

# BGP Path Attributes

## BGP Path Attributes

BGP (Border Gateway protocol is a path vector routing protocol, meaning it uses path attributes to determine the best routing path. There are eight (8) attributes that BGP uses in the determination of that best path.

Mnemonic	First Letter	BGP Path Attribute
We	W	Weight
Love	L	Local_pref
Oranges	O	Originate
As	A	AS_path
Oranges	O	Origin type
Mean	M	MED (Multiple Exit Discriminator)
Pure	P	Paths
Refreshment	R	Router-ID

This is not inclusive of all 13 path attributes but this covers the majority of them. particularly those that we often see used in practice.

## WEIGHT

- Cisco specific parameter
- Local to the router
- Preference: highest weight

```
Router1#show bgp ipv4 unicast
BGP table version is 10, local router ID is 2.2.2.2
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,
               t secondary path,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found
```

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 1.1.1.0/24	172.16.1.1	0		0	65001 i
*> 2.2.2.0/24	0.0.0.0	0		32768	i
*>i 3.3.3.0/24	172.16.2.2	0	100	0	i
*>i 4.4.4.0/24	172.16.3.1	0	100	0	65003 i
* 172.16.1.0/29	172.16.1.1	0		0	65001 i
*>	0.0.0.0	0		32768	i
* i 172.16.2.0/29	172.16.2.2	0	100	0	i
*>	0.0.0.0	0		32768	i
*>i 172.16.3.0/29	172.16.2.2	0	100	0	i
*> 192.168.10.0	172.16.1.1	0		0	65001 i
*>i 192.168.20.0	172.16.3.1	0	100	0	65003 i

## LOCAL PREFERENCE (Local\_pref)

This parameter often gets used for route manipulation.

- Default value of 100
- Preference: highest local\_pref

```
Router1#show bgp ipv4 unicast
BGP table version is 10, local router ID is 2.2.2.2
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,
               t secondary path,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found
```

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 1.1.1.0/24	172.16.1.1	0		0	65001 i
*> 2.2.2.0/24	0.0.0.0	0		32768	i
*>i 3.3.3.0/24	172.16.2.2	0	100	0	i
*>i 4.4.4.0/24	172.16.3.1	0	100	0	65003 i
* 172.16.1.0/29	172.16.1.1	0		0	65001 i
*>	0.0.0.0	0		32768	i
* i 172.16.2.0/29	172.16.2.2	0	100	0	i
*>	0.0.0.0	0		32768	i
*>i 172.16.3.0/29	172.16.2.2	0	100	0	i
*> 192.168.10.0	172.16.1.1	0		0	65001 i
*>i 192.168.20.0	172.16.3.1	0	100	0	65003 i

## ORIGINATE

- How a path was sourced
- Preference: local paths from network or redistribute commands are preferred versus local aggregates via aggregate-address command

## AUTONOMOUS SYSTEM PATH (AS\_path)

- The number of autonomous systems in the path
- Preference: shortest AS\_path
- It is the number of autonomous systems in the path **NOT** the number of routers in the path.

```
Router1#show bgp ipv4 unicast
BGP table version is 10, local router ID is 2.2.2.2
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,
               t secondary path,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found
```

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 1.1.1.0/24	172.16.1.1	0		0	65001 i
*> 2.2.2.0/24	0.0.0.0	0		32768	i
*>i 3.3.3.0/24	172.16.2.2	0	100	0	i
*>i 4.4.4.0/24	172.16.3.1	0	100	0	65003 i
* 172.16.1.0/29	172.16.1.1	0		0	65001 i
*>	0.0.0.0	0		32768	i
* i 172.16.2.0/29	172.16.2.2	0	100	0	i
*>	0.0.0.0	0		32768	i
*>i 172.16.3.0/29	172.16.2.2	0	100	0	i
*> 192.168.10.0	172.16.1.1	0		0	65001 i
*>i 192.168.20.0	172.16.3.1	0	100	0	65003 i

## ORIGIN TYPE

- Preference: lowest origin type

1. IGP
2. EGP
3. ? Incomplete

```
Router1#show bgp ipv4 unicast
BGP table version is 10, local router ID is 2.2.2.2
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,
               t secondary path,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found
```

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 1.1.1.0/24	172.16.1.1	0		0	65001 i
*> 2.2.2.0/24	0.0.0.0	0		32768	i
*>i 3.3.3.0/24	172.16.2.2	0	100	0	i
*>i 4.4.4.0/24	172.16.3.1	0	100	0	65003 i
* 172.16.1.0/29	172.16.1.1	0		0	65001 i
*>	0.0.0.0	0		32768	i
* i 172.16.2.0/29	172.16.2.2	0	100	0	i
*>	0.0.0.0	0		32768	i
*>i 172.16.3.0/29	172.16.2.2	0	100	0	i
*> 192.168.10.0	172.16.1.1	0		0	65001 i
*>i 192.168.20.0	172.16.3.1	0	100	0	65003 i

## MED (Multi-exit Discriminator)

- Optional non-transitive attribute
- A hint to external neighbors about the preferred path into an autonomous system (AS) that has multiple entry points
- Preference: lowest MED

```
Router1#show bgp ipv4 unicast
BGP table version is 10, local router ID is 2.2.2.2
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,
               t secondary path,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network          Next Hop      Metric LocPrf Weight Path
*>  1.1.1.0/24       172.16.1.1          0         0 65001 i
*>  2.2.2.0/24       0.0.0.0             0        32768 i
*>i  3.3.3.0/24       172.16.2.2          0        100     0 i
*>i  4.4.4.0/24       172.16.3.1          0        100     0 65003 i
*   172.16.1.0/29    172.16.1.1          0         0 65001 i
*>  0.0.0.0           0.0.0.0             0        32768 i
* i 172.16.2.0/29    172.16.2.2          0        100     0 i
*>  0.0.0.0           0.0.0.0             0        32768 i
*>i 172.16.3.0/29    172.16.2.2          0        100     0 i
*> 192.168.10.0      172.16.1.1          0         0 65001 i
*>i 192.168.20.0     172.16.3.1          0        100     0 65003 i
```

## PATHS (eBGP vs iBGP)

- Preference: eBGP over iBGP

eBGP	iBGP
Administrative distance: <b>20</b>	Administrative distance: <b>200</b>

## ROUTER-ID

- Preference: route from the lowest router ID

## Summary of the Attributes

Mnemonic	First Letter	BGP Path Attribute	Preference
We	W	Weight	Higher
Love	L	Local_pref	Higher
Oranges	O	Originate	Local vs Aggregate
As	A	AS_path	Lower

Oranges	O	Origin type	IGP vs EGP vs ?
Mean	M	MED	Lower
Pure	P	Paths	eBGP vs oBGP
Refreshment	R	Router-ID	Lower

## BGP Route Manipulation

```
R4#show bgp ipv4 unicast
BGP table version is 9, local router ID is 40.0.0.1
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,
               t secondary path,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found
```

	Network	Next Hop	Metric	LocPrf	Weight	Path
*	10.0.0.0/24	34.34.34.1			0	65023 65001 ?
*>		24.24.24.1			0	65023 65001 ?
*	12.12.12.0/30	34.34.34.1			0	65023 65001 ?
*>		24.24.24.1			0	65023 65001 ?
*	13.13.13.0/30	34.34.34.1			0	65023 65001 ?
*>		24.24.24.1			0	65023 65001 ?
*	20.0.0.0/24	34.34.34.1			0	65023 65001 ?
*>		24.24.24.1			0	65023 65001 ?
*>	24.24.24.0/30	0.0.0.0	0		32768	?
*	30.0.0.0/24	34.34.34.1			0	65023 65001 ?
*>		24.24.24.1			0	65023 65001 ?
*>	34.34.34.0/30	0.0.0.0	0		32768	?
*>	40.0.0.0/24	0.0.0.0	0		32768	?

Scenario: Make the preferred path for the 20.0.0.0 network go through another router

```
R4(config)#ip prefix-list PREF20 permit 20.0.0.0/24
R4(config)#route-map MAP20 permit 10
R4(config-route-map)#match ip address prefix-list PREF20
R4(config-route-map)#set ?
```

```

R4(config-route-map)#set ?
  aiqp-metric      accumulated metric value
  as-path          Prepend string for a BGP AS-path attribute
  automatic-tag    Automatically compute TAG value
  clns             OSI summary address
  comm-list        set BGP community list (for deletion)
  community        BGP community attribute
  dampening        Set BGP route flap dampening parameters
  default          Set default information
  extcomm-list     Set BGP/VPN extended community list (for deletion)
  extcommunity     BGP extended community attribute
  global           Set to global routing table
  interface        Output interface
  ip               IP specific information
  ipv6             IPv6 specific information
  level            Where to import route
  lisp             Locator ID Separation Protocol specific information
  local-preference BGP local preference path attribute
  metric           Metric value for destination routing protocol
  metric-type      Type of metric for destination routing protocol
  mpls-label       Set MPLS label for prefix
  origin           BGP origin code
  tag              Tag value for destination routing protocol
  traffic-index    BGP traffic classification number for accounting
  vrf              Define VRF name
  weight           BGP weight for routing table

```

```

R4(config-route-map)#set weight 999
R4(config-route-map)#exit
R4(config)#route-map MAP20 permit 20
R4(config-route-map)#exit
R4(config)#router bgp 65004
R4(config-router)#neighbor 34.34.34.1 route-map MAP20 in
R4(config-router)#end
R4#clear ip bgp *

```

```

R4#show bgp ipv4 unicast
BGP table version is 9, local router ID is 40.0.0.1
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,
               t secondary path,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network          Next Hop           Metric LocPrf Weight Path
*>  10.0.0.0/24      24.24.24.1              0 65023 65001 ?
*      34.34.34.1              0 65023 65001 ?
*>  12.12.12.0/30    24.24.24.1              0 65023 65001 ?
*      34.34.34.1              0 65023 65001 ?
*>  13.13.13.0/30    24.24.24.1              0 65023 65001 ?
*      34.34.34.1              0 65023 65001 ?
*   20.0.0.0/24      24.24.24.1              0 65023 65001 ?
*>      34.34.34.1              9999 65023 65001 ?
*>  24.24.24.0/30    0.0.0.0                  0      32768 ?
*>  30.0.0.0/24      24.24.24.1              0 65023 65001 ?
*      34.34.34.1              0 65023 65001 ?
*>  34.34.34.0/30    0.0.0.0                  0      32768 ?
*>  40.0.0.0/24      0.0.0.0                  0      32768 ?

```

# Summary of Route Manipulation Steps

<b>Create a prefix list</b>	Router(config)#ip prefix-list [list name] permit [network IP]
<b>Create a route map</b>	Router(config)#route-map [map name] permit [line #] Router(config-route-map)#match ip address prefix-list [list name] Router(config-route-map)#set weight [value]
<b>Apply the route map to BGP configuration</b>	Router(config-router)#neighbor [neighbor IP address] route-map [map name] [in/out]

## BGP Transitive and Non-transitive Attributes

Transitive Attributes are those BGP attributes that are ALLOWED to be sent to other BGP peers. Non-transitive attributes are NOT allowed to be sent to other peers.

There are four categories of path attributes:

<b>Well-known mandatory</b>	This attribute MUST exist in the BGP UPDATE. If this attribute is missing a NOTIFICATION error is generated and the session is closed. Must be recognized by all BGP routers and must be included in every update message. Routing information errors occur without this attribute.
<b>Well-known discretionary</b>	Can be recognized by all BGP routers; can be included in every update message as needed.
<b>Optional transitive</b>	Transitive attribute between ASs. A BGP router not supporting this attribute can still receive routes with this attribute and advertise them to other peers.
<b>Optional non-transitive</b>	If a BGP router does not support this attribute, it will not advertise routes with this attribute.

<b>BGP Path Attribute</b>	<b>Category</b>
Weight	Cisco specific local to router
Local_pref	Well-known discretionary
AS_path	Well-known mandatory
Origin type	Well-known mandatory
MED	Optional non-transitive

# Troubleshooting BGP

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