由於IOS-XR上的路由策略不是最優而導致BGP收斂緩慢的故障排除

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簡介

本文描述如何診斷Cisco IOS® XR路由器上由於非最佳路由策略而發生的緩慢BGP收斂問題。

背景

BGP收斂時間由許多因素組成。其中之一是通過配置的路由策略處理入口或出口BGP更新的時間。可以通過多種方式編寫路由策略來執行特定任務。最佳方式有助於改進BGP收斂、最小化潛在流量丟棄並避免臨時路由環路。Cisco IOS® XR包括一個分析工具，用於測量特定路由策略花費的時間，以便估計其處理時間。

問題

BGP收斂速度慢有時是採用非最佳方式寫入路由策略的結果。

解決方案

有一個用於路由策略的策略分析工具，它可以在不影響效能的情況下使用，以測量路由策略在某個特定連線點上每個語句所花費的時間。您可以檢查路由策略在此特定連線點的運行時間。預設情況下，僅對聚合路由策略狀態啟用分析。

```
router bgp 65000
neighbor 10.0.54.6
remote-as 65000
update-source Loopback0
address-family ipv4 unicast
route-policy INGRESS-ROUTE-POLICY in
!
neighbor 10.0.54.11
remote-as 65001
ebgp-multihop 255
```

```
update-source Loopback0
address-family ipv4 unicast
route-policy EGRESS-ROUTE-POLICY out
```

<#root>

```
RP/0/RSP1/CPU0:XR1#
show pcl protocol bgp speaker-0 neighbor-in-dflt default-IPv4-Uni-10.0.54.6 policy profile


Policy profiling data
Policy : INGRESS-ROUTE-POLICY
Pass : 1440233
Drop : 0
# of executions : 1440233
Total execution time : 57095msec     <===========

RP/0/RSP1/CPU0:XR1#
show bgp ipv4 unicast neighbors 10.0.54.11 | i Update group


Update group: 0.3 Filter-group: 0.5 No Refresh request being processed
RP/0/RSP1/CPU0:XR1#

RP/0/RSP1/CPU0:XR1#
show pcl protocol bgp speaker-0 neighbor-out-dflt default-IPv4-Uni-UpdGrp-0.3-Out policy profile


Policy profiling data
Policy : EGRESS-ROUTE-POLICY
Pass : 726751
Drop : 0
# of executions : 726751
Total execution time : 108099msec <===========
RP/0/RSP1/CPU0:XR1#
```

您可以看到處理INGRESS-ROUTE-POLICY和EGRESS-ROUTE-POLICY所花費的累計時間量。

該分析可應用於任何連線點的入口或出口路由策略。

<#root>

```
RP/0/RSP1/CPU0:XR1#
show pcl protocol bgp speaker-0 ?


  debug-policy                 Attachpoint name
  permnet                      Attachpoint name
  import                       Attachpoint name
  export                       Attachpoint name
  interafi-import              Attachpoint name
  source-rt                    Attachpoint name
  interafi-export              Attachpoint name
  retain-rt                    Attachpoint name
```

```
  addpath                       Attachpoint name
  neighbor-in-dflt              Attachpoint name
  neighbor-in-vrf               Attachpoint name
  neighbor-out-dflt             Attachpoint name
  neighbor-out-vrf              Attachpoint name
  orf-dflt                      Attachpoint name
  orf-vrf                       Attachpoint name
  dampening-dflt                Attachpoint name
  dampening-vrf                 Attachpoint name
  default-originate-dflt        Attachpoint name
  default-originate-vrf         Attachpoint name
  clear-policy                  Attachpoint name
  show-policy-node0_RSP1_CPU0   Attachpoint name
  aggregation-dflt              Attachpoint name
  aggregation-vrf               Attachpoint name
  nexthop                       Attachpoint name
  allocate-label                Attachpoint name
  label-mode                    Attachpoint name
  l2vpn-import                  Attachpoint name
  l2vpn-export                  Attachpoint name
  redistribution-dflt           Attachpoint name
  redistribution-vrf            Attachpoint name
  rib-install-dflt              Attachpoint name
  rib-install-vrf               Attachpoint name
  network-dflt                  Attachpoint name
  network-vrf                   Attachpoint name
  redistribution-dflt           Attachpoint name
  redistribution-vrf            Attachpoint name
  rib-install-dflt              Attachpoint name
  rib-install-vrf               Attachpoint name
  network-dflt                  Attachpoint name
  network-vrf                   Attachpoint name
  l2vpn-export-mp2mp            Attachpoint name
  l2vpn-export-vfi              Attachpoint name
  l2vpn-export-evi              Attachpoint name
  l2vpn-export-mspw             Attachpoint name
  l2vpn-export-instance         Attachpoint name
  WORD                          Attachpoint name
RP/0/RSP1/CPU0:XR1#
```

您可以根據需要清除統計資訊。

<#root>

```
RP/0/RSP1/CPU0:XR1#
clear pcl protocol bgp speaker-0 neighbor-in-dflt default-IPv4-Uni-10.0.54.6 policy profile

RP/0/RSP1/CPU0:XR1#
clear pcl protocol bgp speaker-0 neighbor-out-dflt default-IPv4-Uni-UpdGrp-0.3-Out policy profile
```

如果啟用debug pcl profile detail，則會獲取每個路由策略條目的詳細統計資訊。

<#root>

```
RP/0/RSP1/CPU0:XR1#
```

debug pcl profile detail

這些輸出是在收到完整的Internet BGP表標度並進一步傳播後收集的。

<#root>

```
RP/0/RSP1/CPU0:XR1#
```

show pcl protocol bgp speaker-0 neighbor-in-dflt default-IPv4-Uni-10.0.54.6 policy profile

```
Policy profiling data
Policy : INGRESS-ROUTE-POLICY
Pass : 720100
Drop : 0
# of executions : 720100
Total execution time : 222788msec <============== about 3.7 minutes to process ingress updates

Node Id   Num visited      Exec time  Policy engine operation
-----------------------------------------------------------------------------
PXL_0_1        720100     221796msec  if as-path aspath-match ... then    <===============
PXL_0_3          3525          3msec    set local-preference 150
                 3525          0msec
PXL_0_2        716575        225msec    set local-preference 50
               716575         82msec
```

```
RP/0/RSP1/CPU0:XR1#
```

show pcl protocol bgp speaker-0 neighbor-out-dflt default-IPv4-Uni-UpdGrp-0.3-Out policy profile

```
Policy profiling data
Policy : EGRESS-ROUTE-POLICY
Pass : 720105
Drop : 0
# of executions : 720105
Total execution time : 221975msec  <============== about 3.7 minutes to process egress updates

Node Id   Num visited      Exec time  Policy engine operation
-------------------------------------------------------------------------------
PXL_0_1        720105       3005msec  if as-path aspath-match ... then









PXL_0_5             0          0msec    set med 70
                    0          0msec


PXL_0_2        720105     218008msec    if as-path aspath-match ... then    <==============


PXL_0_3            25          0msec      set med 80
                   25          0msec


PXL_0_4        720080        145msec      set med 90
               720080         76msec
```

```
RP/0/RSP1/CPU0:XR1#
```

您可以看到，INGRESS-ROUTE-POLICY的線路PXL_0_1和EGRESS-ROUTE-POLICY的線路PXL_0_2尤其耗時，並且會降低收斂速度。

如果將它們與路由策略相關聯，您會發現INGRESS-ROUTE-POLICY中的AS-PATH-SET-11和EGRESS-ROUTE-POLICY中的AS-PATH-SET-22都會導致該問題。每個AS路徑集由100個正規表示式行組成，這是編寫策略非常低效的方法，因為它不會利用任何可能的最佳化或正規表示式的強大功能。

```
route-policy INGRESS-ROUTE-POLICY
  if as-path in AS-PATH-SET-11 then
    set local-preference 150
  else
    set local-preference 50
  endif
end-policy


route-policy EGRESS-ROUTE-POLICY
  if as-path in AS-PATH-SET-21 then
    set med 70
  elseif as-path in AS-PATH-SET-22 then
    set med 80
  else
    set med 90
  endif
end-policy


as-path-set AS-PATH-SET-11
  ios-regex '^65101 65201_',
  ios-regex '^65102 65202_',
  ios-regex '^65103 65203_',
  ios-regex '^65104 65204_',
  ios-regex '^65105 65205_',
 --- removed 90 similar lines ---
  ios-regex '^65195 65295_',
  ios-regex '^65196 65296_',
  ios-regex '^65197 65297_',
  ios-regex '^65198 65298_',
  ios-regex '^65199 65299_'
end-set

as-path-set AS-PATH-SET-21
  ios-regex '^$'
end-set
```

```
as-path-set AS-PATH-SET-22
  ios-regex '^65169(_65169)*$',
  ios-regex '^65392(_65392)*$',
  ios-regex '^65133(_65133)*$',
  ios-regex '^65231(_65231)*$',
  ios-regex '^65161(_65161)*$',
 --- removed 90 similar lines ---
  ios-regex '^65281(_65281)*$',
  ios-regex '^65336(_65336)*$',
  ios-regex '^65238(_65238)*$',
  ios-regex '^65381(_65381)*$',
  ios-regex '^65103(_65103)*$'
end-set
```

為了提高策略效能，可以使用本機as-path match操作而不是正規表示式來評估AS路徑集的配置。或者，您也可以在路由策略內以摺疊方式使用正規表示式，從而減少使用的正規表示式行的數量。

下表列出路由策略語言(RPL)提供的AS路徑匹配條件。 本機匹配函式使用二進位制匹配演算法，與正規表示式匹配引擎相比，該演算法具有更好的效能。大多數常見的ios-regex匹配場景都可以與其一起編寫（或其組合）。

指令	說明
is-local	確定路由器（或此自治系統或聯盟中的另一台路由器）是否發起路由
長度	根據AS路徑的長度執行條件檢查
neighbor-is	根據一個或多個整數值或引數的序列，測試AS路徑頭部的自治系統編號。
originates-from	從開始根據AS序列測試AS路徑包含發起路由的AS編號。
直通	測試以瞭解指定的整數或引數是否出現在AS路徑中的任何位置，或者整數和引數的序列是否出現。
unique-length	根據AS路徑的長度執行特定檢查，忽略重複項

驗證

這些策略是藉助本地匹配條件重新編排的路由策略。這導致處理時間顯著減少。

```
route-policy INGRESS-ROUTE-POLICY
  if as-path in AS-PATH-SET-11 then
    set local-preference 150
  else
    set local-preference 50
  endif
end-policy

route-policy EGRESS-ROUTE-POLICY
  if as-path is-local then
    set med 70
  elseif as-path in AS-PATH-SET-22 and as-path unique-length is 1 then
    set med 80
  else
    set med 90
  endif
end-policy


as-path-set AS-PATH-SET-11
  neighbor-is '65101 65201',
  neighbor-is '65102 65202',
  neighbor-is '65103 65203',
  neighbor-is '65104 65204',
  neighbor-is '65105 65205',
--- removed 90 similar lines ---
  neighbor-is '65195 65295',
  neighbor-is '65196 65296',
  neighbor-is '65197 65297',
  neighbor-is '65198 65298',
  neighbor-is '65199 65299'
end-set

as-path-set AS-PATH-SET-22
  originates-from '65169',
  originates-from '65392',
  originates-from '65133',
  originates-from '65231',
  originates-from '65161',
--- removed 90 similar lines ---
  originates-from '65281',
  originates-from '65336',
  originates-from '65238',
  originates-from '65381',
  originates-from '65103'
end-set
```

這些輸出是在收到完整的Internet BGP表擴展後收集並進一步傳播的。

<#root>

RP/0/RSP1/CPU0:XR1#

show pcl protocol bgp speaker-0 neighbor-in-dflt default-IPv4-Uni-10.0.54.6 policy profile

```
Policy profiling data
Policy : INGRESS-ROUTE-POLICY
Pass : 720100
Drop : 0
# of executions : 720100
Total execution time : 9612msec <============== about 10 seconds to process ingress updates

Node Id   Num visited      Exec time  Policy engine operation
-------------------------------------------------------------------------------
PXL_0_1        720100       8540msec  if as-path aspath-match ... then





PXL_0_3          7128          2msec    set local-preference 150
                 7128          1msec



PXL_0_2        712972        276msec    set local-preference 50
               712972         80msec


RP/0/RSP1/CPU0:XR1#
```

show pcl protocol bgp speaker-0 neighbor-out-dflt default-IPv4-Uni-UpdGrp-0.3-Out policy profile

```
Policy profiling data
Policy : EGRESS-ROUTE-POLICY
Pass : 720126
Drop : 0
# of executions : 720126
Total execution time : 12399msec <============== about 12 seconds to process egress updates

Node Id   Num visited      Exec time  Policy engine operation
-------------------------------------------------------------------------------
PXL_0_1        720126        190msec  if as-path is-local then
```

```
PXL_0_7              0          0msec    set med 70
                     0          0msec

PXL_0_2         720126      11190msec    if as-path aspath-match ... then

PXL_0_4         262734         65msec      if as-path unique-length is 1 then

PXL_0_5             25          0msec        set med 80
                    25          0msec

PXL_0_6         720101        164msec        set med 90
                720101         57msec
```

```
GOTO :                                    PXL_0_6
```

```
RP/0/RSP1/CPU0:XR1#
```

或者，可以摺疊ios-regex行。這也有助於提高效能。

```
route-policy INGRESS-ROUTE-POLICY
  if as-path in (ios-regex '^(65101_65201|65102_65202|65103_65203|65104_65204|65105_65205|65106_65206|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65111_65211|65112_65212|65113_65213|65114_65214|65115_65215|65116_65216|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65121_65221|65122_65222|65123_65223|65124_65224|65125_65225|65126_65226|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65131_65231|65132_65232|65133_65233|65134_65234|65135_65235|65136_65236|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65141_65241|65142_65242|65143_65243|65144_65244|65145_65245|65146_65246|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65151_65251|65152_65252|65153_65253|65154_65254|65155_65255|65156_65256|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65161_65261|65162_65262|65163_65263|65164_65264|65165_65265|65166_65266|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65171_65271|65172_65272|65173_65273|65174_65274|65175_65275|65176_65276|6
    set local-preference 150
  endif
  if as-path in (ios-regex '^(65181_65281|65182_65282|65183_65283|65184_65284|65185_65285|65186_65286|6
    set local-preference 150
```

```
  else
    set local-preference 50
  endif
end-policy

route-policy EGRESS-ROUTE-POLICY
  if as-path in (ios-regex '^$') then
    set med 70
  endif
  if as-path in (ios-regex '^65169(_65169)*$|^65392(_65392)*$|^65133(_65133)*$|^65231(_65231)*$|^65161(
    set med 80
  endif
  if as-path in (ios-regex '^65354(_65354)*$|^65331(_65331)*$|^65342(_65342)*$|^65295(_65295)*$|^65208(
    set med 80
  endif
  if as-path in (ios-regex '^65149(_65149)*$|^65350(_65350)*$|^65115(_65115)*$|^65300(_65300)*$|^65322(
    set med 80
  endif
  if as-path in (ios-regex '^65102(_65102)*$|^65329(_65329)*$|^65237(_65237)*$|^65218(_65218)*$|^65153(
    set med 80
  endif
  if as-path in (ios-regex '^65263(_65263)*$|^65116(_65116)*$|^65112(_65112)*$|^65114(_65114)*$|^65378(
    set med 80
  endif
  if as-path in (ios-regex '^65105(_65105)*$|^65296(_65296)*$|^65211(_65211)*$|^65317(_65317)*$|^65115(
    set med 80
  endif
  if as-path in (ios-regex '^65371(_65371)*$|^65214(_65214)*$|^65325(_65325)*$|^65354(_65354)*$|^65384(
    set med 80
  endif
  if as-path in (ios-regex '^65220(_65220)*$|^65277(_65277)*$|^65219(_65219)*$|^65213(_65213)*$|^65336(
    set med 80
  endif
  if as-path in (ios-regex '^65249(_65249)*$|^65112(_65112)*$|^65314(_65314)*$|^65385(_65385)*$|^65152(
    set med 80
  endif
  if as-path in (ios-regex '^65196(_65196)*$|^65252(_65252)*$|^65162(_65162)*$|^65271(_65271)*$|^65357(
    set med 80
  endif
  if as-path in (ios-regex '^65317(_65317)*$|^65360(_65360)*$|^65198(_65198)*$|^65256(_65256)*$|^65246(
    set med 80
  endif
  if as-path in (ios-regex '^65356(_65356)*$|^65359(_65359)*$|^65302(_65302)*$|^65118(_65118)*$|^65346(
    set med 80
  endif
  if as-path in (ios-regex '^65225(_65225)*$|^65307(_65307)*$|^65313(_65313)*$|^65189(_65189)*$|^65288(
    set med 80
  endif
  if as-path in (ios-regex '^65381(_65381)*$|^65292(_65292)*$|^65145(_65145)*$|^65325(_65325)*$|^65361(
    set med 80
  endif
  if as-path in (ios-regex '^65156(_65156)*$|^65184(_65184)*$|^65367(_65367)*$|^65302(_65302)*$|^65290(
    set med 80
  endif
  if as-path in (ios-regex '^65351(_65351)*$|^65116(_65116)*$|^65341(_65341)*$|^65123(_65123)*$|^65258(
    set med 80
  endif
  if as-path in (ios-regex '^65397(_65397)*$|^65302(_65302)*$|^65188(_65188)*$|^65187(_65187)*$|^65358(
    set med 80
  endif
  if as-path in (ios-regex '^65217(_65217)*$|^65107(_65107)*$|^65203(_65203)*$|^65377(_65377)*$|^65381(
    set med 80
```

```
  endif
  if as-path in (ios-regex '^65219(_65219)*$|^65308(_65308)*$|^65364(_65364)*$|^65277(_65277)*$|^65396(
    set med 80
  endif
  if as-path in (ios-regex '^65281(_65281)*$|^65336(_65336)*$|^65238(_65238)*$|^65381(_65381)*$|^65103(
    set med 80
  else
    set med 90
  endif
end-policy
```

這些輸出是在收到完整的Internet BGP表刻度後收集的，然後進一步傳播。

<#root>

RP/0/RSP1/CPU0:XR1#

show pcl protocol bgp speaker-0 neighbor-in-dflt default-IPv4-Uni-10.0.54.6 policy profile

```
Policy profiling data
Policy : INGRESS-ROUTE-POLICY
Pass : 720100
Drop : 0
# of executions : 720100
Total execution time : 30119msec  <============== about 30 seconds to process ingress updates

Node Id   Num visited      Exec time  Policy engine operation
-------------------------------------------------------------------------------
PXL_0_1        720100       4434msec  if as-path aspath-match ... then





PXL_0_2           361          0msec    set local-preference 150
PXL_0_3        720100       3039msec    if as-path aspath-match ... then





         --- removed lines ---
GOTO :                                  PXL_0_3



RP/0/RSP1/CPU0:XR1#
```

show pcl protocol bgp speaker-0 neighbor-out-dflt default-IPv4-Uni-UpdGrp-0.3-Out policy profile

```
Policy profiling data
Policy : EGRESS-ROUTE-POLICY
Pass : 720110
Drop : 0
# of executions : 720110
Total execution time : 106566msec  <============== about 1.8 minutes to process egress updates

Node Id   Num visited      Exec time  Policy engine operation
-------------------------------------------------------------------------------
PXL_0_1        720110       2958msec  if as-path aspath-match ... then







PXL_0_2             0          0msec    set med 70
PXL_0_3        720110       5222msec    if as-path aspath-match ... then







PXL_0_4             3          0msec      set med 80
PXL_0_5        720110       4979msec      if as-path aspath-match ... then







PXL_0_6                                     set med 80



          --- removed lines ---
GOTO :                                  PXL_0_3



RP/0/RSP1/CPU0:XR1#
```

結論

使用本機as-path匹配或摺疊正規表示式模式可以提高路由策略的效能。

關於此翻譯
思科已使用電腦和人工技術翻譯本文件，讓全世界的使用者能夠以自己的語言理解支援內容。請注意，即使是最佳機器翻譯，也不如專業譯者翻譯的內容準確。Cisco Systems, Inc. 對這些翻譯的準確度概不負責，並建議一律查看原始英文文件（提供連結）。