Configuring IPv6 Addressing with Stateless Auto-Configuration

Topology



Objective

Configure device interfaces with EUI-64 IPv6 addresses using stateless auto-configuration to establish point-to-point IPv6 connectivity.

Equipment

The physical topology is preconfigured in Packet Tracer using three 1841s and three PCs.

The 1841 routers have two WIC-2T cards inserted. Interfaces S0/0/0, S0/0/1, and S0/1/0 are used to interconnect the three routers:

* S0/0/0 interfaces connect Router1 (DCE) and Router2 – the clock rate is 4,000,000 bits/sec
* S0/0/1 interfaces connect Router2 (DCE) and Router3 – the clock rate is 4,000,000 bits/sec
* S0/1/0 interfaces connect Router3 (DCE) and Router1 – the clock rate is 4,000,000 bits/sec

The built-in F0/0 interface on each router connects to the Ethernet interface on the connected PC.

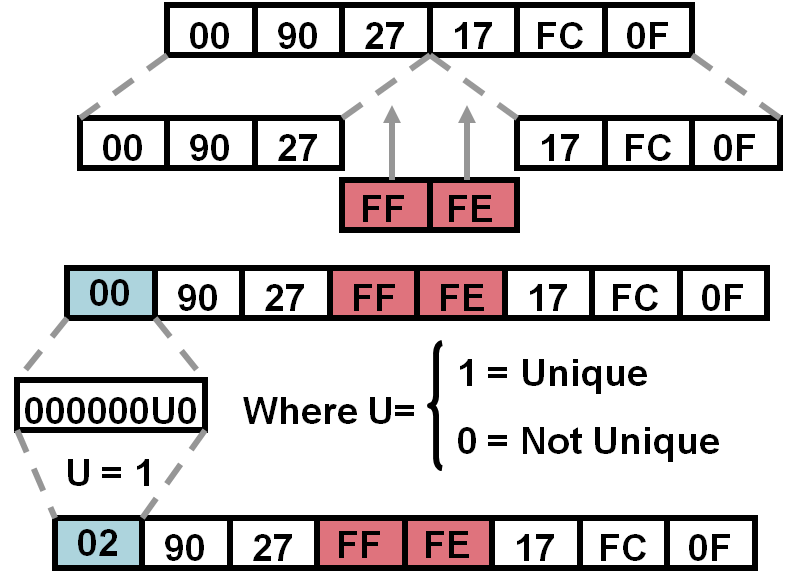
**Note**: **Routerx** in the PT topology has been preconfigured with hostname “**Rx**” for x=1,2,3.

EUI-64 IPv6 Addressing

Cisco uses the EUI-64 format to perform stateless auto-configuration of hosts. EUI stands for “extended unique identifier.” This process of obtaining an IPv6 address automatically does not make use of DHCP, although there is an IPv6 DHCP service which is supported on Cisco routers. Stateless auto-configuration is an alternative way for IPv6 addresses to be assigned to hosts automatically.

A common form of stateless auto-configuration copies the host’s MAC address and expands that 48-bit number to 64 bits by inserting FFFE into the middle 16 bits, as shown in the figure. If the chosen Interface Identifier is globally unique, as an Ethernet MAC address is, the universal/local bit, called the “U” bit, is set to 1 for global scope. It is set to 0 for local scope when addresses are constructed with Interface Identifiers that are not guaranteed to be globally unique. An address with local scope should not be routed to the Internet.

The 64 bits formed in this way become the lower half of the IPv6 address for the host’s interface. The upper half is obtained from the network prefix configured on the router’s interface.



**64-bits become lower part of IPv6 address**

**48-bit MAC Address**

Step 1: Choose IPv6 network prefix.

Choose an IPv6 network prefix of length 64 bits to use in the network connecting PCx and Rx for x=1,2,3. The networks can contain zeroes and the double colon may be used where appropriate. For example, one may select FA00:x::/64. In this case, the 64-bit prefix is FA00:x:0:0.

Record the prefix to be used for R1 F0/0: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the prefix to be used for R2 F0/0: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the prefix to be used for R3 F0/0: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 2: Determine PC Fast Ethernet MAC address.

Click the PC, then click the **Desktop** tab, and then click on **Command Prompt**. Type in **ipconfig /all** and it will show the MAC address.

Record the PC1 MAC address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the PC2 MAC address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the PC3 MAC address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 3: Determine PC EUI-64 address.

Based on the EUI-64 addressing explanation above, determine each PC’s IPv6 Interface Identifier: the lower 64 bits of the IPv6 address. Rewrite each IPv6 Interface Identifier with the U bit set to 1.

Record the PC1 EUI-64 address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the PC2 EUI-64 address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the PC3 EUI-64 address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 4: Determine IPv6 addresses.

Combine the network prefixes you chose with the respective modified IPv6 Interface Identifiers. This results in the correct IPv6 addresses that will ultimately appear in the PCs’ **ipv6config** command outputs. Remember the U bit!

Record the PC1 IPv6 address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the PC2 IPv6 address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Record the PC3 IPv6 address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 5: Configure router FastEthernet 0/0 interface.

1. Configure R1’s F0/0 interface with the network prefix shown in Step 1, specifying **eui-64**. The necessary IPv6 commands are:

R1> **enable**

R1# **configure terminal**

R1(config)# **ipv6 unicast-routing**

R1(config)# **interface FastEthernet 0/0**

R1(config-if)# **ipv6 address FA00:1::/64 eui-64**

R1(config-if)# **ipv6 enable**

1. Repeat the parallel commands on R2 and R3.

Step 6: Configure PCs for stateless autoconfiguration.

To enable stateless autoconfiguration on each PC: select the **Config** tab and under **Global Settings** select the **Auto Config** radio button in the **Gateway/DNS IPv6** section. Then click the **FastEthernet** button to see the EUI IPv6 address assigned to the PC.

Step 7: Test connectivity.

We have now established IPv6 connectivity between the PC’s and their gateway routers. Next we verify IPv6 connectivity.

1. To determine the IPv6 address of a machine, click the PC, click the Desktop tab, then click the Command Prompt button, and then type the command **ipv6config** to view the PC’s IPv6 address. Here is sample output for PC1:

PC1>**ipv6config**

IPv6 Address....................: FA00:1::201:42FF:FE0C:736B/64

Default Gateway.................: FE80::201:97FF:FE72:B401

Note that the Default Gateway address selected by the PC is a link-local address, not a global unicast IPv6 address in the FA00:1::/64 network.

1. Attempt to ping the IPv6 Default Gateway address:

PC1>**ping FE80::201:97FF:FE72:B401**

Pinging FE80::201:97FF:FE72:B401 with 32 bytes of data:

Reply from FE80::201:97FF:FE72:B401: bytes=32 time=62ms TTL=255

Reply from FE80::201:97FF:FE72:B401: bytes=32 time=31ms TTL=255

Reply from FE80::201:97FF:FE72:B401: bytes=32 time=31ms TTL=255

Reply from FE80::201:97FF:FE72:B401: bytes=32 time=31ms TTL=255

Ping statistics for FE80::201:97FF:FE72:B401:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 31ms, Maximum = 62ms, Average = 38ms

The ping to the link-local address of the gateway is successful.

1. Find the global unicast IPv6 address of interface F0/0 on R1 on the FA00:1::/64 network:

R1# **show ipv6 interface FastEthernet 0/0**

FastEthernet0/0 is up, line protocol is up

IPv6 is enabled, link-local address is FE80::201:97FF:FE72:B401

No Virtual link-local address(es):

Global unicast address(es):

FA00:1::201:97FF:FE72:B401, subnet is FA00:1::/64 [EUI]

Joined group address(es):

FF02::1

FF02::2

FF02::1:FF72:B401

MTU is 1500 bytes

ICMP error messages limited to one every 100 milliseconds

ICMP redirects are enabled

ICMP unreachables are sent

ND DAD is enabled, number of DAD attempts: 1

ND reachable time is 30000 milliseconds

ND advertised reachable time is 0 milliseconds

ND advertised retransmit interval is 0 milliseconds

ND router advertisements are sent every 200 seconds

ND router advertisements live for 1800 seconds

ND advertised default router preference is Medium

Hosts use stateless autoconfig for addresses.

1. Try to ping the global unicast address of interface F0/0 on R1 from PC1:

PC1>**ping FA00:1::201:97FF:Fe72:B401**

Pinging FA00:1::201:97FF:Fe72:B401 with 32 bytes of data:

Reply from FA00:1::201:97FF:FE72:B401: bytes=32 time=47ms TTL=255

Reply from FA00:1::201:97FF:FE72:B401: bytes=32 time=32ms TTL=255

Reply from FA00:1::201:97FF:FE72:B401: bytes=32 time=31ms TTL=255

Reply from FA00:1::201:97FF:FE72:B401: bytes=32 time=31ms TTL=255

Ping statistics for FA00:1::201:97FF:FE72:B401:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 31ms, Maximum = 47ms, Average = 35ms

1. Repeat the parallel verifications on PC2 and R2 and on PC3 and R3.

Step 8: Enable IPv6 on router interfaces.

1. Configure the command **ipv6 enable** on the following interfaces:

* S0/0/0 on R1 and R2
* S0/0/1 on R2 and R3
* S0/1/0 on R3 and R1

1. Ensure that all these interfaces are up with the **show ipv6 interface brief** command. For example:

R1# **show ipv6 interface brief**

FastEthernet0/0 [up/up]

FE80::201:97FF:FE72:B401

FA00:1::201:97FF:FE72:B401

FastEthernet0/1 [administratively down/down]

Serial0/0/0 [up/up]

FE80::202:16FF:FEEB:3D01

Serial0/0/1 [administratively down/down]

Serial0/1/0 [up/up]

FE80::207:ECFF:FE56:BE01

Serial0/1/1 [administratively down/down]

Vlan1 [administratively down/down]

Step 9: Test connectivity.

1. Attempt to ping from R2 to R1 using the link-local address of interface S0/0/0 on R1 (addresses will vary):

R2# **ping FE80::202:16FF:FEEB:3D01**

Output Interface: serial0/0/0

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to FE80::202:16FF:FEEB:3D01, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 31/34/47 ms

Since link-local addresses are not routable, they may be associated with devices connected to any interface of R2; this is why the user is prompted to enter the output interface of R2 (serial0/0/0) for pinging R1’s link local address.

1. Repeat this test from R3 to R2 and from R1 to R3.

At this point, with all IPv6 addresses in the topology auto-configured, there is point-to-point IPv6 connectivity between every pair of neighboring devices.