Configure BGP Routers for Optimal Performance and Reduced Memory Consumption

Contents

Introduction

This document describes how to achieve optimal with minimal memory requirements for Border Gateway Protocol (BGP) routers.

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

This document is not restricted to specific software and hardware versions.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

Background Information

This document illustrates how to achieve optimal routing in an enterprise network connected to multiple Internet service providers (ISPs), while the memory requirements of the Border Gateway Protocol (BGP) routers are reduced. You can use the AS_PATH filters which accepts only routes originated from an ISP and

its directly connected autonomous systems and does not receive the full BGP routing table from an ISP.

This section provides a network diagram as an example. In the example, you filter incoming BGP updates at Router 1 and Router 2 to accept the routes of the ISP and the routes of the directly connected autonomous system. Router 1 accepts routes for ISP-A and its directly connected autonomous system C1. Similarly, Router 2 accepts routes for ISP-B and C2. The rest of the networks, which do not belong to the ISPs and their client autonomous system, use the default route that points toward ISP-A or ISP-B, based on the enterprise routing policy.

You can observe how memory utilization varies when Router 1 accepts the complete BGP routing table of approximately 100,000 routes from its ISP, as compared to when you apply inbound AS_PATH filters on Router 1.

Note: The actual number of prefixes that make up a full feed can vary. The values in this document serve only as an example. Route-servers can provide a good idea of how many prefixes make up a full BGP table.

Note: All tools and internal websites are for registered Cisco clients only.

BGP Router Receives Complete BGP Routing Table

This is the configuration of Router 1:

Router 1

hostname R1
!
router bgp XX
  no synchronization
  neighbor 157.x.x.x remote-as 701
  neighbor 157.x.x.x filter-list 80 out
!
ip as-path access-list 80 permit ^$
!
end

The **show ip bgp summary** command output shows that 98,410 prefixes have been received from ISP-A (BGP neighbor 157.x.x.x):

```
<#root>

R1#

show ip bgp summary

BGP router identifier 65.yy.yy.y, local AS number XX
BGP table version is 611571, main routing table version 611571
98769 network entries and 146299 paths using 14847357 bytes of memory
23658 BGP path attribute entries using 1419480 bytes of memory
```

```
20439 BGP AS-PATH entries using 516828 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
5843 BGP filter-list cache entries using 70116 bytes of memory
BGP activity 534001/1904280 prefixes, 2371419/2225120 paths, scan interval 15 secs

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
165.yy.yy.a     4  6xx9   32962  826287   611571    0    0 01:56:13        1
165.yy.yy.b     4  6xx9   32961  855737   611571    0    0 01:56:12        1
165.yy.yy.c     4  6xx9  569699  865164   611571    1    0 01:55:39    47885

157.x.x.x       4   701 3139774  262532   611571    0    0 00:07:24    98410
```

The **show ip route summary** command output shows that 80,132 BGP routes are installed in the routing table:

```
<#root>

R1#

show ip route summary

IP routing table name is Default-IP-Routing-Table(0)
Route Source    Networks    Subnets     Overhead    Memory (bytes)
connected       0           4           256         576
static          0           1           64          144
eigrp 6         0           5           768         720
bgp  XX

80132

       18622       6320256     14326656
  External: 87616 Internal: 11138 Local: 0
internal        854                                 994056
Total           80986       18632       6321344     15322152
```

This command shows the amount of memory the BGP process occupies in RAM:

```
<#root>

R1#

show processes memory | begin BGP

 PID TTY  Allocated      Freed    Holding    Getbufs    Retbufs Process
  73   0  678981156   89816736

70811036

          0          0

BGP Router

  74   0    2968320  419750112      61388    1327064        832 BGP I/O
  75   0          0    8270540       9824          0          0 BGP Scanner


                70882248 Total BGP

                                  77465892 Total all processes
```

The BGP process uses approximately 71 MB of memory.

BGP Router Configured with Inbound AS_PATH Filter List

In this example, you apply the inbound filter list to accept routes originated by ISP-A and its directly connected autonomous systems. In the example, ISP-A advertises a default route (0.0.0.0) via external BGP (eBGP), so routes that do not pass the filter list use the default route toward ISP-A. This is the configuration for the filter list:

Router 1

```
hostname R1
 !
router bgp XX
  no synchronization
  neighbor 157.x.x.x remote-as 701
  neighbor 157.x.x.x filter-list 80 out
  neighbor 157.x.x.x filter-list 85 in

!--- This line filters inbound BGP updates.

 !
ip as-path access-list 80 permit ^$
ip as-path access-list 85 permit ^701_[0-9]*$

!--- The AS_PATH list filters ISP and the directly connected autonomous system routes.

 !
end
```

This**show ip bgp summary**command output shows 31,667 prefixes received from ISP-A (neighbor 157.xx.xx.x):

```
<#root>

R1#

show ip bgp summary

BGP router identifier 165.yy.yy.y, local AS number XX
BGP table version is 92465, main routing table version 92465
36575 network entries and 49095 paths using 5315195 bytes of memory
4015 BGP path attribute entries using 241860 bytes of memory
3259 BGP AS-PATH entries using 78360 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
4028 BGP filter-list cache entries using 48336 bytes of memory
BGP activity 1735069/3741144 prefixes, 4596920/4547825 paths, scan interval 15 secs

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
165.yy.yy.a     4  6319  226694 1787061    92465    0    0 17:31:04        1
```

```
165.yy.yy.b     4  6319  226814 1806986    92465    0    0 19:51:53        1
165.yy.yy.c     4  6319 1041069 1822703    92465    0    0 19:44:52    17424

157.xx.xx.x     4   701 14452518  456341    92465    0    0 19:51:37    31667
```

The **show ip route summary** command output shows 27,129 BGP routes in the routing table:

```
<#root>

R1#

show ip route summary

IP routing table name is Default-IP-Routing-Table(0)
Route Source    Networks    Subnets     Overhead    Memory (bytes)
connected       0           4           256         576
static          0           1           64          144
eigrp 6319      0           6           896         864
bgp 6319

27129

       9424        2339392     5299332
  External: 19134 Internal: 17419 Local: 0
internal        518                                 602952
Total           27647       9435        2340608     5903868
```

The memory used by the BGP process is approximately 28 MB, as shown here:

```
<#root>

R1#

show processes memory | include BGP

 PID TTY  Allocated      Freed    Holding    Getbufs    Retbufs Process
  73   0  900742224  186644540

28115880

         0

 0 BGP Router

  74   0    5315232  556232160       6824    2478452        832 BGP I/O
  75   0          0   39041008       9824          0          0 BGP Scanner


28132528 Total BGP

                                34665820 Total all memory
```

Troubleshoot Memory-Related Issues

To check the memory used by the BGP process, use the **show processes memory | include bgp** command.

The most common issues related to an overuse of memory are listed here:

- Memory allocation failure "%SYS-2-MALLOCFAIL".
- Refused Telnet sessions.
- No output from some **show** commands.
- "Low on memory" error messages.
- "Unable to create EXEC - no memory or too many processes" console messages.
- Router hanging, or no console response.
- If you run BGP-related debugs, it usually causes excessive memory consumption, which can also result in memory errors due to BGP. Debugs for BGP must be run with caution and are to be avoided if they are not required.

When you run the full Internet BGP routes from one BGP peer, the amount of RAM needed depends on the device characteristics and scalability. However, given the continuous growth of Internet routes, the minimum memory required can be around 8 GB of RAM or higher.

The memory consumption by BGP routes depends on the number of attributes, such as multipath support, soft reconfiguration, the number of peers, and AS_PATH. For more details on the BGP memory requirement, refer to RFC 1774.

Conclusion

This chart illustrates the memory savings by when you implement the filter list:

	Number of Prefixes	Memory Consumed
No Filtering	98,410	70,882,248
Autonomous System Filter	31,667	28,132,528

When the BGP router receives its neighbor full BGP routing table (98,410 routes), the router consumes approximately 71 MB. With the AS_PATH filters applied to inbound updates, the size of the BGP routing table is reduced to 31,667 routes, and the memory consumption is approximately 28 MB. This decrease in memory utilization is more than 60 percent with optimal routing.

If you review the AS Internet Graph compiled by the Cooperative Association for Internet Data Analysis (CAIDA), you can see which ISPs have the highest degree of interconnectivity (those closest to the center of the chart). With less interconnectivity, fewer routes pass through the AS_PATH filter, and the BGP memory consumption is lower. However, it is important to note that whenever AS_PATH filters are set, you need to configure a default route (0/0). Routes that do not pass the AS_PATH filter list use the default route.

Related Information

- **Understand Load Sharing with BGP in Single/Multihomed Environments**
- **Use HSRP to Provide Redundancy in a Multihomed BGP Network**
- **Technical Support - Cisco Systems**