 3

R3(config)#router bgp 100
R3(config-router)#
R3(config-router)#neighbor 13.0.0.1 remote-as 100
R3(config-router)#neighbor 13.0.0.1 update-source fastEthernet 1/0

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```
R3(config-router)#network 34.0.0.0 mask 255.255.255.0
R3(config-router)#neighbor 34.0.0.4 remote-as 200
R3(config-router)#network 13.0.0.0 mask 255.255.255.0
R3(config-router)#
```

Router 4

```
R4(config)#
R4(config)#router bgp 200
R4(config-router)#
R4(config-router)#neighbor 24.0.0.1 remote-as 200
R4(config-router)#neighbor 24.0.0.1 update-source fastEthernet 1/0
R4(config-router)#network 34.0.0.0 mask 255.255.255.0
R4(config-router)#neighbor 34.0.0.3 remote-as 100
R4(config-router)#network 24.0.0.0 mask 255.255.255.0
R4(config-router)#exit
R4(config)#
```

Step 4: Verify the BGP protocol by pinging from Router1 to all interfaces

R1#ping 12.0.0.2

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 12.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/29/36 ms
```

R1#ping 13.0.0.3

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 13.0.0.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/26/36 ms
```

R1#ping 24.0.0.4

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 24.0.0.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/64 ms
```

R1#ping 34.0.0.4

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 34.0.0.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/56/60 ms
```


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Step 5: Configure Local Preference (Influencing Outbound Traffic from AS 100)

```
R1#
R1#configure terminal
R1(config)#
R1(config)#route-map smile_ip permit 10
R1(config-route-map)#
R1(config-route-map)#set local-preference 200
R1(config-route-map)#
R1(config-route-map)#exit
R1(config)#router bgp 100
R1(config-router)#
R1(config-router)#neighbor 13.0.0.3 route-map smile_ip in
R1(config-router)#exit
R1(config)#exit
```

Step 6: Configure MED (Influencing Inbound Traffic to AS 100)

```
R2(config)#
R2(config)#route-map set_med permit 10
R2(config-route-map)#set metric 50
R2(config-route-map)#exit
R2(config)#
R2(config)#router bgp 200
R2(config-router)#
R2(config-router)#neighbor 12.0.0.1 route-map set_med out
R2(config-router)#exit
R2(config)#
```

Step 7: Verification

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

```
BGP router identifier 13.0.0.1, local AS number 100
BGP table version is 7, main routing table version 7
4 network entries using 576 bytes of memory
6 path entries using 480 bytes of memory
3/3 BGP path/bestpath attribute entries using 408 bytes of memory
1 BGP AS-PATH entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 1488 total bytes of memory
BGP activity 4/0 prefixes, 6/0 paths, scan interval 60 secs

Neighbor    V    AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
12.0.0.2    4   200    19      15       7    0    0 00:08:42      3
13.0.0.3    4   100    12      15       7    0    0 00:07:41      2
```

R1#show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        12.0.0.0/24 is directly connected, FastEthernet0/0
L        12.0.0.1/32 is directly connected, FastEthernet0/0
      13.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        13.0.0.0/24 is directly connected, FastEthernet1/0
L        13.0.0.1/32 is directly connected, FastEthernet1/0
      24.0.0.0/24 is subnetted, 1 subnets
B        24.0.0.0 [20/50] via 12.0.0.2, 00:00:24
      34.0.0.0/24 is subnetted, 1 subnets
B        34.0.0.0 [200/0] via 13.0.0.3, 00:07:31
```

R1#show ip bgp

```
BGP table version is 7, local router ID is 13.0.0.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 r>  12.0.0.0/24      12.0.0.2                50             0 200 i
 * i 13.0.0.0/24      13.0.0.3                 0    100      0 i
 *>                   0.0.0.0                  0         32768 i
 *>  24.0.0.0/24      12.0.0.2                50             0 200 i
 *   34.0.0.0/24      12.0.0.2                50             0 200 i
 *>i                  13.0.0.3                 0    100      0 i
```


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R1#show ip bgp neighbors

```
BGP neighbor is 12.0.0.2,  remote AS 200, external link
 BGP version 4, remote router ID 24.0.0.1
 BGP state = Established, up for 00:09:48
 Last read 00:00:16, last write 00:00:23, hold time is 180, keepalive interval is 60 seconds
 Neighbor sessions:
  1 active, is not multisession capable (disabled)
 Neighbor capabilities:
  Route refresh: advertised and received(new)
  Four-octets ASN Capability: advertised and received
  Address family IPv4 Unicast: advertised and received
  Enhanced Refresh Capability: advertised and received
  Multisession Capability:
  Stateful switchover support enabled: NO for session 1
 Message statistics:
  InQ depth is 0
  OutQ depth is 0

                 Sent      Rcvd
  Opens:            1         1
  Notifications:    0         0
  Updates:          3         7
  Keepalives:      12        12
```

For video demonstration of the given practical click on the link below or scan the QR-code

https://youtu.be/lW8dKINlkm8

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