BGP Policy Control

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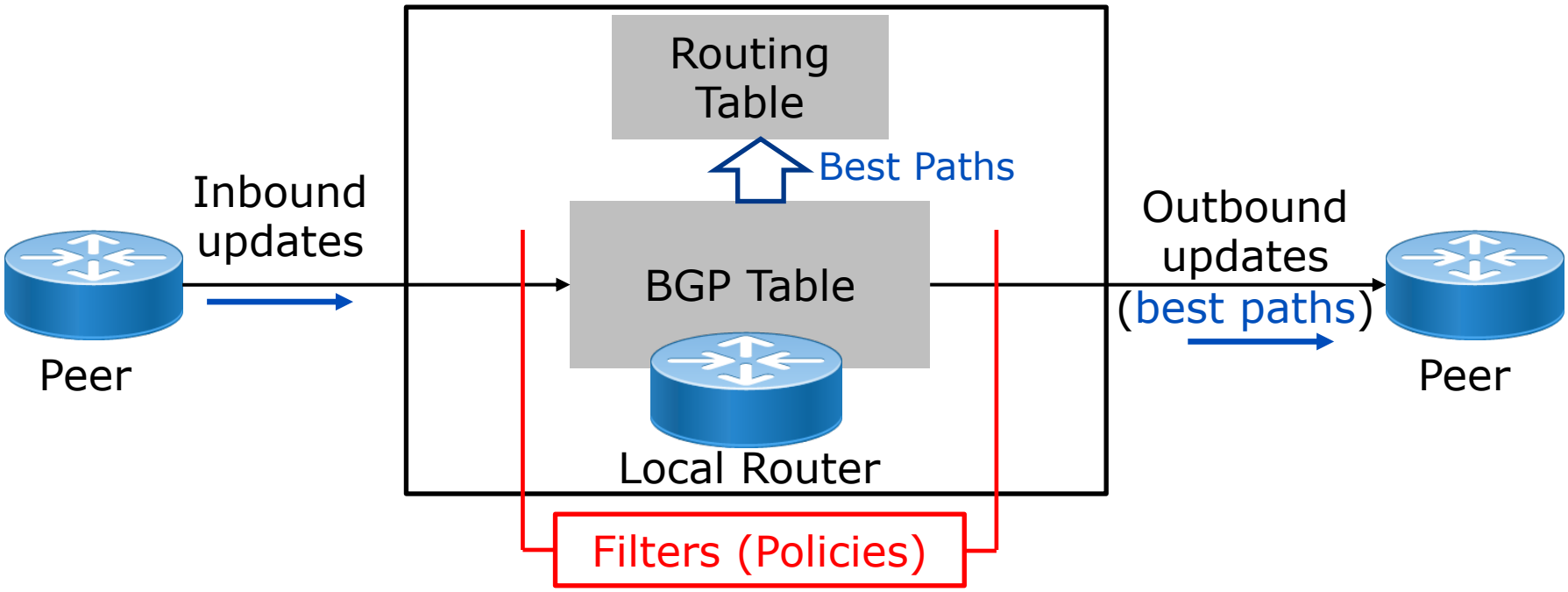


Policy Control – Selecting prefixes

- Match via a prefix list filter
- Match via an AS path filter
- Match via a community tag filter
- Or some combination of the above

Policy Control – Setting attributes

- Change the AS path, via prepending
- Set a Local Preference value
- Set a MED value
- Add or remove community tags

Path control - Attributes

- Inbound Traffic:
  - AS_Path, MED, Community tag
- Outbound Traffic:
  - Local_Pref

Prefix lists

- Typically allows you to select a prefix or a range of prefixes
  - Might also select an aggregate and some sub-aggregates
- Could be built using a tool (RPSL) from data held in an Internet Routing Registry
  - IRRToolSet (rtconfig)
  - bgpq3

Prefix list filter (IOS)

```
ip prefix-list name/num [seq#] permit | deny
prefix/length [ge value][le value]
```

- Ex 1:

```
ip prefix-list TEST permit 0.0.0.0/0 ge 8 le 24
```

  - Allows any prefix with prefix length between 8 and 24
  - Implicit DENY at the end!

- Ex 2:

```
ipv6 prefix-list TEST-v6 permit 2001:6400::/32 le 48
```

  - Permit the prefix 2400:6400::/32 up to /48
  - Implicit DENY at the end!

Prefix list filter (IOS)

- Ex 3:

```
ip prefix-list TEST deny 0.0.0.0/0
```

  – Deny default route

- Ex 4:

```
ipv6 prefix-list TEST-v6 deny ::/0
```

  – Deny IPv6 default routes

Prefix list filter (IOS)

```
router bgp 17821
 network 100.100.0.0 mask 255.255.224.0
 neighbor 20.20.20.1 remote-as 20
 neighbor 20.20.20.1 prefix-list MY-PREFIX out
 neighbor 20.20.20.1 prefix-list PEER-PREFIX in
!
ip prefix-list MY-PREFIX permit 100.100.0.0/19
ip prefix-list MY-PREFIX deny 0.0.0.0/0 le 32
!
ip prefix-list PEER-PREFIX permit 200.200.0.0/16
ip prefix-list PEER-PREFIX deny 0.0.0.0/0 le 32
```

AS Path filters

- Used typically when prefix lists are too long
- AS-path access list use regular expressions to select routes based on components in their AS path, or the whole path

```
.       Matches any one character
*       Matches any sequence of pattern before *
+       match at least one preceding expression
^       beginning with
$       ending with
_       matches start, end, space, comma, braces
()      to contain regular expression
[]      to contain number ranges
```

AS Path filter (IOS)

ip as-path access-list *num* [**permit|deny**] *regex*

– Example regular expressions:

^$	locally originated routes
_100$	originated by AS 100
_100_200_	passing through 100 and 200
^(_100)+$	originated by 100, multiple occurrence
^701(_[0-9]+)*_(5539|8495|8763)$	received from 701 and originated from either 5539, or 8495, or 8763 while passing through any ASes

– Example:

```
ip as-path access-list 10 permit ^100$
```

- Allow any prefix originated and received from AS100
- Implicit DENY at the end

– Use **filter-list** to apply AS path access-lists

AS Path filter (IOS)

```
router bgp 17821
 network 100.100.0.0 mask 255.255.224.0
 neighbor 30.30.30.1 remote-as 30
 neighbor 30.30.30.1 filter-list 30 out
 neighbor 30.30.30.1 filter-list 40 in
!
ip as-path access-list 30 permit ^$
ip as-path access-list 40 permit ^30$
```

Community access lists

- Communities can be used to select prefixes
  - Set a community when you import a prefix into BGP
  - Set a community when you learn a prefix from a peer
  - Select prefixes based on the presence of a community
- Be careful to not allow peers to set your communities if you use them for filtering
  - Ex: tagging their prefixes as your “customer” routes
- Communities have global scope unless you explicitly delete them on export

Collecting policy together

- While prefix lists and AS path access lists can be applied directly it is more common to use ***policy statements*** to collect the various components together
  - Cisco IOS: route-map
  - Junos: policy-statement
  - Huawei: route-policy

Route-map (IOS)

route-map *name* [**permit | deny**] [*sequence*]

- Default is permit
  - Implicit DENY at the end!

```
route-map TEST permit 10
 match A B C
 match D
 set X
 set Y
route-map TEST permit 20
 match E
 set Z
route-map TEST permit 30
```

```
If {(A or B or C)
and D} match
Then {set X and Y}
```

```
Else
If E matches
Then set Z
```

```
Else (for everything else)
Do/set nothing
```

Match (conditions) & Set (actions)

Command	Description
`match community`	BGP community tag
`match as-path`	AS-path access list
`match ip address`	Access list or prefix-list

Command	Description
`set as-path <prepend>`	Modify AS-path
`set community`	Apply BGP community tag
`set metric`	Modify MED
`set local-preference`	Modify local preference

Route-map

```
router bgp 17821
 neighbor 30.30.30.1 remote-as 30
 neighbor 30.30.30.1 route-map AS-OUT out
 neighbor 30.30.30.1 route-map LP-IN in
!
route-map AS-OUT permit 10
 set as-path prepend 17821 17821 17821
!
route-map LP-IN permit 10
 match as-path 1
 set local-preference 150
!
route-map LP-IN permit 20
!
ip as-path access-list 1 permit _30$
```

Route-map

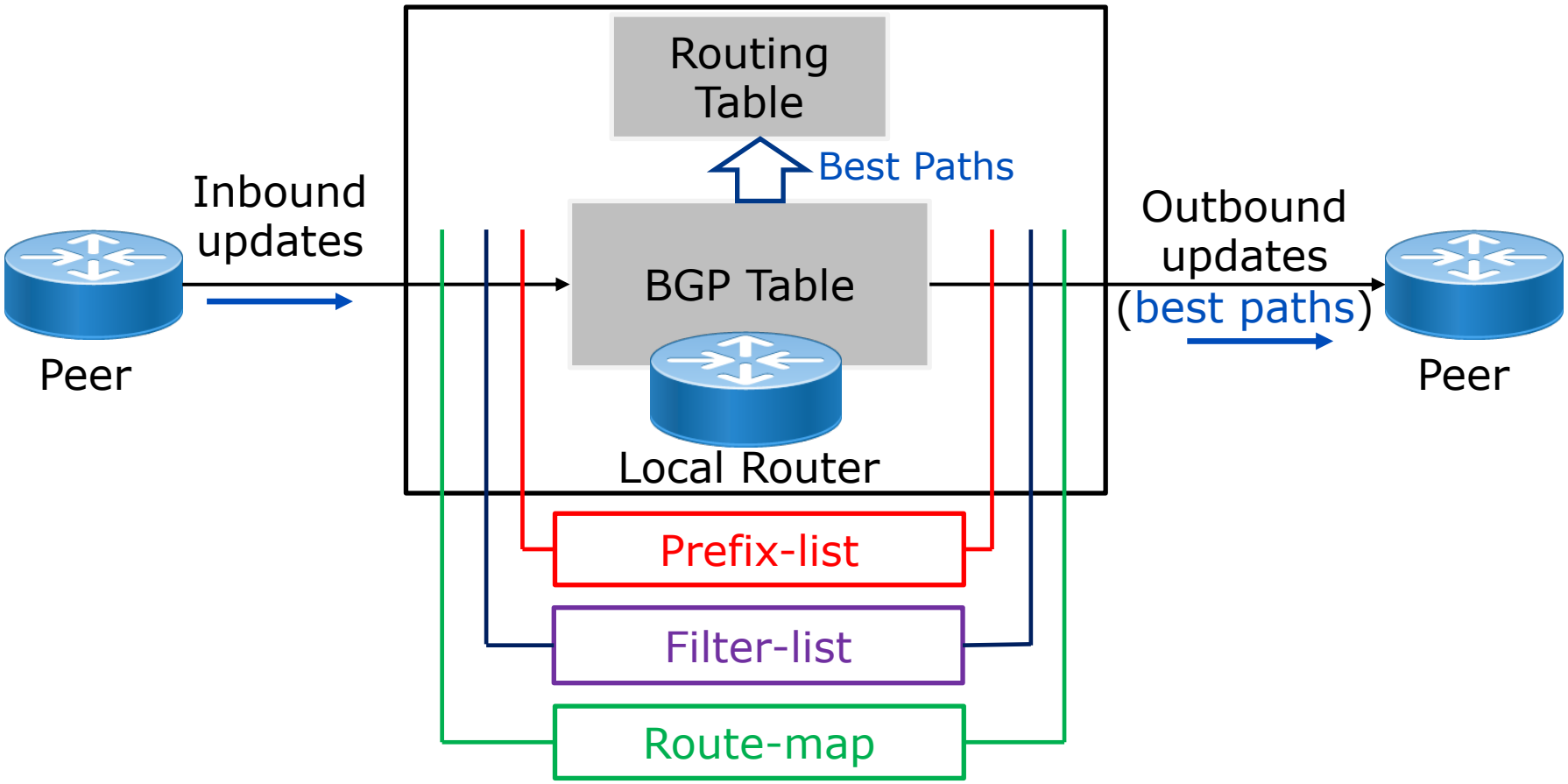
- Setting and Matching communities:

```
router bgp 17821
 network 100.100.0.0 mask 255.255.224.0 route-map SET-AGG
 neighbor 20.20.20.1 remote-as 20
 neighbor 20.20.20.1 send-community
 neighbor 20.20.20.1 route-map TR-IN in
!
route-map SET-AGG permit 10
 set community 17821:1000
!
route-map TR-IN permit 10
 match community 5
 set local-preference 150
!
route-map TR-IN permit 20
!
ip community-list 5 permit 20:3000
ip community-list 5 permit 20:4000
```

Applying Policy Filters

- Incoming/Outgoing updates are filtered through policies
  - BGP table (Loc_RIB) does not contain routes rejected by policies
- Whenever there is a BGP policy change, we need to
  - Trigger an update to force in/outbound routes through the new filters (else only the ones already in BGP table)
    - either through a Hard Reset or a Soft Reset (Route Refresh)
- If the filter is applied to:
  - Outbound routes:
    - need to resend its BGP table through the filter
  - Inbound routes:
    - need its neighbors to resend their BGP tables

Order of processing (IOS)



Hard Reset

- Hard reset of a BGP session
  - Tears down the TCP connection
  - Re-establish the TCP session
  - Resend the BGP table to neighbors affected by the reset
  - Relearn all routes from neighbors

```
clear ip bgp *
clear ip bgp <peer-address>
clear bgp ipv6 unicast *
clear bgp ipv6 unicast <peer-address>
```

  - Disrupts network connectivity
    - Same as a router reboot!

Route Refresh

- RFC2819, RFC7313
  - Does not tear down the BGP session
  - Either
    - Requests the peer to resend its BGP table (Adj-RIB-out)
    - Sends own BGP table (Adj-RIB-out) to the peer
  - Negotiated (automatically) between two BGP speakers
    - Both need to support route refresh
    - IOS example:

```
sh ip bgp neighbor <peer-address>
sh ip bgp all neighbors
sh bgp ipv6 unicast neihgbors
```

```
Neighbor capabilities:
    Route refresh: advertised and received
```

Route Refresh

- IOS example:

```
clear ip bgp <peer-address> [soft] in
clear bgp ipv6 unicast <peer-address> [soft] in
```

  - Tells neighbor to resend its BGP table

```
clear ip bgp <peer-address> [soft] out
clear bgp ipv6 unicast <peer-address> [soft] out
```

  - Resends full BGP table to its neighbor

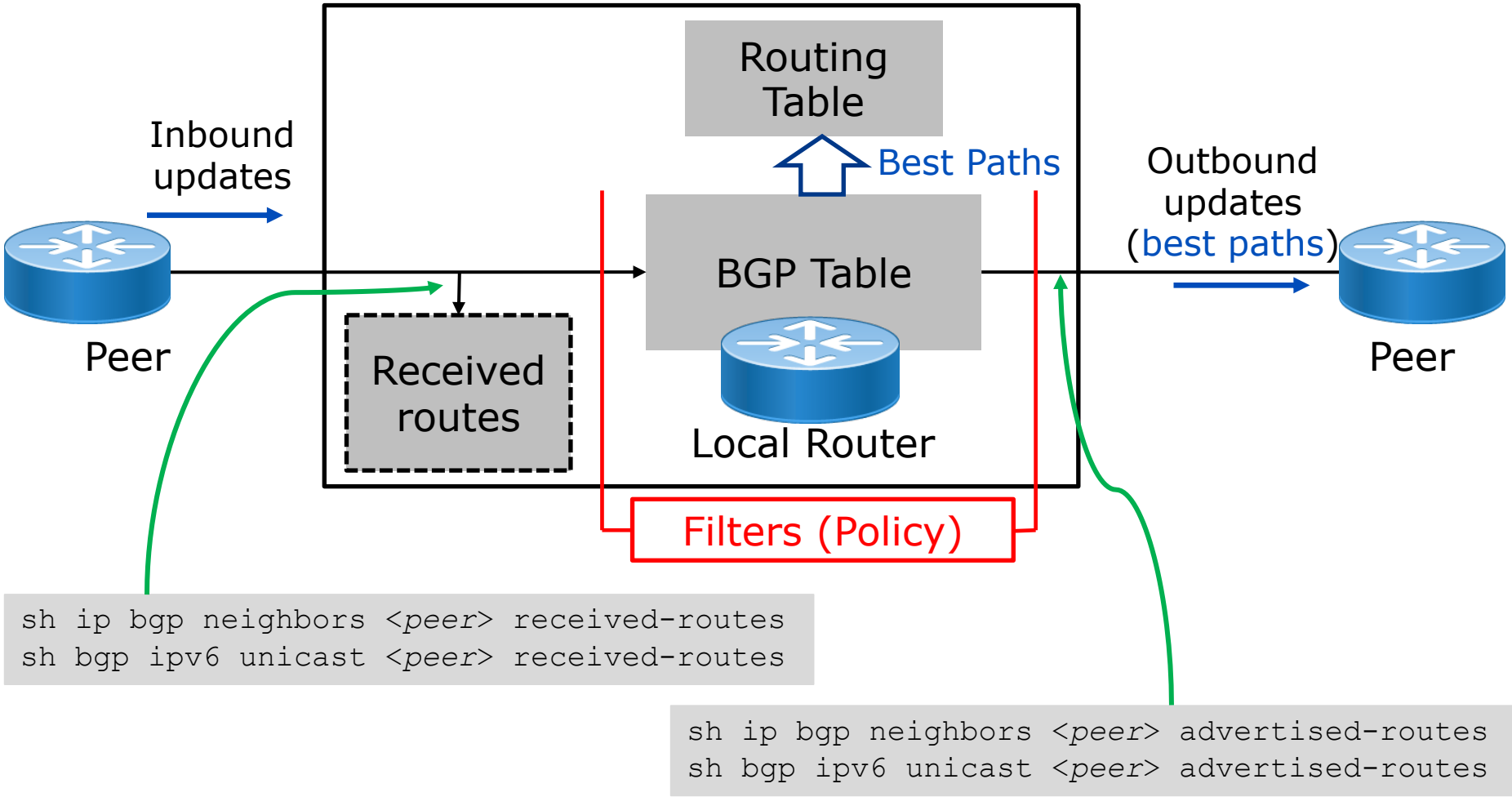
- Huawei example:

```
refresh bgp ipv6 <peer-address> export
```

Soft Reconfiguration

- All current routers should support route refresh
  - If the router (local or peer) does not have route refresh capability, use soft-reconfiguration
- With soft-reconfiguration, the router stores a copy of the received routes in addition to the BGP table (allowed by policy filters)
  - Thus, requires additional memory!

Soft Reconfiguration



Soft Reconfiguration

```
router bgp 17821
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 route-map SET-LPREF in
 neighbor 1.1.1.1 soft-reconfiguration inbound
```

- Whenever there is change in policy

```
clear ip bgp 1.1.1.1 soft [in|out]
```

  - If “in”, runs the stored received routes through the new filter
  - If ”out”, sends the BGP table through the filters
  - Does not tear down the BGP session!

- Route refresh capability cannot be used if soft-reconfig is used!

Acknowledgement:

- Philip Smith
- Cisco Systems


Questions