CCENT Study Guide

Chapter 14

Internet Protocol Version 6 (IPv6)

Chapter 14 Objectives

- The CCENT Topics Covered in this chapter include:
- **1.11 Identify the appropriate IPv6 addressing scheme**
- **to satisfy addressing requirements in a LAN/WAN**
- **environment.**
- **1.12 Configure, verify, and troubleshoot IPv6 addressing.**
- **1.13 Configure and verify IPv6 Stateless Address Auto**
- **Configuration.**
- **1.14 Compare and contrast IPv6 address types.**
- 1.14.a Global unicast
- 1.14.b Unique local
- 1.14.c Link local
- 1.14.d Multicast
- 1.14.e Modified EUI 64
- 1.14.f Autoconfiguration
- 1.14.g Anycast
- **3.6 Configure, verify, and troubleshoot IPv4 and IPv6**
- **static routing.**
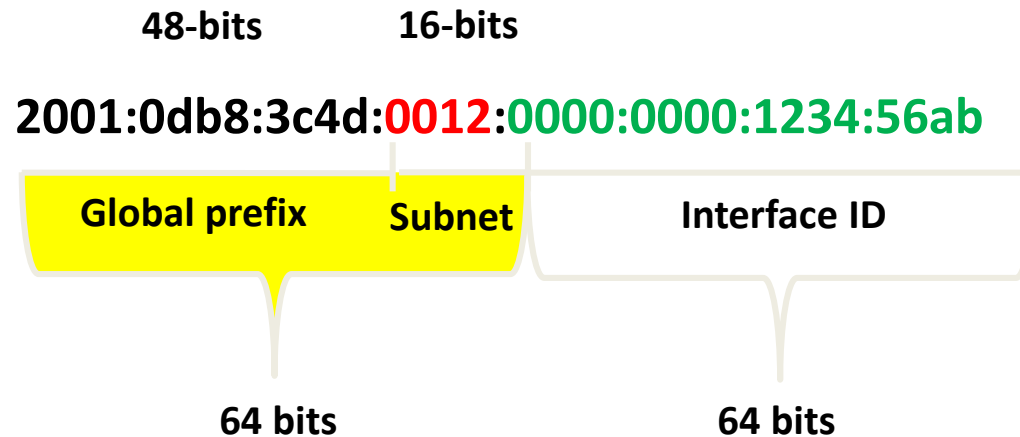- 3.6.a Default route

Why Do We Need IPv6?

Well, the short answer is because we need to communicate and our current system isn't really cutting it anymore. It's kind of like the Pony Express trying to compete with airmail!

Consider how much time and effort we've been investing for years while we scratch our heads to resourcefully come up with slick new ways to conserve bandwidth and IP addresses. Sure, variable length subnet masks (VLSMs) are wonderful and cool, but they're really just another invention to help us cope while we desperately struggle to overcome the worsening address drought.

IPv4 has only about 4.3 billion addresses available—in theory—and we know that we don't even get to use most of those! Sure, the use of Classless Inter-Domain Routing (CIDR) and Network Address Translation (NAT) has helped to extend the inevitable dearth of addresses, but we will still run out of them, and it's going to happen within a few years.

China is barely online, and we know there's a huge population of people and corporations there that surely want to be.

Figure 14.1: IPv6 address example

48-bits   **16-bits**

2001:0db8:3c4d:0012:0000:0000:1234:56ab

| Global prefix | Subnet | Interface ID |

64 bits   **64 bits**

As you can clearly see, the address is definitely much larger. But what else is different? Well, first, notice that it has eight groups of numbers instead of four, and also that those groups are separated by colons instead of periods. And hey, wait a second… there are letters in that address! Yep, the address is expressed in hexadecimal just like a MAC address is, so you could say this address has eight 16-bit hexadecimal colon-delimited blocks.

Address Types

Unicast

Packets addressed to a unicast address are delivered to a single interface. For load balancing, multiple interfaces across several devices can use the same address, but we'll call that an anycast address.

Global unicast addresses (2000::/3)

These are your typical publicly routable addresses and they're the same as in IPv4. Global addresses start at 2000::/3. Figure 14.2 shows how a unicast address breaks down. The ISP can provide you with a minimum /48 network ID, which in turn provides you with 16-bits to create a unique 64-bit router interface address. The last 64-bits are the unique host ID.

Link-local addresses (FE80::/10)

These are like the Automatic Private IP Address (APIPA) addresses that Microsoft uses to automatically provide addresses in IPv4 in that they're not meant to be routed. In IPv6 they start with FE80::/10.

Unique local addresses (FC00::/7)

Unique local addresses were designed to replace site-local addresses, so they basically do almost exactly what IPv4 private addresses do: allow communication throughout a site while being routable to multiple local networks.

Multicast (FF00::/8)

Again, same as in IPv4, packets addressed to a multicast address are delivered to all interfaces tuned into the multicast address. Sometimes people call them "one-to-many" addresses. It's really easy to spot a multicast address in IPv6 because they always start with *FF*.

Anycast

These are referred to as one-to-nearest addresses.

Figure 14.2: IPv6 global unicast addresses
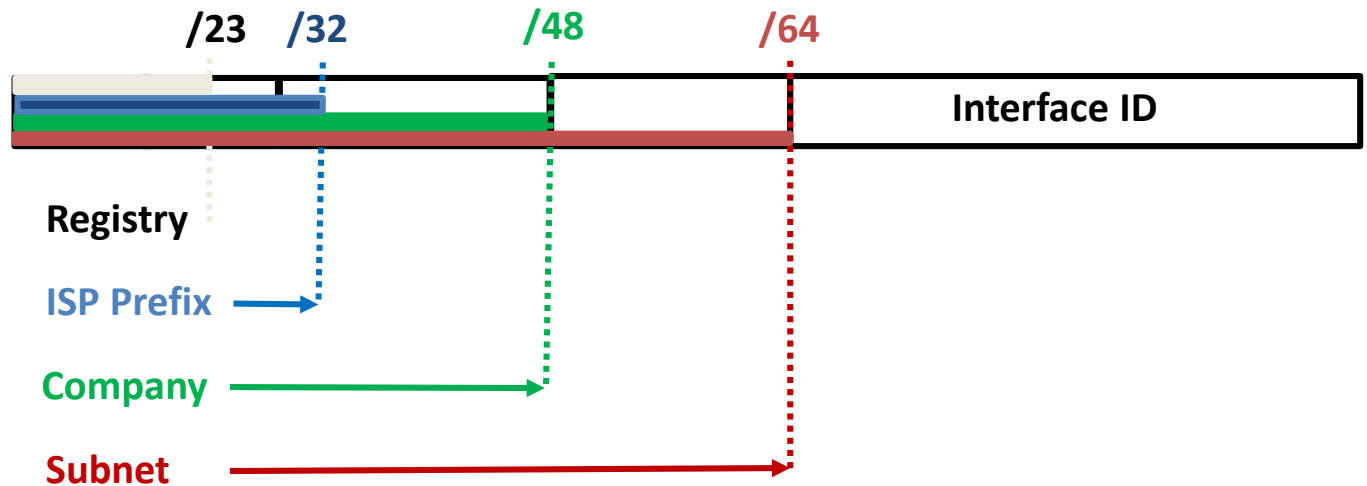
In order to enable IPv6 on a router, you have to use the `ipv6 unicast-routing` global configuration command:

```
Corp(config)#ipv6 unicast-routing
```

By default, IPv6 traffic forwarding is disabled, so using this command enables it.

You can now use the interface configuration command `ipv6 address <ipv6prefix>/<prefix-length> [eui-64]`

Here's an example:

```
Corp(config-if)#ipv6 address 2001:db8:3c4d:1:0260:d6FF.FE73:1987/64
```
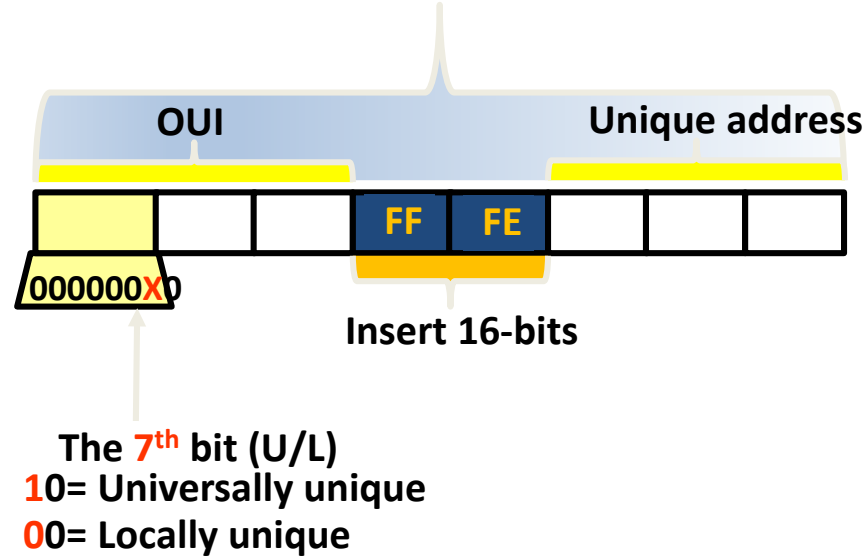
or you can use the eui-64 option. Remember, the EUI-64 (extended unique identifier) format allows the device to use its MAC address and pad it to make the interface ID. Check it out:

```
Corp(config-if)#ipv6 address 2001:db8:3c4d:1::/64 eui-64
```

Figure 14.4: EUI-64 interface ID assignment

Autoconfiguration is an especially useful solution because it allows devices on a network to address themselves with a link-local unicast address as well as with a global unicast address.

64 bit Interface ID

OUI   **Unique address**

| 000000X0 | | | FF | FE | | | |

Insert 16-bits

The **7th** bit (U/L)
10= Universally unique
00= Locally unique

Let's say I have a device with a MAC address that looks like this: 0060:d673:1987. After it's been padded, it would look like this: 0260:d6FF:FE73:1987.

So where did that 2 in the beginning of the address come from?

Figure 14.5: Two steps to IPv6 autoconfiguration

Step 2: Router sends RA message FF02::1 ICMP type 134

Step 1: Host sends RS message FF02::2 ICMP type 133

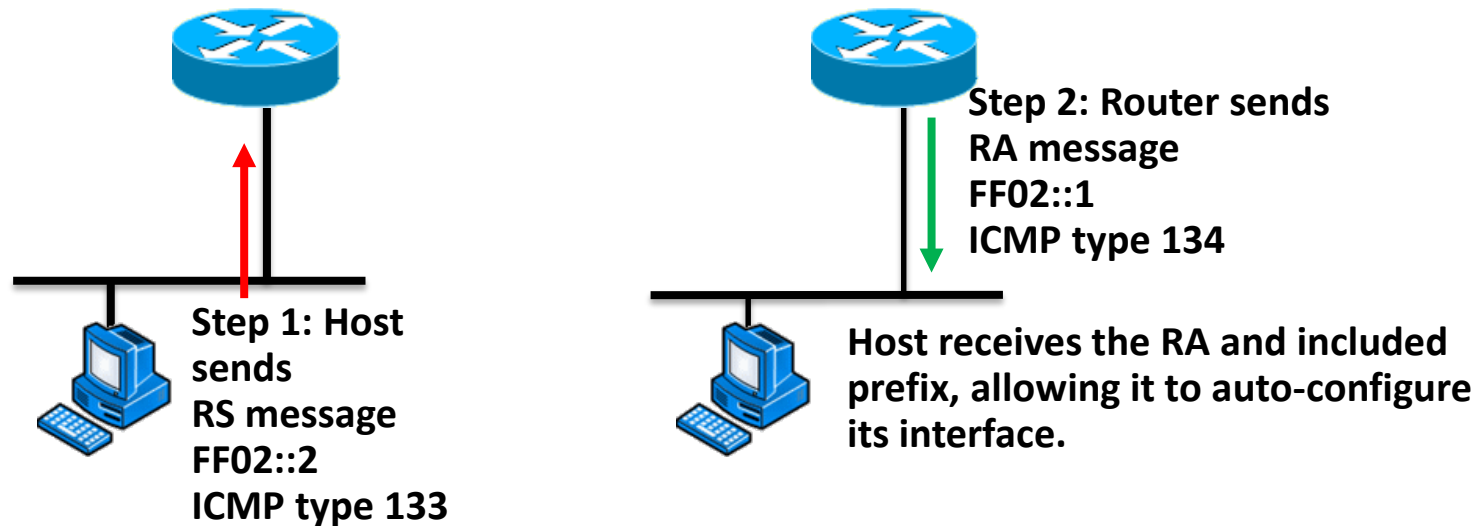**Host receives the RA and included prefix, allowing it to auto-configure its interface.**

# Figure 14.6: IPv6 autoconfiguration example

In this figure, the Branch router needs to be configured, but I just don't feel like typing in an IPv6 address on the interface connecting to the Corp router. I also don't feel like typing in any routing commands, but I need more than a link-local address on that interface. So basically, I want to have the Branch router work with IPv6 on the internetwork with the least amount of effort.

Branch(config-if)#ipv6 address autoconfig default
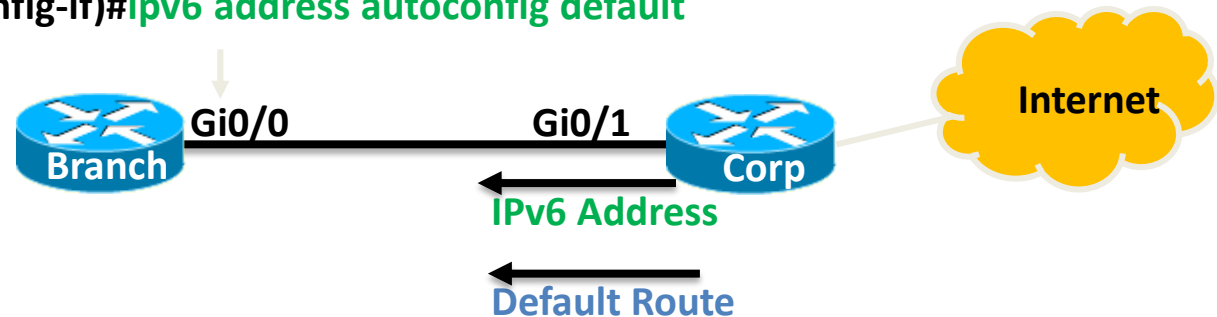
Using the command `ipv6 address autoconfig`, the interface will listen for RAs and then, via the EUI-64 format, it will assign itself a global address

Figure 14.7: IPv6 header
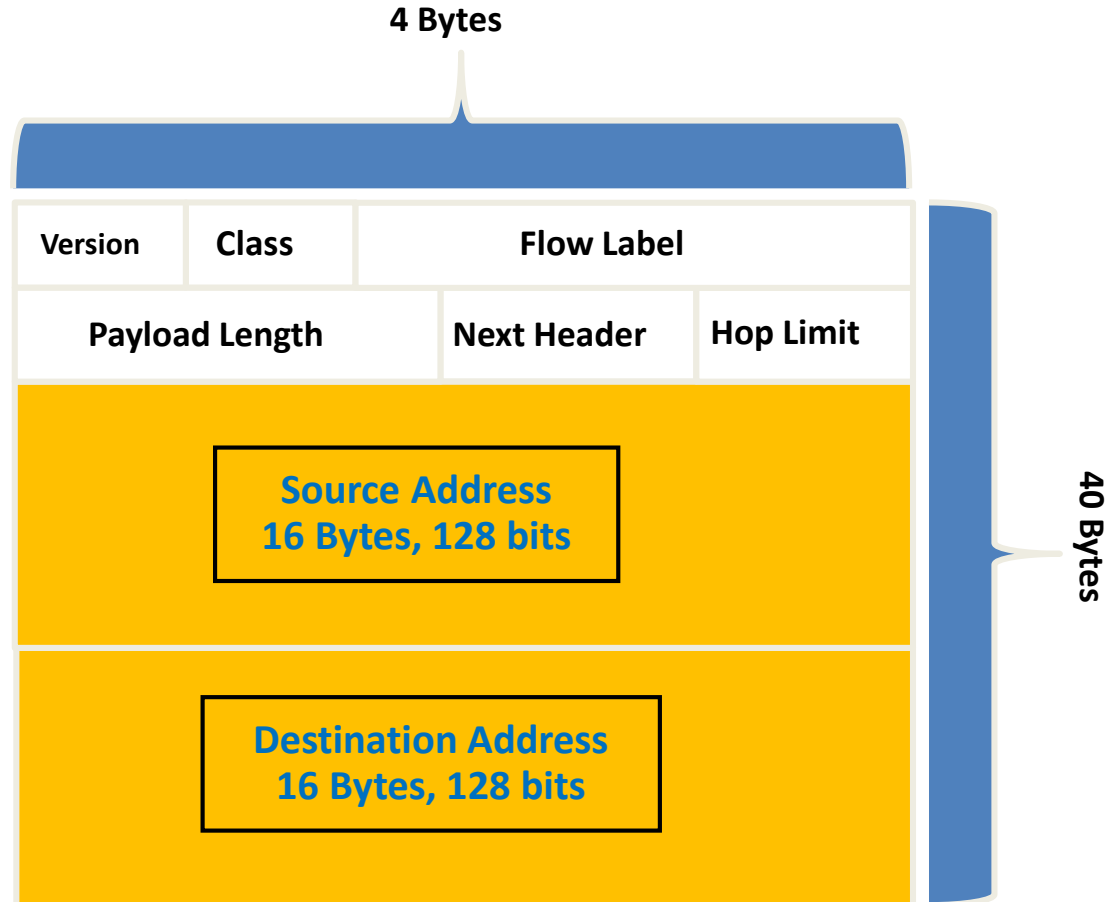
When IPv6 designers devised the header, they created fewer, streamlined fields that would also result in a faster routed protocol at the same time.
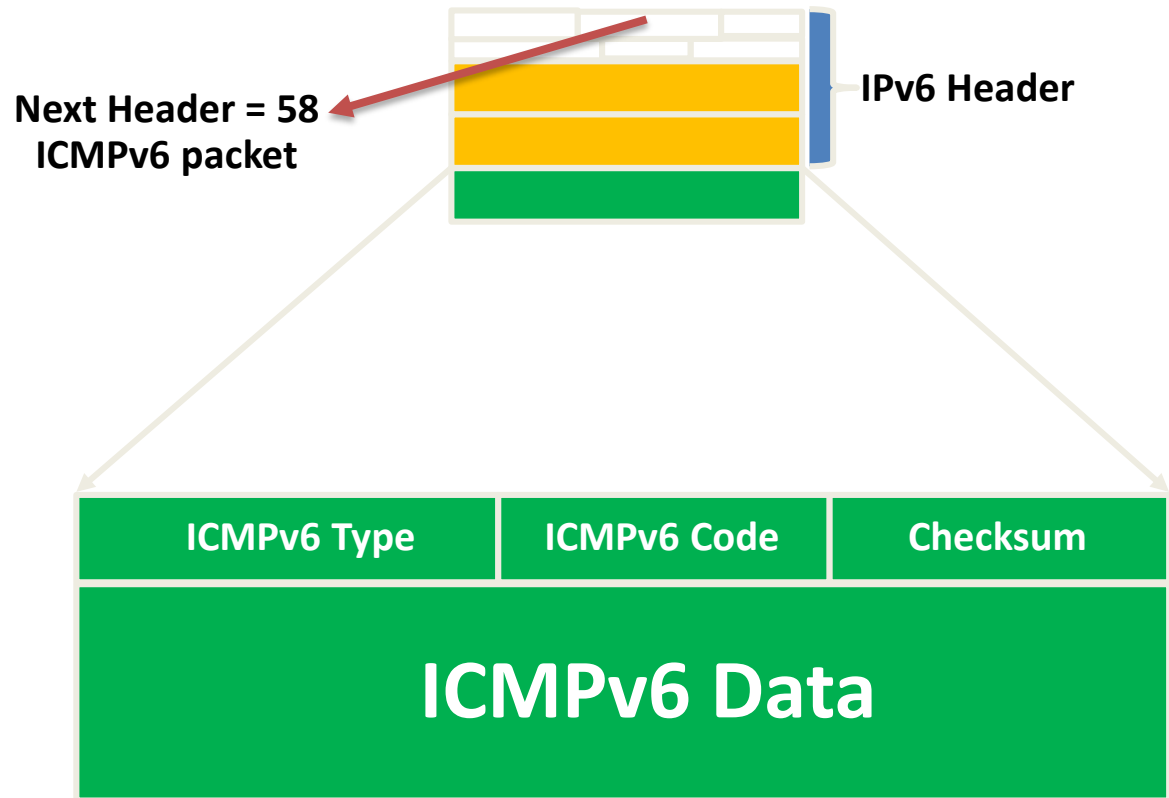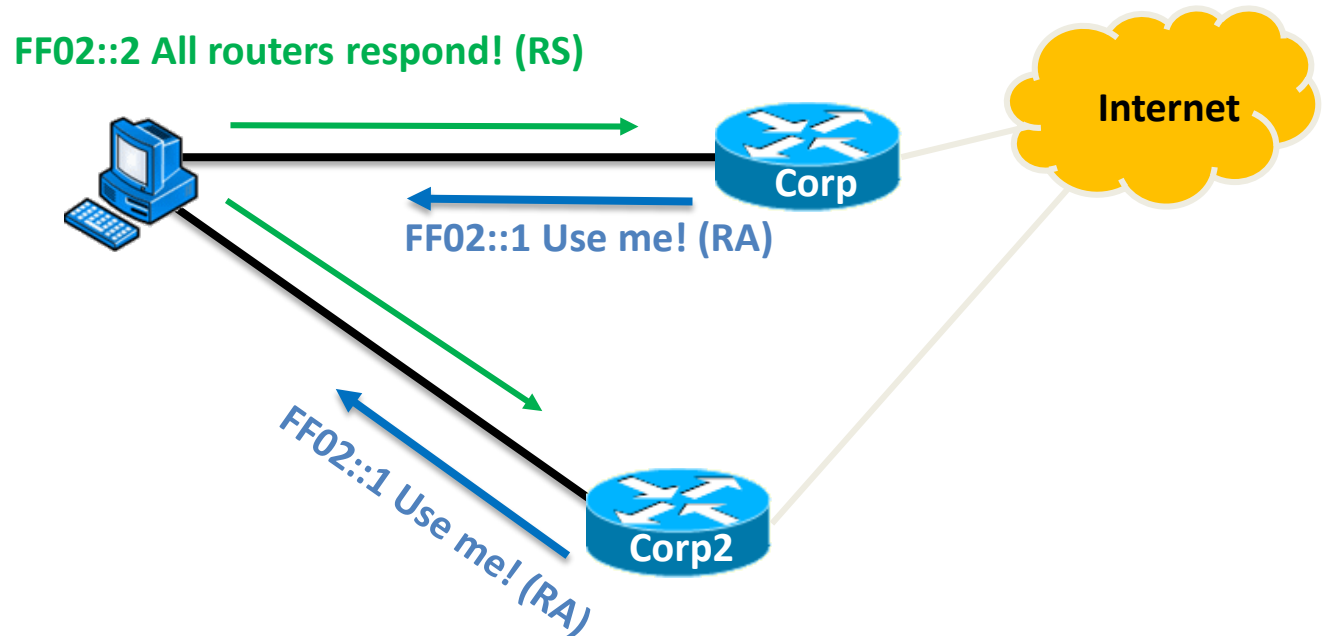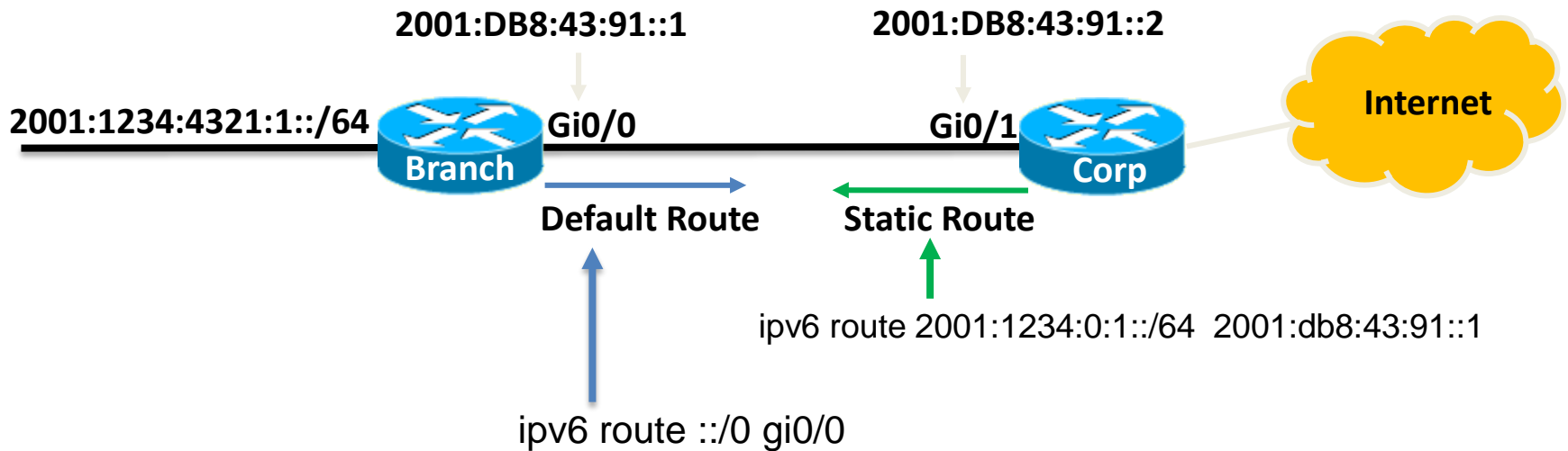
Figure 14.8: ICMPv6

Figure 14.8 shows how ICMPv6 has evolved to become part of the IPv6 packet itself.

Figure 14.9: Router solicitation (RS) and router advertisement (RA)

IPv6 hosts send a router solicitation (RS) onto their data link asking for all routers to respond, and they use the multicast address FF02::2 to achieve this. Routers on the same link respond with a unicast to the requesting host, or with a router advertisement (RA) using FF02::1.

Figure 14.12: IPv6 static and default routing

2001:DB8:43:91::1   2001:DB8:43:91::2

2001:1234:4321:1::/64   Gi0/0   Gi0/1   Internet

Branch   Corp

Default Route   Static Route

ipv6 route 2001:1234:0:1::/64 2001:db8:43:91::1

ipv6 route ::/0 gi0/0

First, I created a static route on the Corp router to the remote network 2001:1234:4321:1::/64 using the next hop address. I could've just as easily used the Corp router's exit interface. Next, I just set up a default route for the Branch router with ::/0 and the Branch exit interface of Gi0/0.

Written Labs and Review Questions

– Read through the Exam Essentials section together in class.

– Open your books and go through all the written labs and the review questions.

– Review the answers in class.