**CCNA**

640-802

**IPV6**







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# Why Do We Need IPv6?

 It’s reality the number of people and devices that connect to networks increases each and every day.



 IPv4 has only about 4.3 billion addresses available in theory, and we know that we don’t even get to use all of those.

 There really are only about 250 million addresses that can be assigned to devices.

 The use of Classless Inter-Domain Routing (CIDR) and Network Address ranslation (NAT) has helped to extend the inevitable dearth of addresses, but we will run out of them, and it’s going to happen within a few years.

 So we have to do something before we run out of addresses and lose the ability to connect with each other and that happens to be implementing IPv6.





# The Benefits and Uses of IPv6



 IPv6 give us lots of addresses (3.4×10^38 = definitely enough).

 But there are many other features built into this version that make it well worth the cost, time, and effort required to migrate to it.

 IPv6 also allows multiple addresses for hosts and networks. This is especially important for enterprises jonesing for availability.

 The new version of IP now includes an expanded use of multicast ommunication (one device sending to many hosts or to a select group), which will also join in to boost efficiency on networks because communications will be more specific.

 IPv4 uses broadcasts which interrupts each and every device on the network. IPv6 uses multicast traffic.





# IPv6 Addressing and Expressions



IPv6 addressing has 128 bits.



? It has eight groups of numbers instead of four and also that those groups are separated by colons instead of periods.

? The address is expressed in hexadecimal just like a MAC address.

? This address has eight 16-bit hexadecimal colon-delimited blocks.





 When you use a web browser to make an HTTP connection to an IPv6 device, you have to type the address into the browser with brackets around the literal address, because a colon is already being used by the browser for specifying a port number.

 If you don’t enclose the address in brackets, the browser will have no way to identify the information.

 Here’s an example of how this looks:

 http://[2001:0db8:3c4d:0012:0000:0000:1234:56ab]/default.html





# Shortened Expression



You can drop any leading zeros in each of the individual blocks. Example:

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

 2001:db8:3c4d:12:0:0:1234:56ab

 Whole blocks that don’t have anything in them except zeros? we can remove the two blocks of zeros by replacing them with double colons.

Example:

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

 2001:db8:3c4d:12::1234:56ab

 But you can only replace one contiguous block of zeros in an address.





If address has four blocks of zeros . Example:

 2001:0000:0000:0012:0000:0000:1234:56ab

 2001::12:0:0:1234:56ab





# Address Types



## Unicast

 Packets addressed to a unicast address are delivered to a single interface. For load balancing, multiple interfaces can use the same address.

## Global unicast addresses

 These are your typical publicly routable addresses, and they’re the same as they are in IPv4.

## Link-local addresses

 These are like the private addresses in IPv4 in that they’re not meant to be routed.

 That gives you the ability to throw a temporary LAN together for meetings or for creating a small LAN that’s not going to be routed but still needs to share and access files and services locally



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**Address Types** (contd…)

## Unique local addresses



 These addresses are also intended for non-routing purposes, but they are nearly globally unique.

## Multicast

 Again, same as in IPv4, packets addressed to a multicast address are delivered

 to all interfaces identified by 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

 Like multicast addresses, an anycast address identifies multiple interfaces, but anycast packet is only delivered to one address which it finds first defined in terms of routing distance.

 You could call them one-to-one-of many addresses.



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# Special Addresses

 0:0:0:0:0:0:0:0 Equals ::. This is the equivalent of IPv4’s 0.0.0.0, and is typically the source address of a host when you’re using stateful configuration.



 0:0:0:0:0:0:0:1 Equals ::1. The equivalent of 127.0.0.1 in IPv4.

 0:0:0:0:0:0:192.168.100.1 This is how an IPv4 address would be written in a mixed IPv6/IPv4 network environment.

 2000::/3 The global unicast address range.

 FC00::/7 The unique local unicast range.

 FE80::/10 The link-local unicast range.

 FF00::/8 The multicast range.

 3FFF:FFFF::/32 Reserved for examples and documentation.

 2001:0DB8::/32 Also reserved for examples and documentation.

 2002::/16 Used with 6to4, which is the transition system the structure that allows IPv6 packets to be transmitted over an IPv4 network without the need to configure explicit tunnels.







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**How IPv6 Works in an Internetwork**





# Autoconfiguration



 Autoconfiguration is an incredibly useful solution because it allows devices on a network to address themselves with a link-local unicast address.

 To perform autoconfiguration, a host goes through a basic two- step process:

 First, the host needs the prefix information (similar to the network portion of an IPv4 address) to configure its interface, so it sends a router solicitation (RS) request for it.

 This RS is then sent out as a multicast to each router’s multicast address.

 The actual information being sent is a type of ICMP message, and like everything in networking, this ICMP message has a number that identifies it. The RS message is ICMP type 133.





 The router answers back with the required prefix information via a router advertisement (RA).

 An RA message also happens to be a multicast packet that’s sent to each node’s multicast address and is ICMP type 134.

 RA messages are sent on a periodic basis, but the host sends the RS for an immediate response so it doesn’t have to wait until the next scheduled RA to get what it needs.



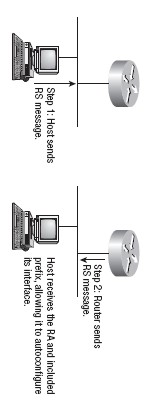




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Two steps to IPv6 auto configuration

These two steps are shown in Figure





# Configuring Cisco Routers with IPv6



 To enable IPv6 on a router, you have to use the **ipv6 unicast- routing global configuration command:** By default, IPv6 traffic forwarding is disabled, so using this command enables it.

 Corp(config)# ipv6 unicast-routing

 IPv6 isn’t enabled by default on any interfaces either, so we have to go to each interface individually and enable it.

 To do this, just add an address to the interface.





 You 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

 You can specify the entire 128-bit global IPv6 address or you can use the eui-64 option.

 The eui-64 format allows the device to use its MAC address and pad it to make the interface ID. :

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

 To configure a router so that it only uses link-local addresses, use the

**ipv6 enable Interface** configuration command:

 Corp(config-if)#ipv6 enable





# DHCPv6



 DHCPv6 works pretty much the same way DHCP does in v4, with the obvious difference that it supports the new addressing scheme for IPv6.

 Router1(config)#**ipv6 dhcp pool ?**

 WORD DHCP pool name

 Router1(config)#**ipv6 dhcp pool test**

 Router1(config-dhcp)#**dns-server ?**

 Hostname or X:X:X:X::X Server’s name or IPv6 address

 Router1(config-dhcp)#**domain-name lammle.com**

 Router1(config-dhcp)#**prefix-delegation pool test lifetime 3600 3600**

 Router1(config)#**int fa 0/0**

 Router1(config-if)#**ipv6 dhcp server test**

 We have a fully configured DHCPv6 server applied to our interface fa0/0.





# RIPng



 The primary features of RIPng are the same as they were with RIPv2. It is still a distance-vector protocol, has a max hop count of 15, and uses split horizon, poison reverse, and other loop avoidance mechanisms, but it now uses UDP port 521.

 And it still uses multicast to send its updates too, but in IPv6, it uses FF02::9 for the transport address.

 You configure or enable the advertisement of a network from interface configuration mode instead of with a network command in router configuration mode.





 Router1(config-if)#ipv6 rip 1 enable

 1 is a tag that identifies the process of RIPng that’s running.

 But if you need to go to router configuration mode to configure something else like redistribution, you still can.

 If you do that, it will look like this on your router:

 Router1(config)#ipv6 router rip 1

 Router1(config-rtr)#





# Verifying RIPng



 Router#sh ipv6 route

 Router#sh ipv6 protocols

 Router#sh ipv6 rip

 Router#sh ipv6 interface serial 0/0/1

 Router#debug ipv6 rip





# EIGRPv6



 EIGRPv6 is still an advanced distance-vector protocol that has some link-state features.

 The neighbor discovery process using hellos still happens, and it still provides reliable communication with reliable transport protocol that gives us loop-free fast convergence using the Diffusing Update Algorithm (DUAL).

 Hello packets and updates are sent using multicast transmission, and as with RIPng, EIGRPv6’s multicast address stayed almost the same.

 In IPv4 it was 224.0.0.10; in IPv6, it’s FF02::A (A = 10 in hexadecimal notation).





## The configuration for EIGRPv6 is going to look like this:

.

 Router1(config)#ipv6 router eigrp 10

 The 10 is still the autonomous system (AS) number. The prompt changes to (config-rtr), and from here you must perform a no shutdown:

 Router1(config-rtr)#no shutdown

 Other options also can be configured in this mode, like redistribution.

 Router1(config-if)#ipv6 eigrp 10

 The 10 in the interface command again references the AS number that was enabled in the configuration mode.





# OSPFv3



 A link-state routing protocol that divides an entire internetwork or autonomous system into areas, making a hierarchy.

 In OSPF version 2, the router ID (RID) is determined by the highest IP addresses assigned to the router (or you could assign it). In version 3, you assign the RID, area ID, and link-state ID, which are all still 32-bit values but are not found using the IP address anymore because an IPv6 address is 128 bits.

 Adjacencies and next-hop attributes now use link-local addresses, and OSPFv3 still uses multicast traffic to send its updates and acknowledgments, with the addresses FF02::5 for

 OSPF routers and FF02::6 for OSPF-designated routers. These new addresses are the replacements for 224.0.0.5 and 224.0.0.6, respectively



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# The configuration of OSPFv3

 Router1(config)#ipv6 router osfp 10



 Router1(config-rtr)#router-id 1.1.1.1

 You get to perform some configurations from router configuration mode like summarization and redistribution, but we don’t even need to configure OSPFv3 from this prompt if we configure OSPFv3 from the interface.

 When the interface configuration is completed, the router configuration process is added automatically and the interface configuration looks like this:

 Router1(config-if)#ipv6 ospf 10 area 0.0.0.0



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# Migrating to IPv6 Dual Stacking

 It allows devices to communicate using either IPv4 or IPv6. Dual stacking lets you upgrade your devices and applications on the network one at a time.



 For configuring dual stacking on a Cisco router, you have to enable IPv6 forwarding and apply an address to the interfaces already configured with IPv4.

 Corp(config)#ipv6 unicast-routing

 Corp(config)#interface fastethernet 0/0

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

 Corp(config-if)#ip address 192.168.255.1 255.255.255.0





# 6to4 Tunneling



 6to4 tunneling is really useful for carrying IPv6 data over a network that’s still IPv4.

 To use this we need a couple of dual-stacked routers.

 And we have to add a little configuration to place a tunnel between those routers. We just have to tell each router where the tunnel begins and where we want it to end up.





Router1(config)#int tunnel 0

Router1(config-if)#ipv6 address 2001:db8:1:1::1/64 Router1(config-if)#tunnel source 192.168.30.1

Router1(config-if)#tunnel destination 192.168.40.1

Router1(config-if)#tunnel mode ipv6ip Router2(config)#int tunnel 0

Router2(config-if)#ipv6 address 2001:db8:2:2::1/64 Router2(config-if)#tunnel source 192.168.40.1

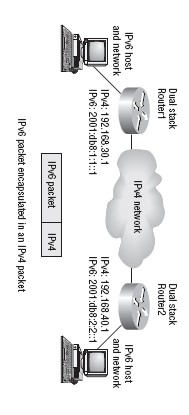
Router2(config-if)#tunnel destination 192.168.30.1 Router2(config-if)#tunnel mode ipv6ip







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**Creating a 6to4 tunnel**

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## NAT-PT

 With NAT-PT there is no encapsulation the data of the source packet is removed from one IP type and repackaged as the new destination IP type.

 **Static NAT-PT** provides a one-to-one mapping of a single IPv4 address to a single IPv6 address (sounds like static NAT).

 **Dynamic NAT-PT** which uses a pool of IPv4 addresses to provide a one-to-one mapping with an IPv6 address (sounding kind of familiar).

 **Network Address Port Translation (NAPT-PT)** which provides a many-to one mapping of multiple IPv6 addresses to one IPv4 address and a port number.



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