BGP Routing Policies

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Foreword

BGP can be used to combine many policy tools, use BGP path attributes such as AS_PATH, COMMUNITY and so on as well as filter routes received from or sent to peers. This section will introduce many of the policy mechanisms within BGP to support manipulation of all traffic.

Objectives

Upon completion of this section, you will be able to:

- Understand the BGP route selection process
- Understand BGP filters

Contents

Review of the BGP Route Selection Process

BGP path selection

Review of the BGP Route Selection Process

- If the route's next hop is unreachable, ignore it
- Select the route with highest Preferred-Value
- Select the route with highest local preference
- Choose aggregate routes over non aggregate routes
- Local manual aggregation routing priority takes precedence over local automatic aggregation routing
- Network command presides over import-route command in local route import
- Select the route with the shortest AS_PATH.
- BGP compares the origin attribute of the route and selects the route with the lowest origin attribute code: IGP is lower than EGP, which is lower than Incomplete.
- Select the route with the lowest MED value.

Review of the BGP Route Selection Process (cont.)

- Prefer the route with the shortest path to the BGP NEXT_HOP. This is the route with the lowest IGP metric to the next-hop router.
  - ⇨ When all the above are identical, they are equivalent route and can be used for load balancing
    - − Note: AS_PATH must be the same
    - − The last 3 route selection rules can be ignored when load balancing is implemented
- Selects the route with the shortest cluster-list
- Prefer the route with smaller Originator ID. Select the route with smaller router ID if Originator ID is unavailable.
- Prefer the route with smaller peer IP address.

Contents

Review of the BGP Route Selection Process

BGP path selection

BGP Route Selection Parameters

- The important parameters that affect the BGP route selection
  - ⇨ Preferred Value
  - ⇨ **Local-Preference**
  - ⇨ **AS-Path**
  - ⇨ Origin
  - ⇨ **MED**
  - ⇨ EBGP/IBGP
  - ⇨ IGP Cost
  - ⇨ Cluster-list
  - ⇨ **Communities**

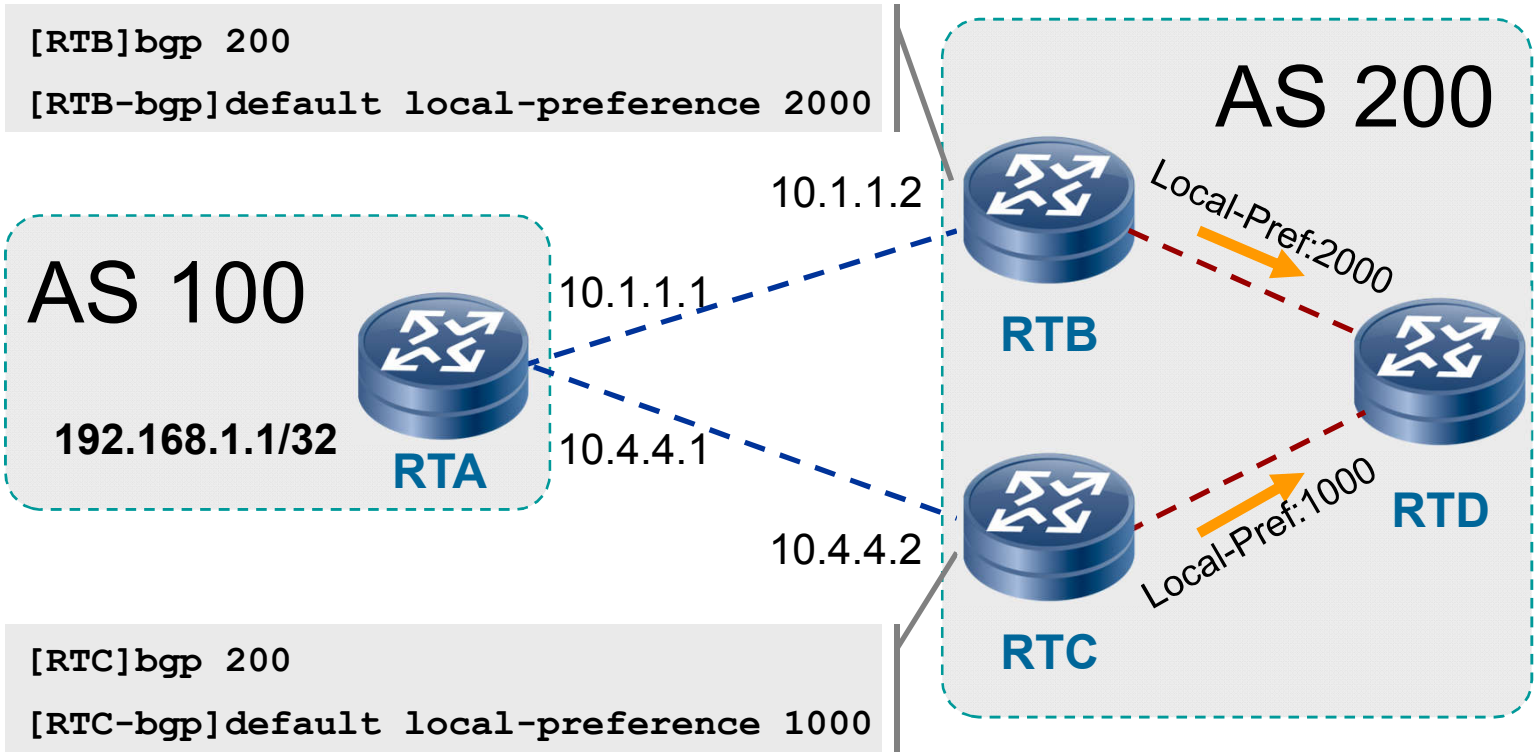
BGP Local-Preference

- **default local-preference** command is used to configure the BGP default local preference, higher values are preferred.

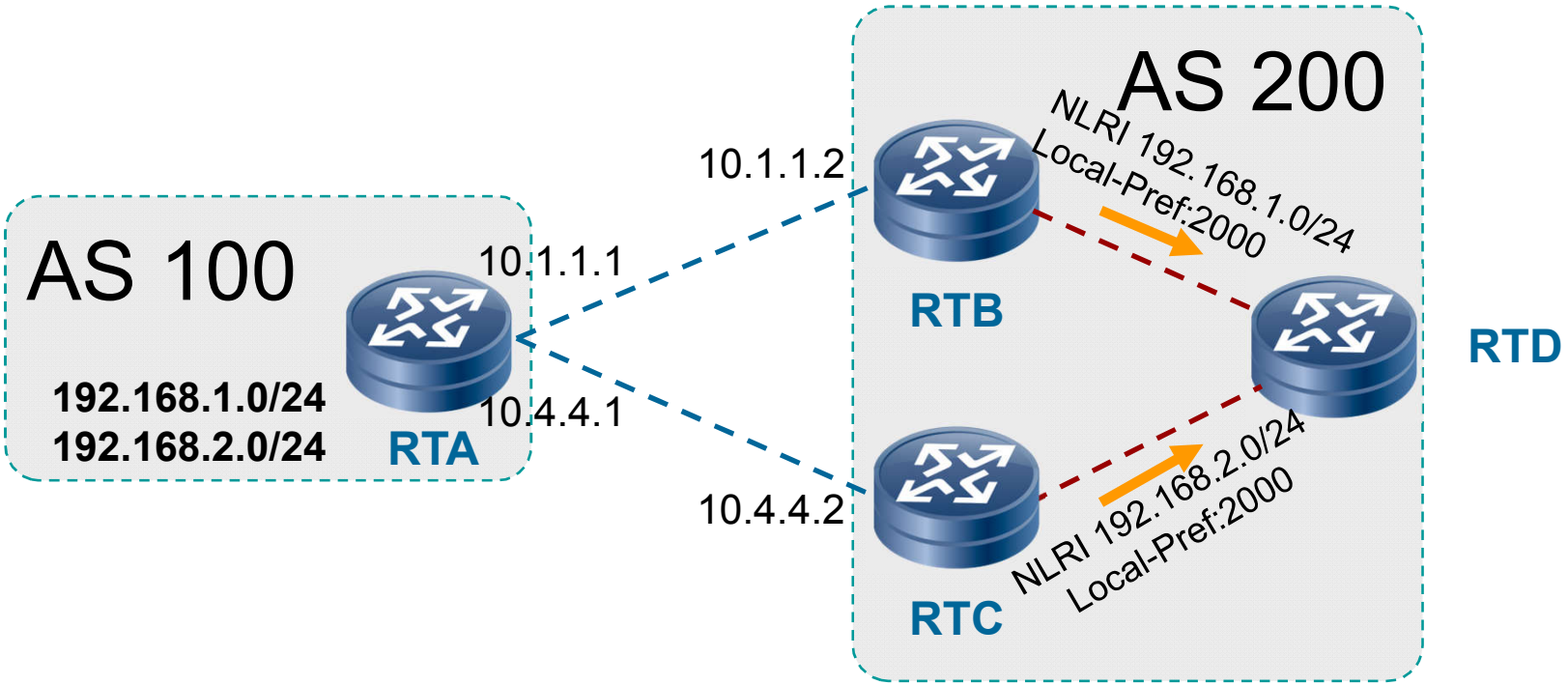
  [Router-bgp] **default local-preference** ***preference***

- By default, the local preference value is 100.
- Configuring different local preference values will affect the BGP route selection. When multiple routes to reach a particular network exist on a BGP router, the route with higher local preference will be selected.
- Local preference is used only within an AS between IBGP peers, it will not be advertized to other AS`.

Configure the Default Value of the Local-Preference



Configuring Local-Preference via Policy



- RTD can reach AS100 via 2 different routes.
  - ⇨ The next hop is RTB for the traffic to reach 192.168.1.0/24.
  - ⇨ The next hop is RTC for the traffic to reach 192.168.2.0/24.

Policy Configuration on RTB

```
#
acl number 2000
 rule 5 permit source 192.168.1.0 0.0.0.255
#
bgp 200
 peer 10.1.1.1 as-number 100
 peer 3.3.3.3 as-number 200
 #
 ipv4-family unicast
  undo synchronization
  peer 10.1.1.1 enable
  peer 10.1.1.1 route-policy test1 import
#
route-policy test1 permit node 10
 if-match acl 2000
 apply local-preference 2000
route-policy test1 permit node 20
 apply local-preference 1000
#
```

Policy Configuration on RTC

```
#
acl number 2000
 rule 5 permit source 192.168.2.0 0.0.0.255
#
bgp 200
 peer 10.4.4.1 as-number 100
 peer 2.2.2.2 as-number 200
 #
 ipv4-family unicast
  undo synchronization
  peer 10.4.4.1 enable
  peer 10.4.4.1 route-policy test1 import
#
route-policy test1 permit node 10
 if-match acl 2000
 apply local-preference 2000
route-policy test1 permit node 20
 apply local-preference 1000
#
```

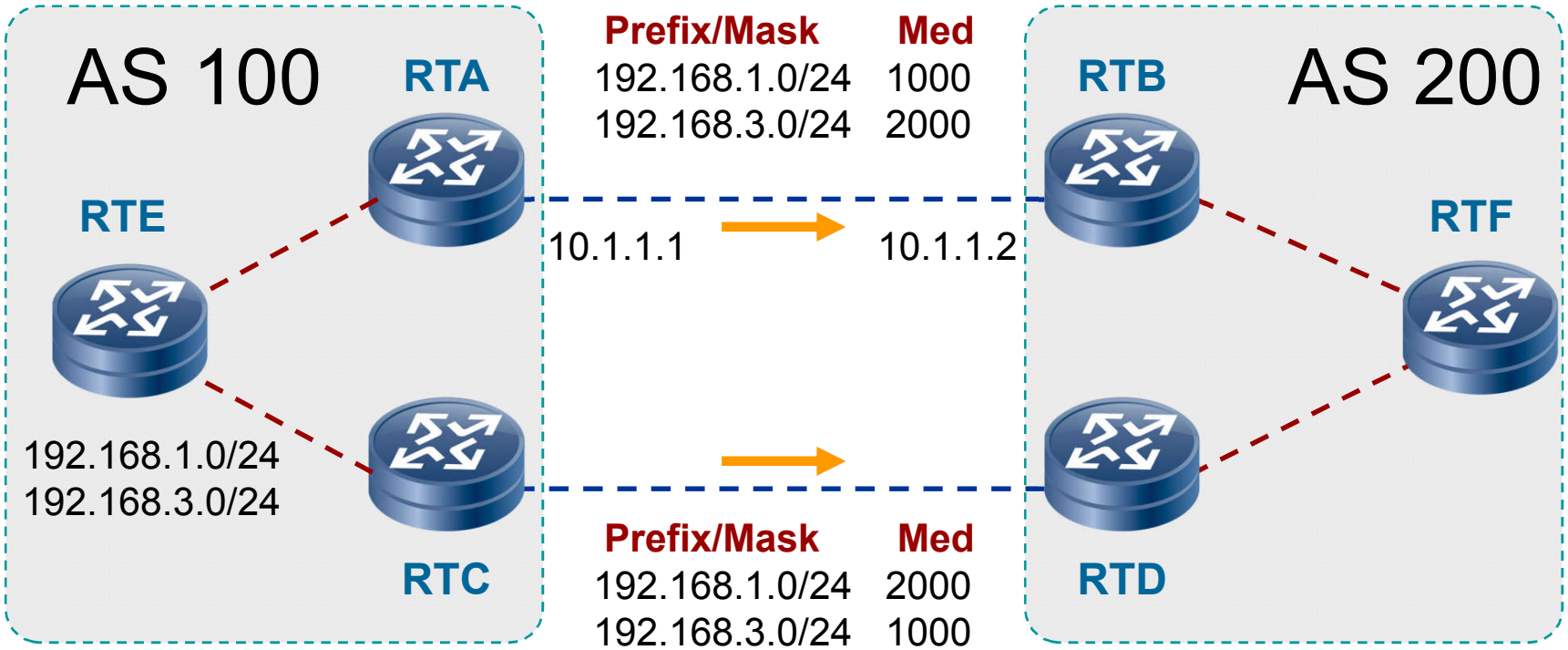
BGP MED

- **default med** command is used to configure the default MED value

  [Router-bgp] **default med** ***med***

- By default, the MED value is 0.
- Configuring different MED values will affect the BGP route selection.
- The lowest MED value is preferred. The MED value is considered as metric or cost. We prefer the route with lowest cost.
- MED attributes that sent to an EBGP peer, will only be seen within that AS. It is not passed beyond the receiving AS.

Configuring MED via Policy



- The MED value is configured in AS100 via policy to influence the BGP route selection in AS200. The configuration of MED value realize the incoming traffic control when multiple paths exist.

Policy Configuration on RTA

```
#
bgp 100
 peer 10.1.1.2 as-number 200
 peer 3.3.3.3 as-number 100
 peer 5.5.5.5 as-number 100
 #
 ipv4-family unicast
  undo synchronization
  peer 10.1.1.2 enable
  peer 10.1.1.2 route-policy test1 export
  peer 3.3.3.3 enable
  peer 5.5.5.5 enable
#
route-policy test1 permit node 10
 if-match ip-prefix 1
 apply cost 2000
route-policy test1 permit node 20
 apply cost 1000
#
 ip ip-prefix 1 index 10 permit 192.168.3.0 24 greater-equal 24 less-equal 24
#
```

Policy Configuration on RTC

```
#
bgp 100
 peer 10.4.4.1 as-number 200
 peer 1.1.1.1 as-number 100
 peer 5.5.5.5 as-number 100
 #
 ipv4-family unicast
  undo synchronization
  peer 10.4.4.1 enable
  peer 10.4.4.1 route-policy test1 export
  peer 1.1.1.1 enable
  peer 5.5.5.5 enable
#
route-policy test1 permit node 10
 if-match ip-prefix 1
 apply cost 2000
route-policy test1 permit node 20
 apply cost 1000
#
 ip ip-prefix 1 index 10 permit 192.168.1.0 24 greater-equal 24 less-equal 24
#
```

AS-PATH Filter

- We can define multiple filtering policies (permit or deny) under the same as-path-filter number. The operation “OR” is applied during the matching process. This indicates that at least one occurrence is required to make the test true. No occurrence indicates that the test failed

- AS_PATH Filter uses the regular expression method to filter the AS_PATH attribute information.

Regular Expressions

- Regular expressions is a type of BGP filtering method.
- Regular expressions are a formula used to match the string according to certain rules. The decision process is done (permit or deny) on the AS_PATH attribute of the BGP route, based on the matched string. In fact, we can regard the regular expression as an ACL for the AS_PATH.
- Multiple permit or deny filters can be defined using regular expressions. The operation “OR” is applied for the matching process.

Regular Expressions

Characters	Explanation
^	Match the beginning of a string. For example “^200” indicates match only if the first value of the AS_PATH is 200.
$	Match the end of a string. For example “200$” indicates match only if the last value of the AS_PATH is 200.
.	Match any single character, including white space.
+	Matches one or more sequences of the pattern.
_	Match any delimiters. For example, comma, bracket, white space and so on.
*	Match zero or more sequences of the pattern.
( )	To group smaller regular expressions into larger regular expressions, ”()” is often used together with “|”.
|	It is an operator that means “or”.
[ ]	Enable you to specify a range of single characters., ”[]” is often used together with “-”.
-	Separates the end points of a range.

String Matching (1)

- ^ (Caret) matches the beginning of a line
  - ⇨ ^ regular expression
- $ (Dollar) matches the end of a line.
  - ⇨ $ regular expression

```
ip as-path-filter 1 permit ^12.*74$
```

Match the AS number that starts with sequence12 and ends with sequence 74

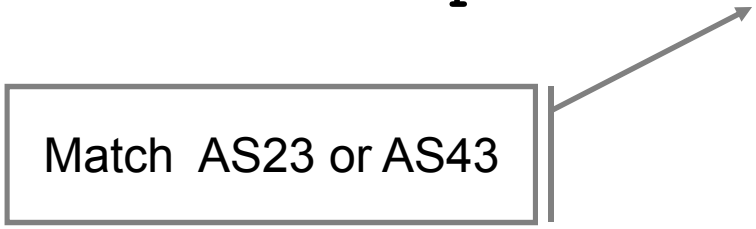
Example

AS_PATH (123 621 743 34512 2374)

String Matching (2)

- | (Bar) is used to specify an OR operation.
  - ⇨ Regular expression 1| Regular expression 2

```
ip as-path-filter 1 permit 23|43
```



Example

AS_PATH (123 621 743 34512 2374)

String Matching (3)

- **[ ]** (Brackets) enable us to specify a range of single characters., ”[]” is often used together with “-”.
- **-** Hyphen
  - ⇨ [regular expression 1-regular expression 2]

```
ip as-path-filter 1 permit [1-3][47]
```

Match AS number 14, 17, 24, 27, 34 or 37

Example

AS_PATH (123 621 743 34512 2374)

String Matching (4)

- _ (Underscore) matches any delimiters. For example, comma, bracket, white space and so on.

```
ip as-path-filter 1 permit _34512 170$
```

AS34512 and AS170 are directly connected

Example

AS_PATH (123 621 743 34512 170)

String Matching (5)

- **.** (Dot) matches any single character, including space.

```
ip as-path-filter 1 permit [1-3].[47]
```

AS_PATH (123 621 743 34512 2374)

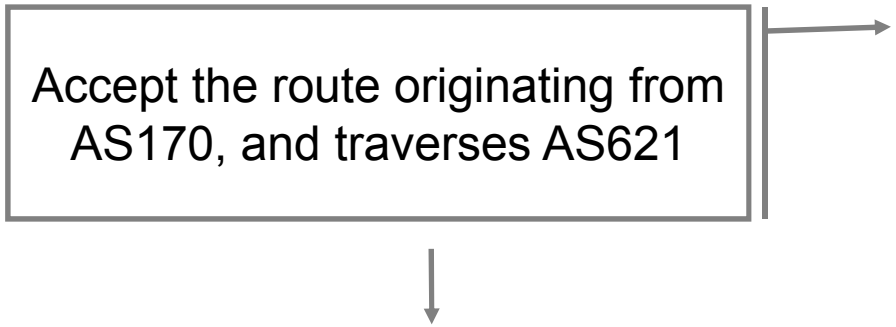
AS_PATH (123 621 743 34512 2374)

AS_PATH (123 621 743 34512 2374)

String Matching (6)

- * (Asterisk) matches zero or more sequences of the pattern.
- + (Plus) matches one or more sequences of the pattern.

```
ip as-path-filter 1 permit _621 .* 170$
```

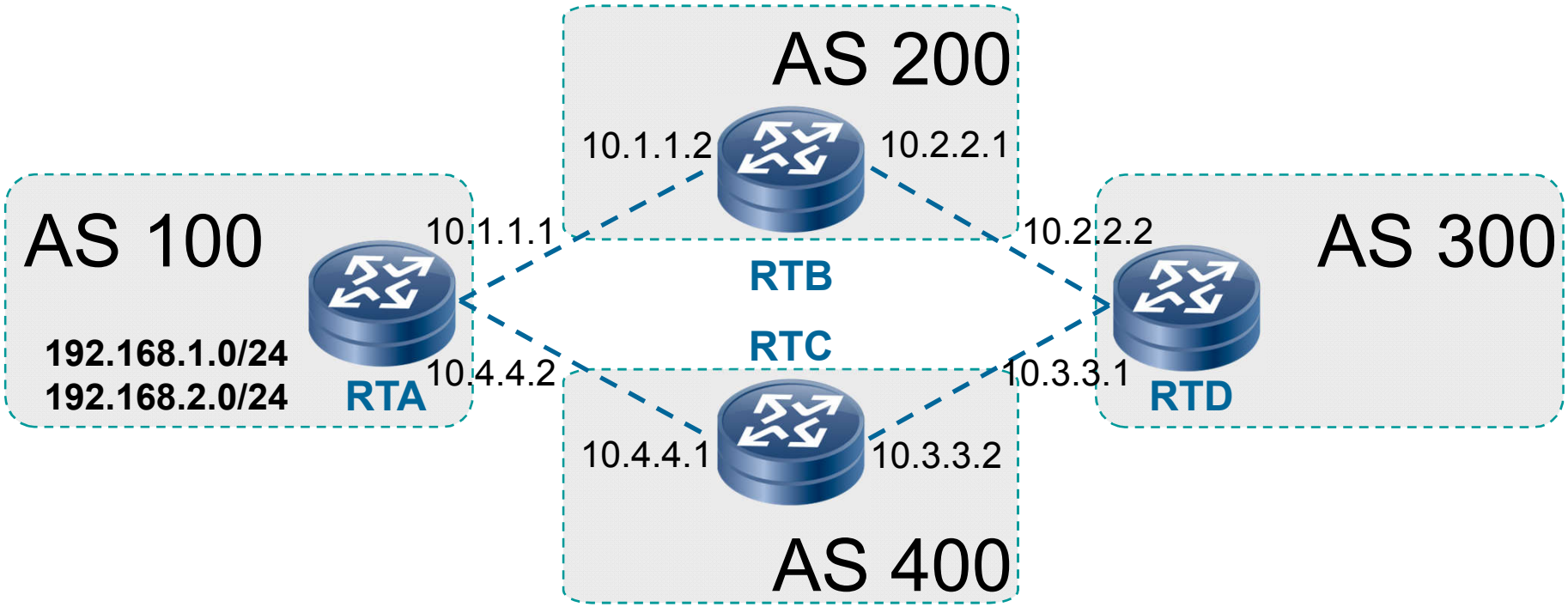


AS_PATH (123 621 743 34512 170)

Common Used Regular Expressions

Regular Expressions	Meaning
^$	Match the routes originated in local AS
.*	Match all routes
_10_	Match the routes traversing AS10
^10$	Match the routes with only AS10 in AS_PATH
^10_	Match the routes received from AS10 directly
^[0-9]+$	Match the routes with only one AS in AS_PATH

AS-Path Filter

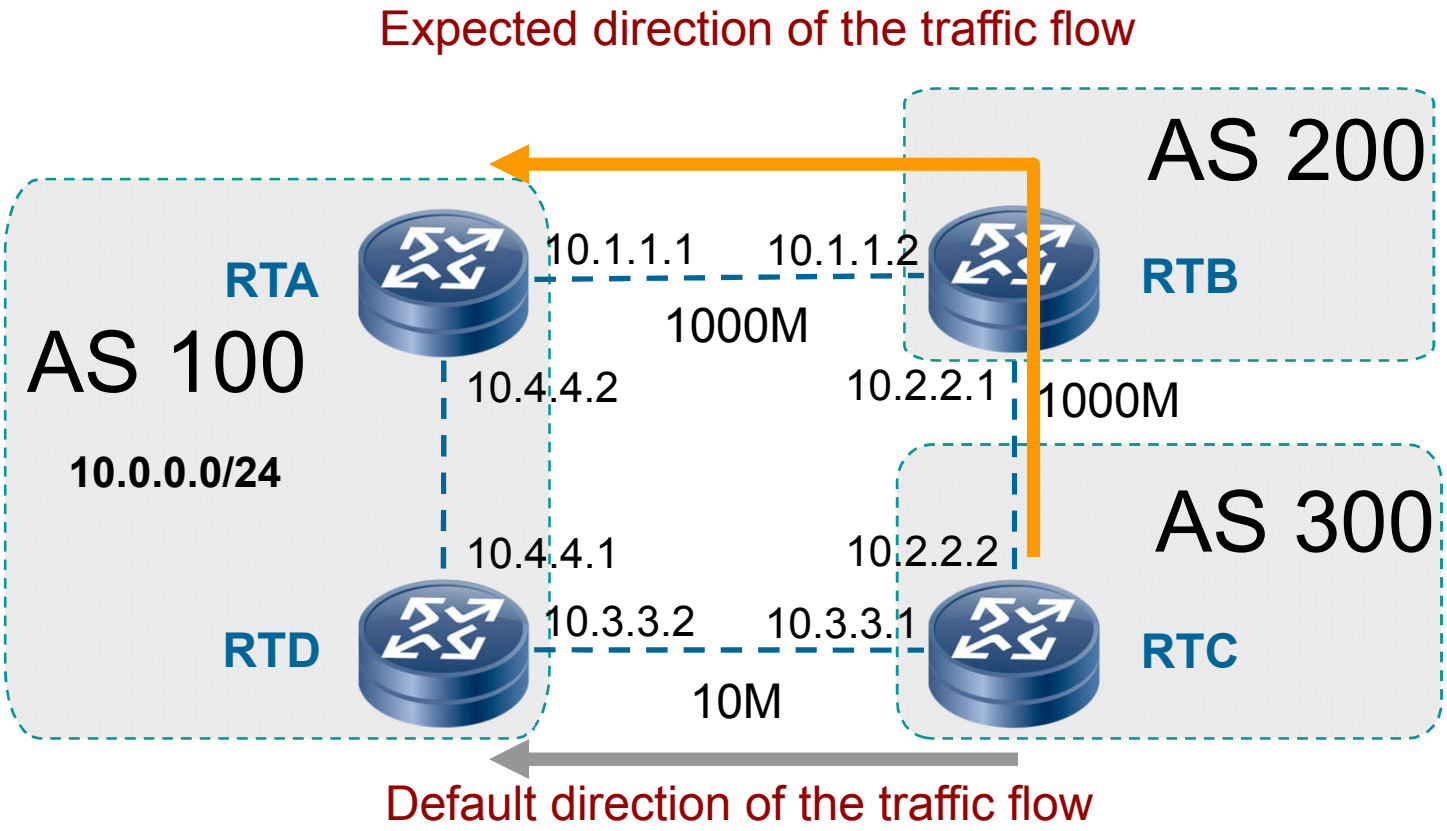


- RTC wants to receive only routing information from AS300.

Configuration on RTC

```
#
bgp 400
 peer 10.4.4.2 as-number 100
 peer 10.3.3.1 as-number 300
 #
 ipv4-family unicast
  undo synchronization
  peer 10.4.4.2 enable
  peer 10.4.4.2 as-path-filter 1 import
  peer 10.3.3.1 enable
  peer 10.3.3.1 as-path-filter 1 import
#
 ip as-path-filter 1 permit ^300_
#
```

BGP Community



Configuration on RTA

```
bgp 100
 peer 10.4.4.1 as-number 100
 peer 10.1.1.2 as-number 200
 #
 ipv4-family unicast
  undo synchronization
  peer 10.4.4.1 enable
  peer 10.1.1.2 enable
  peer 10.1.1.2 route-policy set_community export
  peer 10.1.1.2 advertise-community
#
route-policy set_community permit node 10
 apply community 100:1
```

Configuration on RTD

```
bgp 100
 peer 10.4.4.2 as-number 100
 peer 10.3.3.1 as-number 300
 #
 ipv4-family unicast
  undo synchronization
  peer 10.4.4.2 enable
  peer 10.3.3.1 enable
  peer 10.3.3.1 route-policy set_community export
  peer 10.3.3.1 advertise-community
#
route-policy set_community permit node 10
 apply community 100:2
```

Configuration on RTC

```
bgp 300
 peer 10.2.2.1 as-number 200
 peer 10.3.3.2 as-number 100
 #
 ipv4-family unicast
  undo synchronization
  peer 10.2.2.1 enable
  peer 10.2.2.1 route-policy set_local_pref import
  peer 10.2.2.1 advertise-community
  peer 10.3.3.2 enable
  peer 10.3.3.2 route-policy set_local_pref import
  peer 10.3.3.2 advertise-community
#
route-policy set_local_pref permit node 10
 if-match community-filter 1
 apply local-preference 200
Route-policy set_local_pref permit node 20
 if-match community-filter 2
 apply local-preference 50
#
 ip community-filter 1 permit  100:1
 ip community-filter 2 permit  100:2
```

Display the Community Attribute

```
[RTC]display bgp routing-table community

 Total Number of Routes: 2

 BGP Local router ID is 10.2.2.2
 Status codes: * - valid, > - best, d - damped,
               h - history,  i - internal, s - suppressed, S - Stale
               Origin : i - IGP, e - EGP, ? - incomplete
      Network            NextHop        MED        LocPrf    PrefVal Community

 *    10.0.0.0/24        10.3.3.2       0          50        0       <100:2>
 *>                      10.2.2.1                  200       0       <100:1>
```

Display the Community Attribute (Cont.)

```
[RTC]display bgp routing-table 10.0.0.0

 BGP local router ID : 10.2.2.2
 Local AS number : 300
 Paths:   2 available, 1 best

 BGP routing table entry information of 10.0.0.0/24:
 From: 10.2.2.1 (10.1.1.2)
 Original nexthop: 10.2.2.1
 Community:<100:1>
 AS-path 200 100, origin igp, localpref 200, pref-val 0, valid, external, best,
pre 255
 Advertised to such 1 peers:
    10.3.3.2

 BGP routing table entry information of 10.0.0.0/24:
 From: 10.3.3.2 (10.3.3.2)
 Original nexthop: 10.3.3.2
 Community:<100:2>
 AS-path 100, origin igp, MED 0, localpref 50, pref-val 0, valid, external, pre
255
 Not advertised to any peer yet
```

Summary

- Describe the route policy tools used in BGP.
- List out the parameters that affect the BGP route selection.
- Describe the difference between “+” and “*” used in regular expressions. Describe also the difference between “.” and “_” .

Thank You

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