BGP Policy Control

ISP Training Workshops

Applying Policy with BGP

- Policy-based on AS path, community or the prefix
- Rejecting/accepting selected routes
- Set attributes to influence path selection
- Tools:
  - Prefix-list (filters prefixes)
  - Filter-list (filters ASes)
  - Route-maps and communities

Policy Control – Prefix List

- Per neighbour prefix filter
  - incremental configuration
- Inbound or Outbound
- Based upon network numbers (using familiar IPv4 address/mask format)
- Using access-lists in Cisco IOS for filtering prefixes was deprecated long ago
  - **Strongly discouraged!**

Prefix-list Command Syntax

- Syntax:

```
[no] ip prefix-list list-name [seq seq-value]
  permit|deny network/len [ge ge-value] [le le-
  value]
```

`network/len:` The prefix and its length

`ge ge-value:` "greater than or equal to"

`le le-value:` "less than or equal to"

- Both "ge" and "le" are optional
  - Used to specify the range of the prefix length to be matched for prefixes that are more specific than network/len
- Sequence number is also optional
  - **`no ip prefix-list sequence-number`** to disable display of sequence numbers

Prefix Lists – Examples

- Deny default route

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

- Permit the prefix 35.0.0.0/8

```
ip prefix-list EG permit 35.0.0.0/8
```

- Deny the prefix 172.16.0.0/12

```
ip prefix-list EG deny 172.16.0.0/12
```

- In 192/8 allow up to /24

```
ip prefix-list EG permit 192.0.0.0/8 le 24
```

  - This allows all prefix sizes in the 192.0.0.0/8 address block, apart from /25, /26, /27, /28, /29, /30, /31 and /32.

Prefix Lists – Examples

- In 192/8 deny /25 and above

```
ip prefix-list EG deny 192.0.0.0/8 ge 25
```

  - This denies all prefix sizes /25, /26, /27, /28, /29, /30, /31 and /32 in the address block 192.0.0.0/8.
  - It has the same effect as the previous example

- In 193/8 permit prefixes between /12 and /20

```
ip prefix-list EG permit 193.0.0.0/8 ge 12 le 20
```

  - This denies all prefix sizes /8, /9, /10, /11, /21, /22, … and higher in the address block 193.0.0.0/8.

- Permit all prefixes

```
ip prefix-list EG permit 0.0.0.0/0 le 32
```

  - 0.0.0.0 matches all possible addresses, "0 le 32" matches all possible prefix lengths

Policy Control – Prefix List

- Example Configuration

```
router bgp 100
 network 105.7.0.0 mask 255.255.0.0
 neighbor 102.10.1.1 remote-as 110
 neighbor 102.10.1.1 prefix-list AS110-IN in
 neighbor 102.10.1.1 prefix-list AS110-OUT out
!
ip prefix-list AS110-IN deny 218.10.0.0/16
ip prefix-list AS110-IN permit 0.0.0.0/0 le 32
ip prefix-list AS110-OUT permit 105.7.0.0/16
ip prefix-list AS110-OUT deny 0.0.0.0/0 le 32
```

Policy Control – Filter List

- Filter routes based on AS path
  - Inbound or Outbound
- Example Configuration:

```
router bgp 100
 network 105.7.0.0 mask 255.255.0.0
 neighbor 102.10.1.1 filter-list 5 out
 neighbor 102.10.1.1 filter-list 6 in
!
ip as-path access-list 5 permit ^200$
ip as-path access-list 6 permit ^150$
```

Policy Control – Regular Expressions

- Like Unix regular expressions
  - . Match one character
  - * Match any number of preceding expression
  - + Match at least one of preceding expression
  - ^ Beginning of line
  - $ End of line
  - \ Escape a regular expression character
  - _ Beginning, end, white-space, brace
  - | Or
  - () brackets to contain expression
  - [] brackets to contain number ranges

Policy Control – Regular Expressions

- Simple Examples

.*	match anything
.+	match at least one character
^$	match routes local to this AS
_1800$	originated by AS1800
^1800_	received from AS1800
_1800_	via AS1800
_790_1800_	via AS1800 and AS790
_(1800_)+	multiple AS1800 in sequence (used to match AS-PATH prepends)
_\(65530\)_	via AS65530 (confederations)

Policy Control – Regular Expressions

- Not so simple Examples

^[0-9]+$	Match AS_PATH length of one
^[0-9]+_[0-9]+$	Match AS_PATH length of two
^[0-9]*_[0-9]+$	Match AS_PATH length of one or two
^[0-9]*_[0-9]*$	Match AS_PATH length of one or two (will also match zero)
^[0-9]+_[0-9]+_[0-9]+$	Match AS_PATH length of three
_(701|1800)_	Match anything which has gone through AS701 or AS1800
_1849(_.+_)12163$	Match anything of origin AS12163 and passed through AS1849

Policy Control – Route Maps

- A route-map is like a "programme" for IOS
- Has "line" numbers, like programmes
- Each line is a separate condition/action
- Concept is basically:

  if *match* then do *expression* and exit

  else

  if *match* then do *expression* and exit

  else etc
- Route-map "continue" lets ISPs apply multiple conditions and actions in one route-map

Route Maps – Caveats

- Lines can have multiple set statements
- Lines can have multiple match statements
- Line with only a match statement
  - Only prefixes matching go through, the rest are dropped
- Line with only a set statement
  - All prefixes are matched and set
  - Any following lines are ignored
- Line with a match/set statement and no following lines
  - Only prefixes matching are set, the rest are dropped

Route Maps – Caveats

- Example
  - Omitting the third line below means that prefixes not matching list-one or list-two are dropped

```
route-map sample permit 10
 match ip address prefix-list list-one
 set local-preference 120
!
route-map sample permit 20
 match ip address prefix-list list-two
 set local-preference 80
!
route-map sample permit 30 ! Don't forget this
```

Route Maps – Matching prefixes

- Example Configuration

```
router bgp 100
 neighbor 1.1.1.1 route-map infilter in
!
route-map infilter permit 10
 match ip address prefix-list HIGH-PREF
 set local-preference 120
!
route-map infilter permit 20
 match ip address prefix-list LOW-PREF
 set local-preference 80
!
ip prefix-list HIGH-PREF permit 10.0.0.0/8
ip prefix-list LOW-PREF permit 20.0.0.0/8
```

Route Maps – AS-PATH filtering

- Example Configuration

```
router bgp 100
 neighbor 102.10.1.2 remote-as 200
 neighbor 102.10.1.2 route-map filter-on-as-path in
!
route-map filter-on-as-path permit 10
 match as-path 1
 set local-preference 80
!
route-map filter-on-as-path permit 20
 match as-path 2
 set local-preference 200
!
ip as-path access-list 1 permit _150$
ip as-path access-list 2 permit _210_
```

Route Maps – AS-PATH prepends

- Example configuration of AS-PATH prepend

```
router bgp 300
 network 105.7.0.0 mask 255.255.0.0
 neighbor 2.2.2.2 remote-as 100
 neighbor 2.2.2.2 route-map SETPATH out
!
route-map SETPATH permit 10
 set as-path prepend 300 300
```

- Use your own AS number when prepending
  - Otherwise BGP loop detection may cause disconnects

Route Maps – Matching Communities

- Example Configuration

```
router bgp 100
 neighbor 102.10.1.2 remote-as 200
 neighbor 102.10.1.2 route-map filter-on-community in
!
route-map filter-on-community permit 10
 match community 1
 set local-preference 50
!
route-map filter-on-community permit 20
 match community 2 exact-match
 set local-preference 200
!
ip community-list 1 permit 150:3 200:5
ip community-list 2 permit 88:6
```

Route Maps – Setting Communities

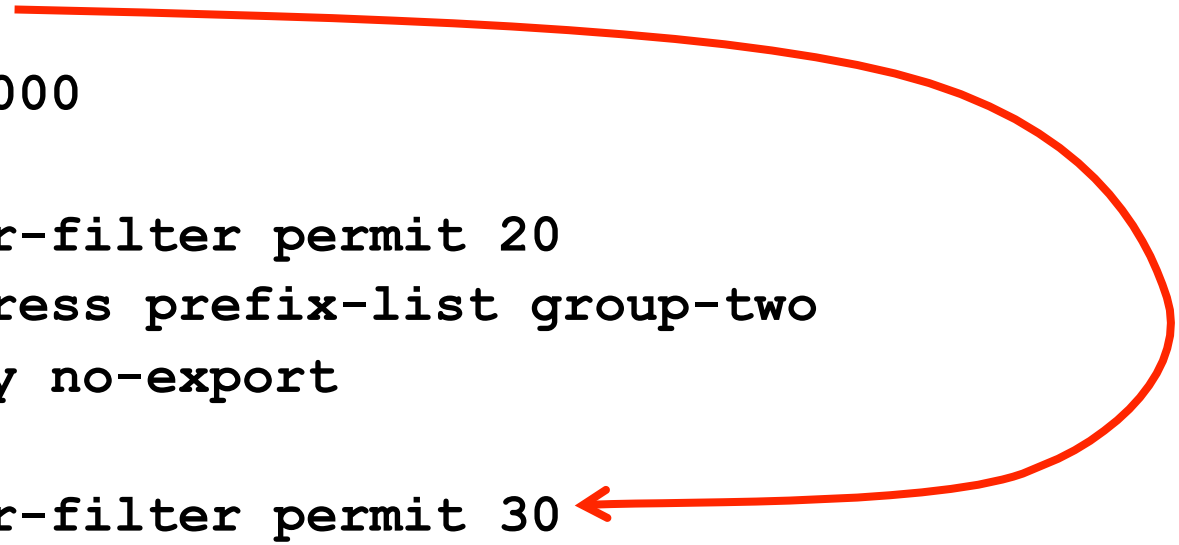
- Example Configuration

```
router bgp 100
 network 105.7.0.0 mask 255.255.0.0
 neighbor 102.10.1.1 remote-as 200
 neighbor 102.10.1.1 send-community
 neighbor 102.10.1.1 route-map set-community out
!
route-map set-community permit 10
 match ip address prefix-list NO-ANNOUNCE
 set community no-export
!
route-map set-community permit 20
 match ip address prefix-list AGGREGATE
!
ip prefix-list NO-ANNOUNCE permit 105.7.0.0/16 ge 17
ip prefix-list AGGREGATE permit 105.7.0.0/16
```

Route Map Continue

- Handling multiple conditions and actions in one route-map (for BGP neighbour relationships only)

```
route-map peer-filter permit 10
 match ip address prefix-list group-one
 continue 30
 set metric 2000
!
route-map peer-filter permit 20
 match ip address prefix-list group-two
 set community no-export
!
route-map peer-filter permit 30
 match ip address prefix-list group-three
 set as-path prepend 100 100
!
```



Managing Policy Changes

- New policies only apply to the updates going through the router AFTER the policy has been introduced or changed
- To facilitate policy changes on the entire BGP table the router handles the BGP peerings need to be "refreshed"
  - This is done by clearing the BGP session either in or out, for example:

```
clear ip bgp <neighbour-addr> in|out
```

- Do NOT forget in or out — doing so results in a hard reset of the BGP session

Managing Policy Changes

- Ability to clear the BGP sessions of groups of neighbours configured according to several criteria
- **`clear ip bgp <addr> [in|out]`**

  `<addr>` may be any of the following

`x.x.x.x`	IP address of a peer
`*`	all peers
`ASN`	all peers in an AS
`external`	all external peers
`peer-group <name>`	all peers in a peer-group

BGP Policy Control

ISP Training Workshops