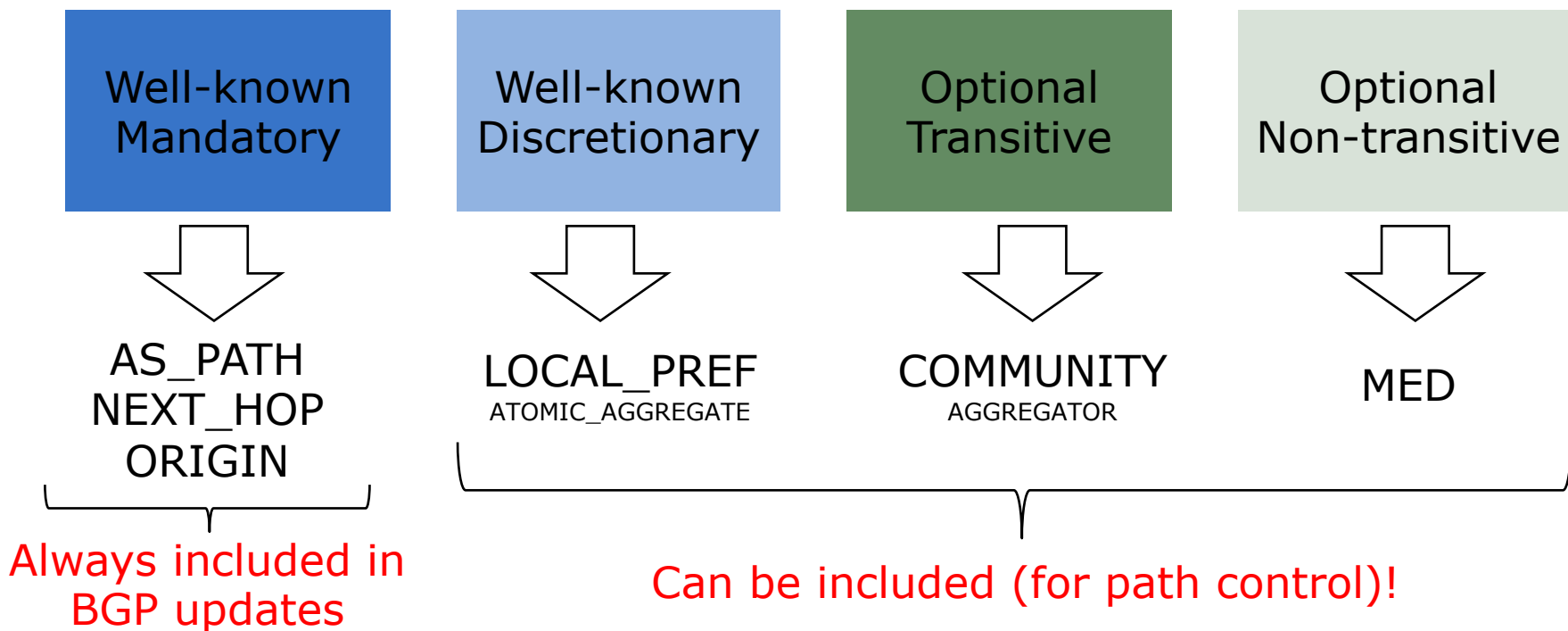


BGP Attributes & Path Selection

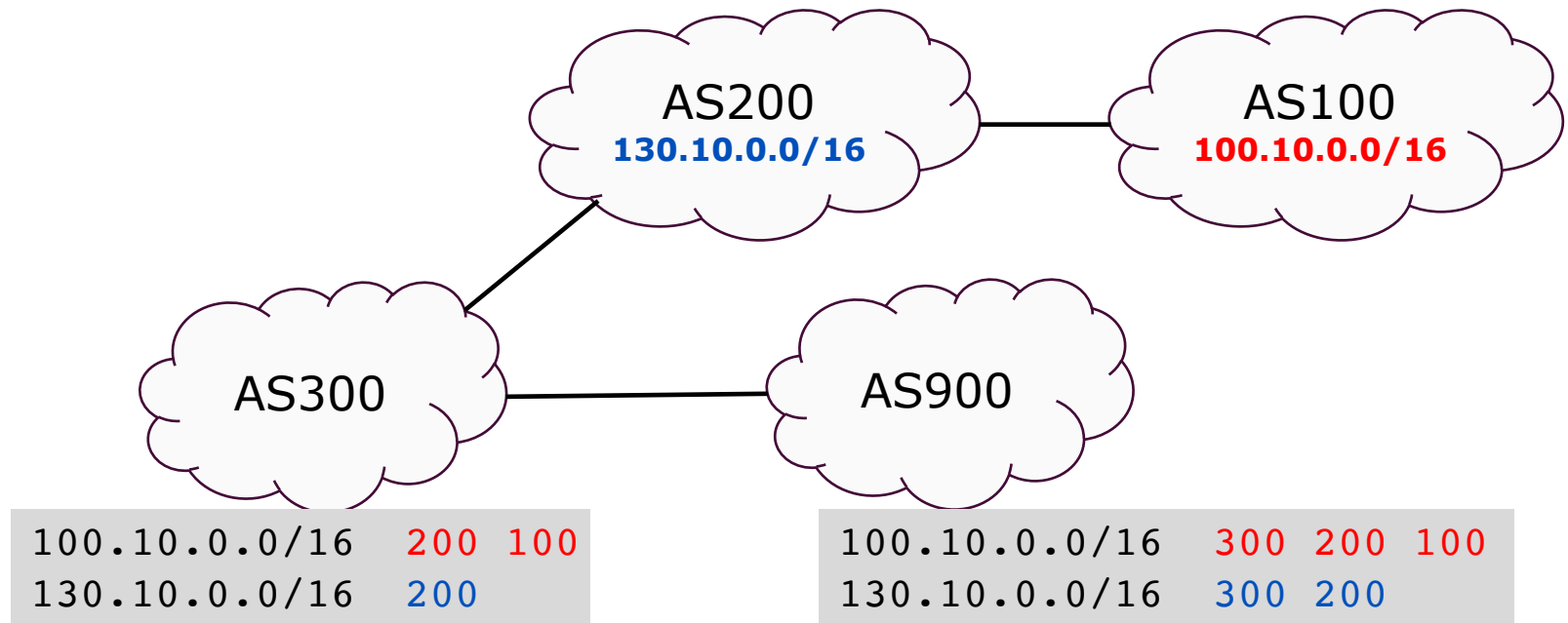
BGP Path Attributes

- Attributes describe the path to network(s)/NLRI
 - Used to enforce routing policies for path control!



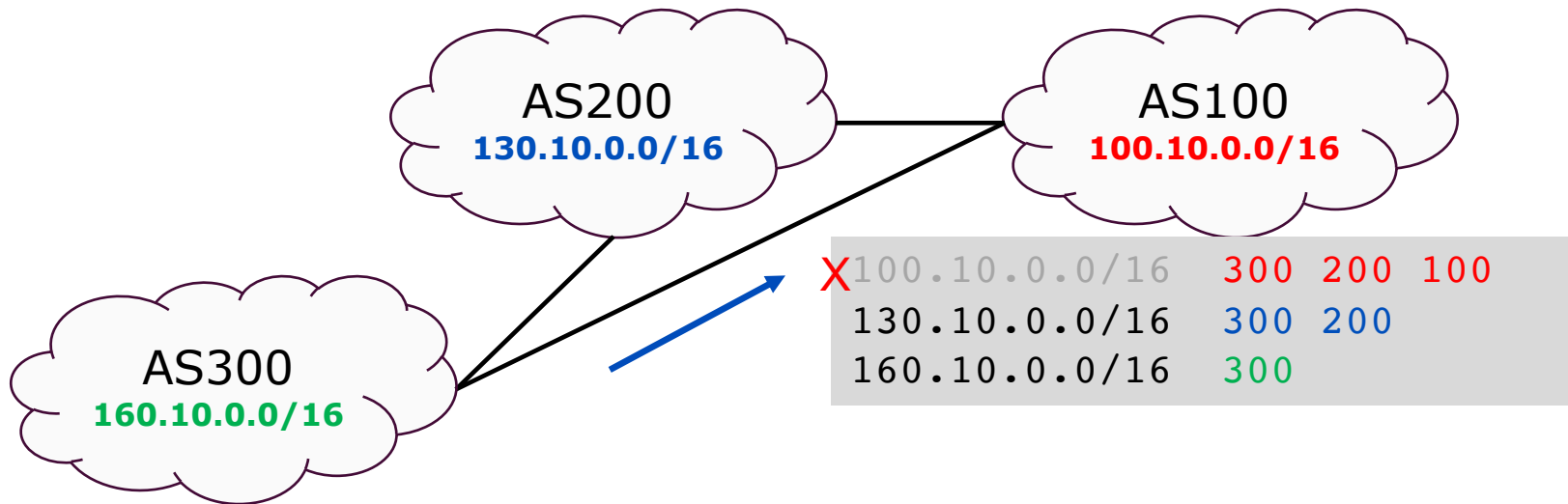
AS_PATH

- Indicates the list of ASes a route has passed through to reach the local AS
 - the list of ASes to reach a destination
 - can influence path selection
 - Shortest AS_PATH wins



AS_PATH

- Used to ensure a loop-free exchange of routing info between ASes
 - If own AS is seen in an update from an eBGP peer, **loop** is detected (**Update is dropped**)!

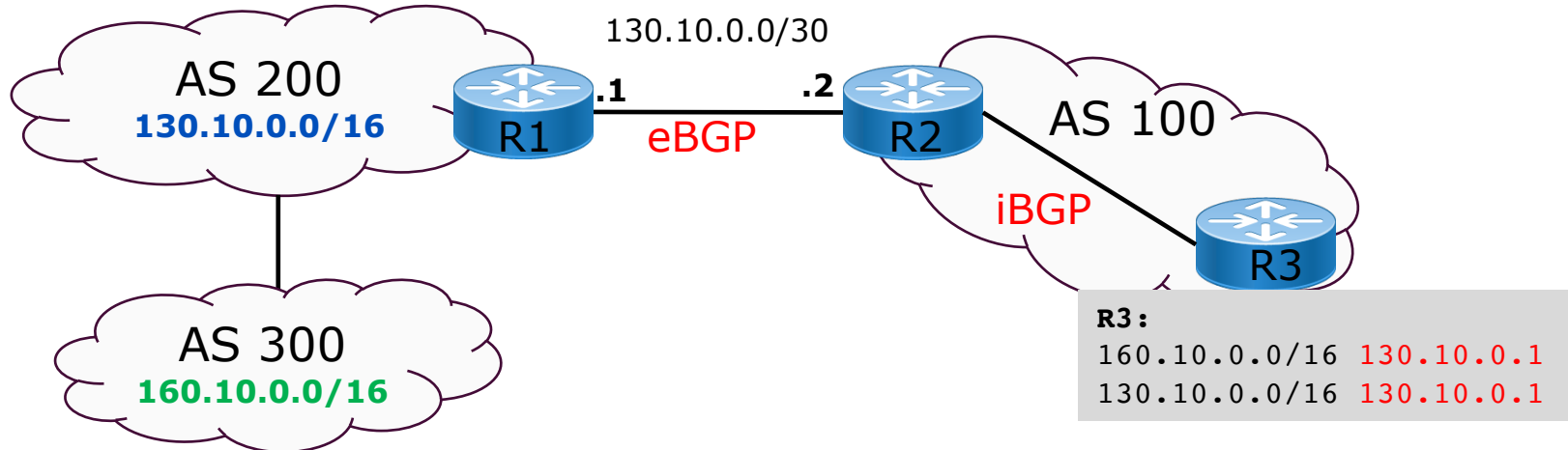


NEXT_HOP

- Indicates the next hop address to reach the destination
 - Source of the update packet!
- For eBGP
 - eBGP neighbor address (to reach the next AS)
- For iBGP
 - Generally the loopback address

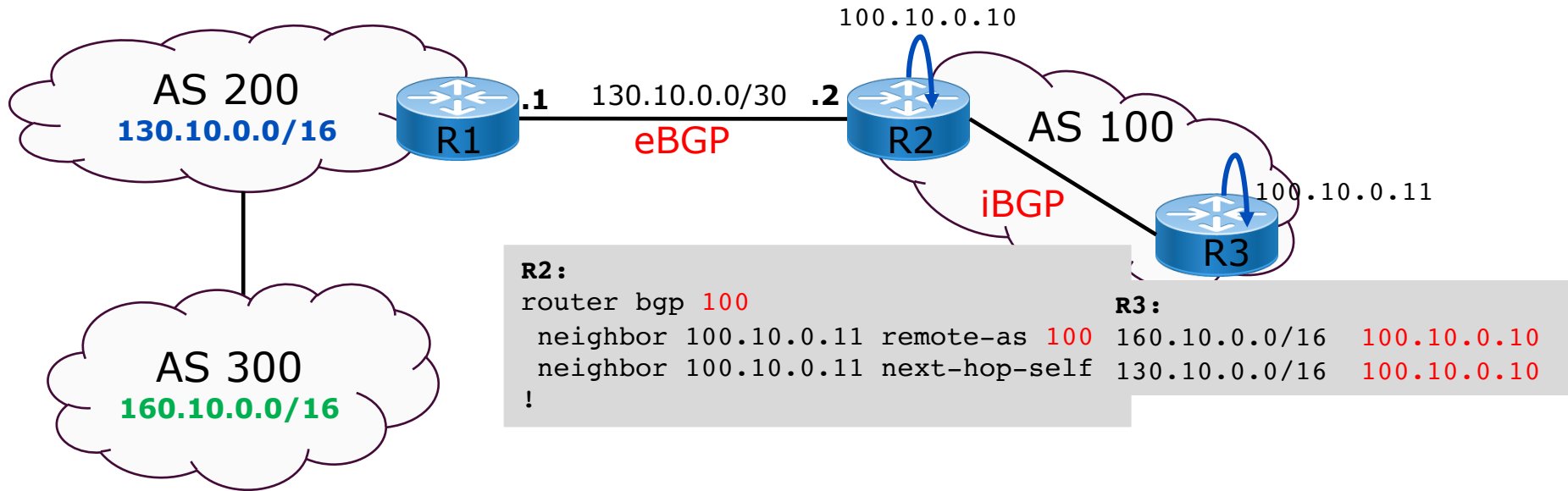
NEXT_HOP

- eBGP learned routes are advertised to iBGP peers without changing the next hop
 - Routers within the AS need to be able to reach the next hop (IGP or static)
 - Else, external routes not installed in the routing table!



Next-Hop-Self

- Override the eBGP next hop default behavior with **next-hop-self** command
 - Advertises itself as the next hop for external routes
 - Reachable through IGP



ORIGIN

- Indicates the origin of the route (path info)
 - Generated by the speaker that originates the route
 - Prefer the path with the lower origin code
- IGP (**i**)
 - Interior to the originating AS (advertised with the **network** command)
- EGP (**e**)
 - Generated by EGP protocol (obsolete!)
- Incomplete (**?**)
 - Route's origin is unknown (usually redistributed)

ORIGIN

```
R1# show ip bgp
BGP table version is 24, local router ID is 172.16.1.2
Status codes: s suppressed, d damped, h history, * valid, > bestpath
internal
Origin codes: i - IGP, e - EGP, ? - incomplete

  Network          Next Hop          Metric  LocPrf  Weight  Path
*> 192.208.10.0    192.208.10.5      0         0        0    300 i
*> 172.16.1.0      0.0.0.0           0         0       32768  i
<output omitted>
```

i = Route generated by the **network** command.

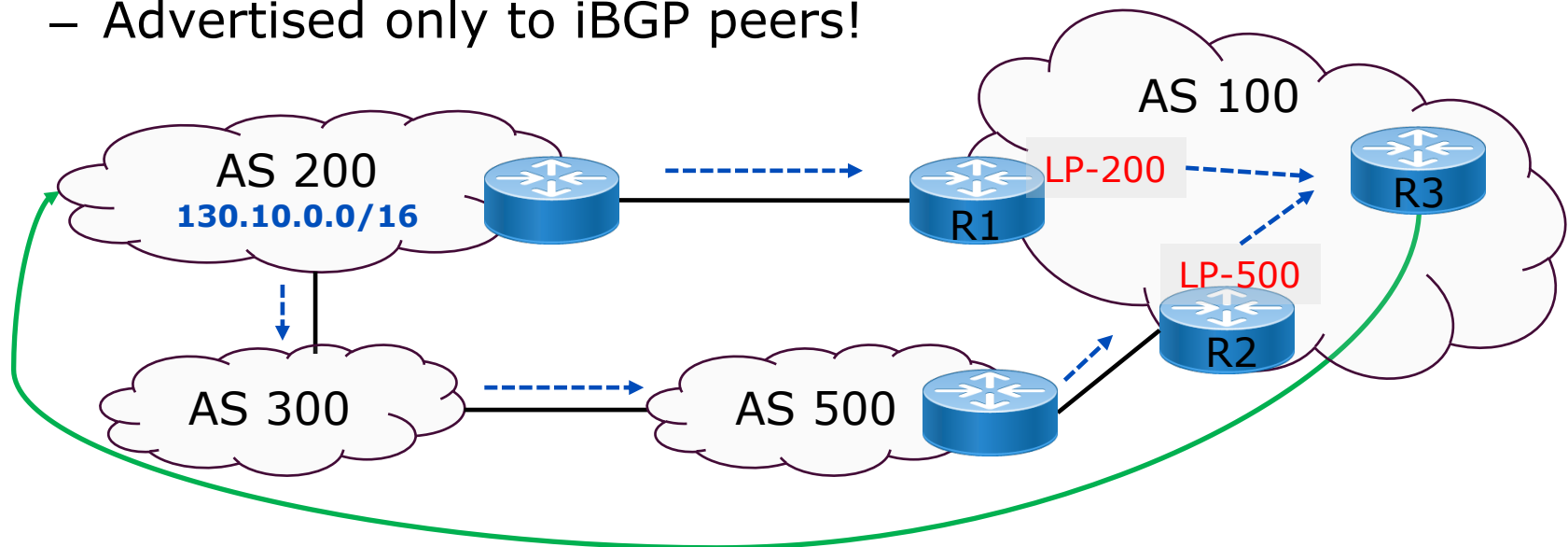
```
R1# show ip bgp
<output omitted>

  Network          Next Hop          Metric  LocPrf  Weight  Path
*> 10.1.1.0/24     0.0.0.0           0         0       32768  ?
*> 192.168.1.0/24  10.1.1.2          84        0       32768  ?
*> 192.168.2.0/24  10.1.1.2          74        0       32768  ?
<output omitted>
```

? = Route generated by unknown method (usually redistributed).

LOCAL_PREF

- Local preference tells routers within the AS (**local**) the preferred path to exit the AS
 - Path with **highest local_pref** wins
 - Outbound traffic!
- Local to the AS
 - Advertised only to iBGP peers!

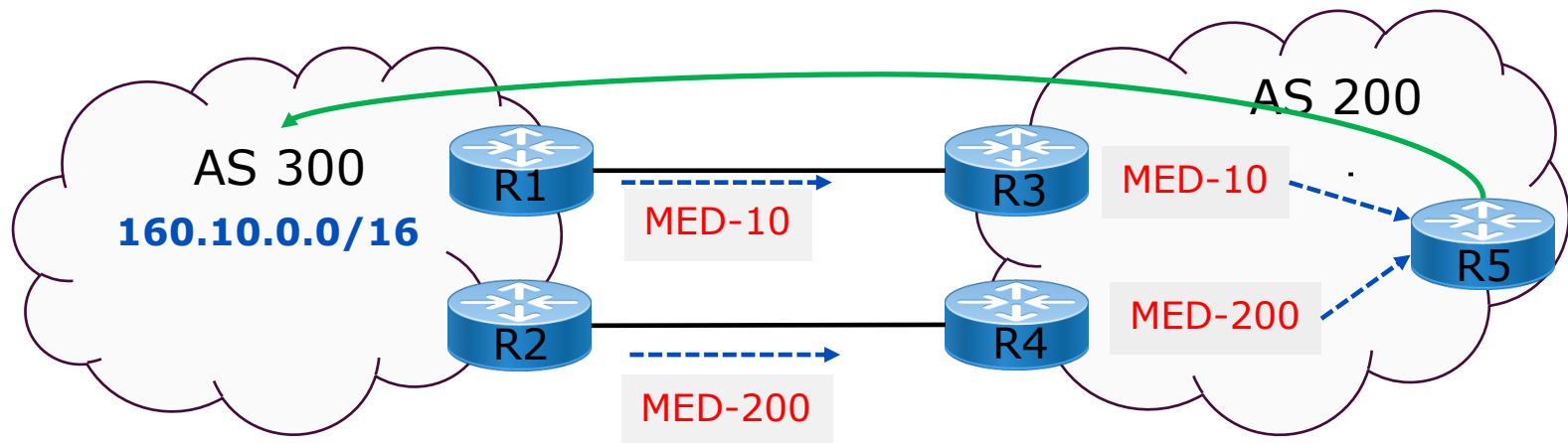


COMMUNITY

- Used to group prefixes (incoming/outgoing) and apply policies to the communities
 - A prefix can belong to more than one community
- Was a 32-bit integer
 - Represented as two 16-bit integers [**ASN:number**]
 - Works well for 2-byte ASN
- With 4-byte ASNs
 - Common to see [**private-ASN:number**]
 - RFC8092 (BGP Large Communities): 96-bit integer
 - [32-bit ASN:32-bit:32-bit]

MED

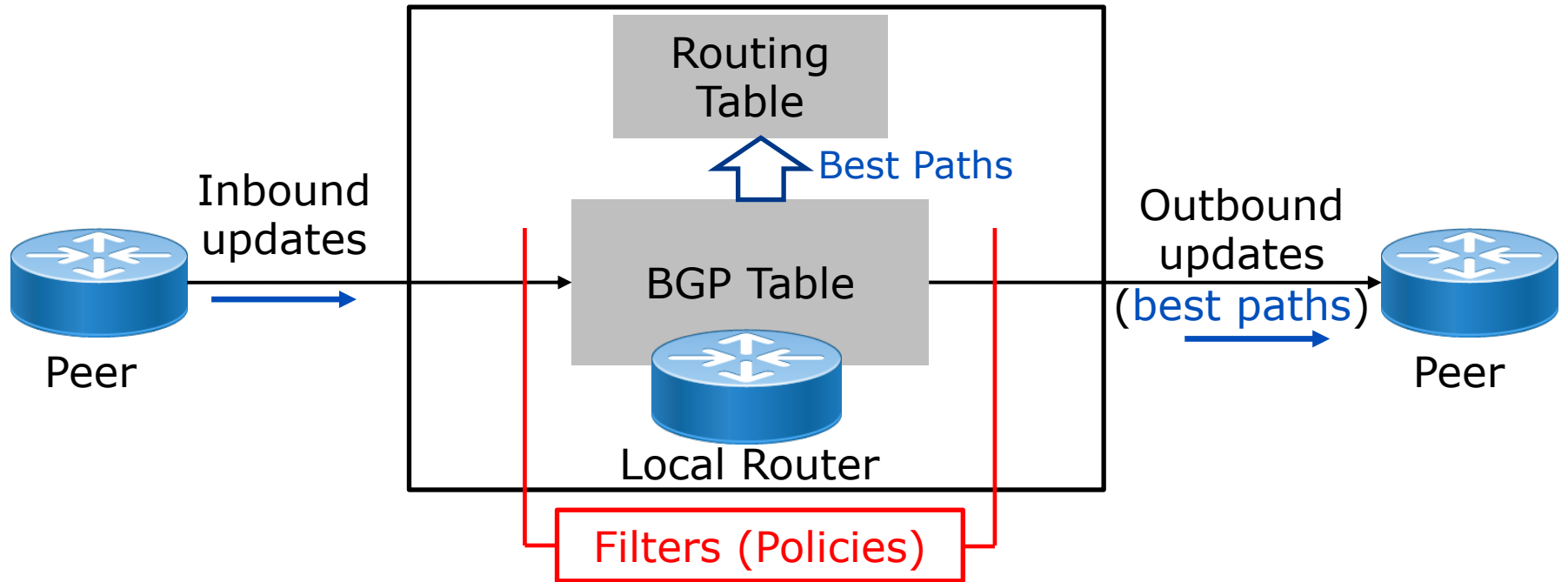
- Multi-exit discriminator is inter-AS non-transitive
 - Indicates to neighbor AS about the preferred entry points into the local AS (**incoming traffic**)
- The path with **lowest MED** wins!



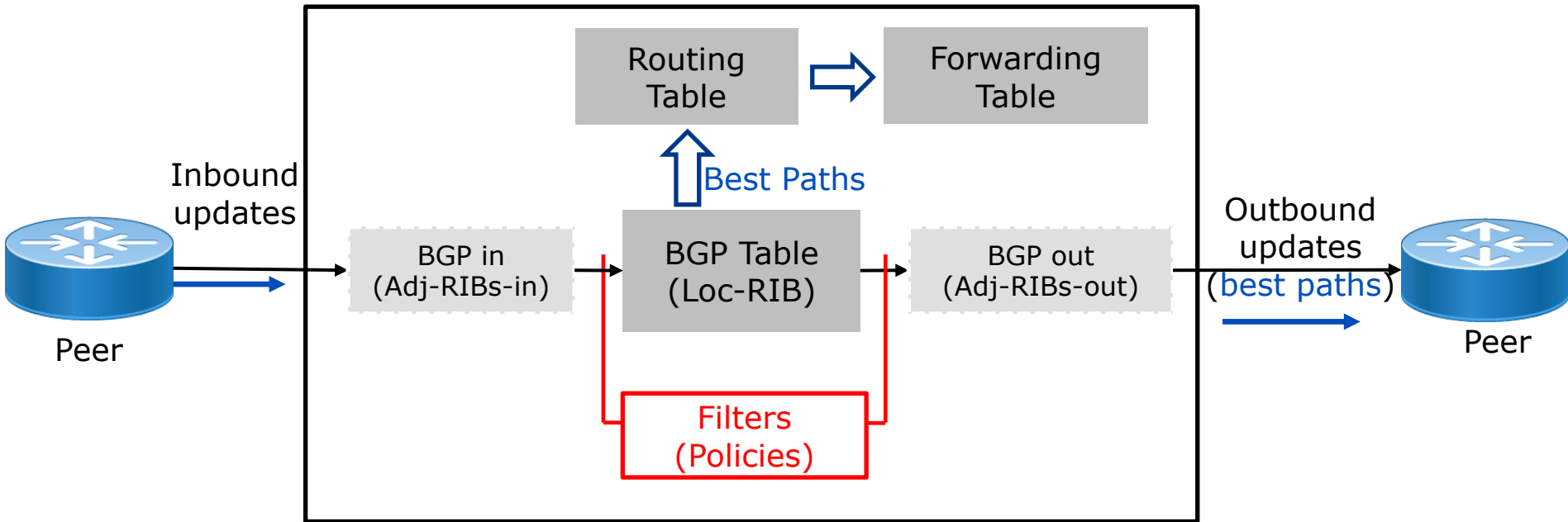
BGP Operation

- BGP learns routes from iBGP and eBGP peers
 - Placed in the BGP table if allowed by local policies/filters
 - Selects best path based on the attributes
 - Installs best path in the routing table
 - Advertises the best paths to its other BGP peers
 - eBGP learned routes to iBGP peers
 - iBGP learned routes to eBGP peers

BGP Operation



BGP Operation



BGP Best Path Selection

Do not consider path if no route to next hop

Highest Local Preference

Locally originated routes

Shortest AS Path

Lowest Origin Code (i<e<?)

Lowest MED/metric

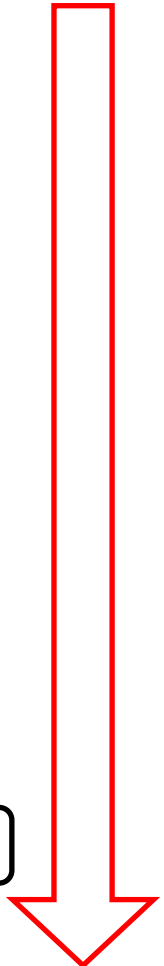
eBGP over iBGP

Lowest IGP cost to next-hop

Oldest eBGP route
(if multipath enabled, use 'n' parallel paths)

Lowest neighbor router-ID (originator-id for reflected routes)

Lowest neighbor IP address



Acknowledgement:

- Philip Smith
- Cisco Systems



Questions

