Review Exercises

Study Planner

Official Cert Guide

Advance your IT career with hands-on learning

CCNP and CCIE Enterprise Core

ENCOR 350-401

BRADLEY EDGEWORTH, CCIE® No. 31574
RAMIRO GARZA RIOS, CCIE® No. 15469
JASON GOOLEY, CCIE® No. 38759
DAVID HUCABY, CCIE® No. 4594

ciscopress.com

```
     Network          Next Hop            Metric LocPrf Weight Path
 *>  2001:DB8::1/128  ::                       0         32768 ?
 *>  2001:DB8::2/128  2001:DB8:0:12::2         0             0 65200 i
 *>  2001:DB8::3/128  2001:DB8:0:12::2                       0 65200 65300 i
 *>  2001:DB8:0:1::/64  ::                     0         32768 ?
 *>  2001:DB8:0:3::/64  2001:DB8:0:12::2                     0 65200 65300 i
 *   2001:DB8:0:12::/64 2001:DB8:0:12::2       0             0 65200 i
 *>                     ::                     0         32768 ?
 *>  2001:DB8:0:23::/64 2001:DB8:0:12::2                     0 65200 65300 i
```

```
R2# show bgp ipv6 unicast | begin Network
     Network          Next Hop            Metric LocPrf Weight Path
 *>  2001:DB8::1/128  2001:DB8:0:12::1       0             0 65100 ?
 *>  2001:DB8::2/128  ::                     0         32768 i
 *>  2001:DB8::3/128  2001:DB8:0:23::3       0             0 65300 i
 *>  2001:DB8:0:1::/64  2001:DB8:0:12::1     0             0 65100 ?
 *>  2001:DB8:0:3::/64  2001:DB8:0:23::3     0             0 65300 i
 *>  2001:DB8:0:12::/64 ::                   0         32768 i
 *                     2001:DB8:0:12::1      0             0 65100 ?
 *>  2001:DB8:0:23::/64 ::                   0         32768 i
                       2001:DB8:0:23::3      0             0 65300 i
```

```
R3# show bgp ipv6 unicast | begin Network
     Network          Next Hop            Metric LocPrf Weight Path
 *>  2001:DB8::1/128  2001:DB8:0:23::2                     0 65200 65100 ?
 *>  2001:DB8::2/128  2001:DB8:0:23::2       0             0 65200 i
 *>  2001:DB8::3/128  ::                     0         32768 i
 *>  2001:DB8:0:1::/64  2001:DB8:0:23::2                   0 65200 65100 ?
 *>  2001:DB8:0:3::/64  ::                   0         32768 i
 *>  2001:DB8:0:12::/64 2001:DB8:0:23::2     0             0 65200 i
 *>  2001:DB8:0:23::/64 ::                   0         32768 i
```

The BGP path attributes for an IPv6 route are displayed with the command **show bgp ipv6 unicast** *prefix/prefix-length*. Example 11-32 shows R3 examining R1's loopback address. Some of the common fields, such as AS_Path, origin, and local preference, are identical to those for IPv4 routes.

Example 11-32 *Viewing the BGP Path Attributes for an IPv6 Route*

```
R3# show bgp ipv6 unicast 2001:DB8::1/128
BGP routing table entry for 2001:DB8::1/128, version 9
Paths: (1 available, best #1, table default)
  Not advertised to any peer
  Refresh Epoch 2
  65200 65100
    2001:DB8:0:23::2 (FE80::2) from 2001:DB8:0:23::2 (192.168.2.2)
      Origin incomplete, localpref 100, valid, external, best
      rx pathid: 0, tx pathid: 0x0
```

Example 11-33 shows the IPv6 BGP route entries for R2. Notice that the next-hop address is the link-local address for the next-hop forwarding address, which is resolved through a recursive lookup.

Example 11-33 *Global RIB for BGP Learned IPv6 Routes*

```
R2# show ipv6 route bgp
IPv6 Routing Table - default - 10 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       H - NHRP, I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea
       IS - ISIS summary, D - EIGRP, EX - EIGRP external, NM - NEMO
       ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect
       RL - RPL, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       la - LISP alt, lr - LISP site-registrations, ld - LISP dyn-eid
       a - Application
B   2001:DB8::1/128 [20/0]
     via FE80::1, GigabitEthernet0/0
B   2001:DB8::3/128 [20/0]
     via FE80::3, GigabitEthernet0/1
B   2001:DB8:0:1::/64 [20/0]
     via FE80::1, GigabitEthernet0/0
B   2001:DB8:0:3::/64 [20/0]
     via FE80::3, GigabitEthernet0/1
```


Key Topic

IPv6 Summarization

The same process for summarizing or aggregating IPv4 routes occurs with IPv6 routes, and the format is identical except that the configuration is placed under the IPv6 address family using the command **aggregate-address** *prefix/prefix-length* [**summary-only**] [**as-set**].

Let's revisit the previous IPv6 deployment but now want to summarize all the loopback addresses (2001:db8:0:1/128, 2001:db8:0:2/128, and 2001:db8:0:3/128) along with the peering link between R1 and R2 (2001:db8:0:12/64) on R2. The configuration would look as shown in Example 11-34.

Example 11-34 *Configuring IPv6 BGP Aggregation on R2*

```
router bgp 65200
 bgp router-id 192.168.2.2
 bgp log-neighbor-changes
 neighbor 2001:DB8:0:12::1 remote-as 65100
 neighbor 2001:DB8:0:23::3 remote-as 65300
 !
 address-family ipv4
  no neighbor 2001:DB8:0:12::1 activate
  no neighbor 2001:DB8:0:23::3 activate
 exit-address-family
 !
```

```
 address-family ipv6
  bgp scan-time 6
  network 2001:DB8::2/128
  network 2001:DB8:0:12::/64
  aggregate-address 2001:DB8::/59 summary-only
  neighbor 2001:DB8:0:12::1 activate
  neighbor 2001:DB8:0:23::3 activate
 exit-address-family
```

Example 11-35 shows the BGP tables on R1 and R3. You can see that all the smaller routes have been aggregated and suppressed into 2001:db8::/59, as expected.

Example 11-35 *Verifying IPv6 Route Aggregation*

```
R3# show bgp ipv6 unicast | b Network
     Network          Next Hop            Metric LocPrf Weight Path
 *>  2001:DB8::/59     2001:DB8:0:23::2         0             0 65200 i
 *>  2001:DB8::3/128   ::                       0         32768 i
 *>  2001:DB8:0:3::/64  ::                      0         32768 i
 *>  2001:DB8:0:23::/64 ::                      0         32768 i

R1# show bgp ipv6 unicast | b Network
     Network          Next Hop            Metric LocPrf Weight Path
 *>  2001:DB8::/59     2001:DB8:0:12::2         0             0 65200 i
 *>  2001:DB8::1/128   ::                       0         32768 ?
 *>  2001:DB8:0:1::/64  ::                      0         32768 ?
 *>  2001:DB8:0:12::/64 ::                      0         32768 ?
 *>  2001:DB8:0:23::/64 2001:DB8:0:12::2        0 65200 65300 i
```

The summarization of the IPv6 loopback addresses (2001:db8:0:1/128, 2001:db8:0:2/128, and 2001:db8:0:3/128) is fairly simple as they all fall into the base IPv6 summary range 2001:db8:0:0::/64. The fourth hextet beginning with a decimal value of 1, 2, or 3 would consume only 2 bits; the range could be summarized easily into the 2001:db8:0:0::/62 (or 2001:db8::/62) network range.

The peering link between R1 and R2 (2001:db8:0:12::/64) requires thinking in hex first, rather than in decimal values. The fourth hextet carries a decimal value of 18 (not 12), which requires 5 bits minimum. Table 11-5 lists the bits needed for summarization, the IPv6 summary address, and the component networks in the summary range.

Table 11-5 IPv6 Summarization Table

Bits Needed	Summary Address	Component Networks
2	2001:db8:0:0::/62	2001:db8:0:0::/64 through 2001:db8:0:3::/64
3	2001:db8:0:0::/61	2001:db8:0:0::/64 through 2001:db8:0:7::/64
4	2001:db8:0:0::/60	2001:db8:0:0::/64 through 2001:db8:0:F::/64
5	2001:db8:0:0::/59	2001:db8:0:0::/64 through 2001:db8:0:1F::/64
6	2001:db8:0:0::/58	2001:db8:0:0::/64 through 2001:db8:0:3F::/64

Currently the peering link between R2 and R3 (2001:db8:0:23::/64) is not being summarized and suppressed, as it is still visible in R1's routing table in Example 11-35. The hex value of 23 (i.e. 0x23) converts to a decimal value of 35, which requires 6 bits. The summarized network range must be changed to 2001:db8::/58 for summarization of the 2001:db9:0:23::/64 network to occur. Example 11-36 shows the configuration change being made to R2.

Example 11-36 *Configuring a Change to Summarize the 2001:db8:0:23::/64 Network*

```
R2# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)# router bgp 65200
R2(config-router)# address-family ipv6 unicast
R2(config-router-af)# no aggregate-address 2001:DB8::/59 summary-only
R2(config-router-af)# aggregate-address 2001:DB8::/58 summary-only
```

Example 11-37 verifies that the 2001:db8:0:23::/64 is now within the aggregate address space and is no longer being advertised to R1.

Example 11-37 *Verifying Summarization of the 2001:db8:0:23::/64 Network*

```
R1# show bgp ipv6 unicast | b Network
     Network            Next Hop            Metric LocPrf Weight Path
 *>  2001:DB8::/58      2001:DB8:0:12::2         0             0 65200 i
 *>  2001:DB8::1/128    ::                       0         32768 ?
 *>  2001:DB8:0:1::/64  ::                       0         32768 ?
 *>  2001:DB8:0:12::/64 ::                       0         32768 ?
```


Exam Preparation Tasks

As mentioned in the section "How to Use This Book" in the Introduction, you have a couple of choices for exam preparation: the exercises here, Chapter 30, "Final Preparation," and the exam simulation questions in the Pearson Test Prep Software Online.

Review All Key Topics

Review the most important topics in the chapter, noted with the Key Topic icon in the outer margin of the page. Table 11-6 lists these key topics and the page number on which each is found.

Key Topic

Table 11-6 Key Topics for Chapter 11

Key Topic Element	Description	Page
Section	Autonomous system numbers	242
Section	Path attributes	243
Paragraph	BGP attribute AS_Path	243
Paragraph	Address family databases and configuration	244
Section	Inter-router communication	244

Key Topic Element	Description	Page
Figure 11-2	BGP Single- and Multi-Hop Sessions	245
Section	BGP session types	245
Section	eBGP	247
Section	Basic BGP configuration	251
Section	Verification of BGP sessions	253
Section	Prefix advertisement	255
Figure 11-9	BGP Database Processing	258
Table 11-4	BGP Table Fields	259
List	BGP summarization techniques	263
Section	Aggregate address	264
Paragraph	Aggregate address with **summary-only**	267
Section	Atomic aggregate	269
Section	Route aggregation with AS_SET	270
Section	Multiprotocol BGP for IPv6	273
Section	IPv6 configuration	274
Section	IPv6 summarization	278

Complete Tables and Lists from Memory

There are no memory tables in this chapter.

Define Key Terms

Define the following key terms from this chapter, and check your answers in the glossary:

address family, AS_Path, atomic aggregate, autonomous system (AS), eBGP session, iBGP session, Loc-RIB table, optional non-transitive, optional transitive, path vector routing protocol, well-known discretionary, well-known mandatory.

Use the Command Reference to Check Your Memory

Table 11-7 lists the important commands from this chapter. To test your memory, cover the right side of the table with a piece of paper, read the description on the left side, and see how much of the command you can remember.

Table 11-7 Command Reference

Task	Command Syntax
Initialize the BGP router process	**router bgp** *as-number*
Identify a BGP peer to establish a session with	**neighbor** *ip-address* **remote-as** *as-number*
Disable the automatic IPv4 address family configuration mode	**no bgp default ip4-unicast**
Initialize a specific address family and sub-address family	**address-family** *afi safi*
Activate a BGP neighbor for a specific address family	**neighbor** *ip-address* **activate**
Advertise a network to BGP	**network** *network* **mask** *subnet-mask* [**route-map** *route-map-name*]
Configure a BGP aggregate IPv4 prefix	**aggregate-address** *network subnet-mask* [**summary-only**] [**as-set**]
Configure a BGP aggregate IPv6 prefix	**aggregate-address** *prefix/prefix-length* [**summary-only**] [**as-set**]
Display the contents of the BGP database	**show bgp** *afi safi* [**network**] [**detailed**]
Display a summary of the BGP table and neighbor peering sessions	**show bgp** *afi safi* **summary**
Display the negotiated BGP settings with a specific peer and the number of prefixes exchanged with that peer	**show bgp** *afi safi* **neighbors** *ip-address*
Display the Adj-RIB-Out BGP table for a specific BGP neighbor	**show bgp** *afi safi* **neighbor** *ip-address* **advertised routes**

References in This Chapter

RFC 1654, *A Border Gateway Protocol 4 (BGP-4)*, by Yakov Rekhter and Tony Li. https://www.ietf.org/rfc/rfc1654.txt, July 1994.

RFC 2858, *Multiprotocol Extensions for BGP-4*, by Yakov Rekhter, Tony Bates, Ravi Chandra, and Dave Katz. https://www.ietf.org/rfc/rfc2858.txt, June 2000.

RFC 4271, *A Border Gateway Protocol 4 (BGP-4)*, Yakov Rekhter, Tony Li, and Susan Hares. https://www.ietf.org/rfc/rfc4271.txt, January 2006.

RFC 4760, *Multiprotocol Extensions for BGP-4*, by Yakov Rekhter, Tony Bates, Ravi Chandra, and Dave Katz. https://www.ietf.org/rfc/rfc4760.txt, January 2007.

RFC 4893, *BGP Support for Four-octet AS Number Space*, by Quaizar Vohra and Enke Chen. https://www.ietf.org/rfc/rfc4893.txt, May 2007.

IP Routing on Cisco IOS, IOS XE, and IOS XR, by Brad Edgeworth, Aaron Foss, and Ramiro Garza Rios. Cisco Press, 2014.