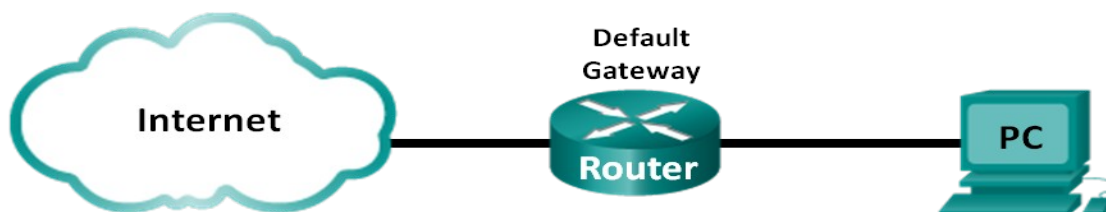# Lab 08 Reference – Identifying IPv6 Addresses

(Please study this document before you work on your packet tracer activity. There is nothing to complete and submit in this document.)

Topology

Objectives

Part 1: Identify the Different Types of IPv6 Addresses

- Review the different types of IPv6 addresses.
- Match the IPv6 address with the correct type.

Part 2: Examine a Host IPv6 Network Interface and Address

- Check PC IPv6 network address settings.

Part 3: Practice IPv6 Address Abbreviation

- Study and review the rules for IPv6 address abbreviation.
- Practice compressing and decompressing IPv6 addresses.

Background / Scenario

With the depletion of the Internet Protocol version 4 (IPv4) network address space and the adoption and transition to IPv6, networking professionals must understand how both IPv4 and IPv6 networks function. Many devices and applications already support IPv6. This includes extensive Cisco device Internetwork Operating System (IOS) support and workstation/server operating system support, such as that found in Windows and Linux.

This lab focuses on IPv6 addresses and the components of the address. In Part 1, you will identify the IPv6 address types, and in Part 2, you will view the IPv6 settings on a PC. In Part 3, you will practice IPv6 address abbreviation.

Required Resources

- 1 PC (Windows 7 or Windows 8\10)

Note: The IPv6 protocol is enabled in Windows 7 and 8/10 by default. The Windows XP operating system does not enable IPv6 by default and is not recommended for use with this lab..

Part 1: Identify the Different Types of IPv6 Addresses

In Part 1, you will review the characteristics of IPv6 addresses to identify the different types of IPv6 addresses.

An IPv6 address is 128 bits long. It is most often presented as 32 hexadecimal characters. Each hexadecimal character is the equivalent of 4 bits (4 x 32 = 128). A non-abbreviated IPv6 host address is shown here:

> **2001:DB8:0001:0000:0000:0000:0000:0001**

A hextet is the hexadecimal, IPv6 version of an IPv4 octet. An IPv4 address is 4 octets long, separated by dots. An IPv6 address is 8 hextets long, separated by colons.

An IPv4 address is 4 octets and is commonly written or displayed in decimal notation.

> **255.255.255.255**

An IPv6 address is 8 hextets and is commonly written or displayed in hexadecimal notation.

> **FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF**

In an IPv4 address, each individual octet is 8 binary digits (bits). Four octets equals one 32-bit IPv4 address.

> **11111111 = 255**
>
> **11111111.11111111.11111111.11111111 = 255.255.255.255**

In an IPv6 address, each individual hextet is 16 bits long. Eight hextets equals one 128-bit IPv6 address.

> **1111111111111111 = FFFF**
>
> **1111111111111111.1111111111111111.1111111111111111.1111111111111111.**
> **1111111111111111.1111111111111111.1111111111111111.1111111111111111 =**
> **FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF**

If we read an IPv6 address starting from the left, the first (or far left) hextet identifies the IPv6 address type. For example, if the IPv6 address has all zeros in the far left hextet, then the address is possibly a loopback address.

> **0000**:0000:0000:0000:0000:0000:0000:0001 = loopback address
>
> ::1 = loopback address abbreviated

As another example, if the IPv6 address has FE80 in the first hextet, then the address is a link-local address.

> **FE80**:0000:0000:0000:C5B7:CB51:3C00:D6CE = link-local address
>
> **FE80**::C5B7:CB51:3C00:D6CE = link-local address abbreviated

Study the chart below to help you identify the different types of IPv6 address based on the numbers in the first hextet.

First Hextet (Far Left)	Type of IPv6 Address
0000 to 00FF	Loopback address, any address, unspecified address, or IPv4-compatible
2000 to 3FFF	Global unicast address (a routable address in a range of addresses that is currently being handed out by the Internet Assigned Numbers Authority [IANA])
FE80 to FEBF	Link-local (a unicast address which identifies the host computer on the local network)
FC00 to FCFF	Unique-local (a unicast address which can be assigned to a host to identify it as being part of a specific subnet on the local network)
FF00 to FFFF	Multicast address

There are other IPv6 address types that are either not yet widely implemented, or have already become deprecated, and are no longer supported. For instance, an **anycast address** is new to IPv6 and can be used by routers to facilitate load sharing and provide alternate path flexibility if a router becomes unavailable. Only routers should respond to an anycast address. Alternatively, **site-local addresses** have been deprecated and replaced by unique-local addresses. Site-local addresses were identified by the numbers FEC0 in the initial hextet.
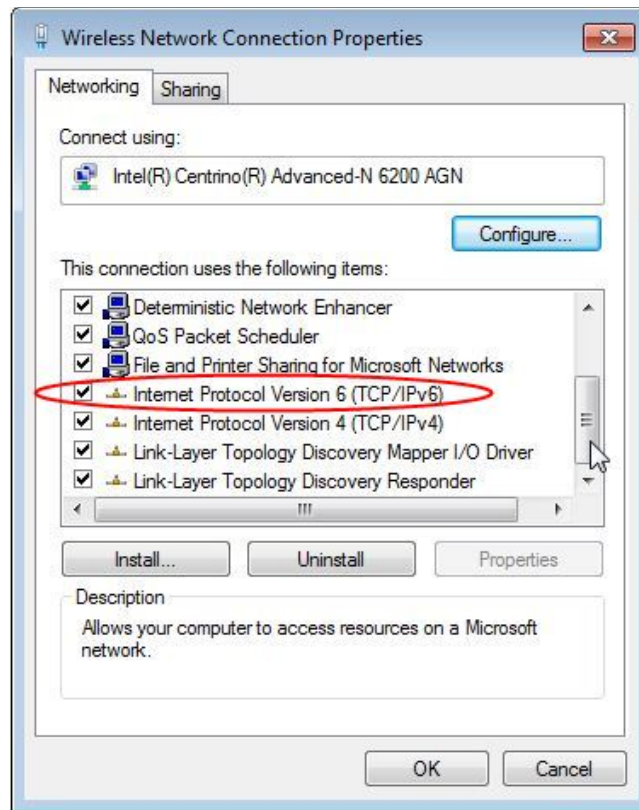
In IPv6 networks, there are no network (wire) addresses or broadcast addresses as there are in IPv4 networks.

Part 2: Examine a Host IPv6 Network Interface and Address

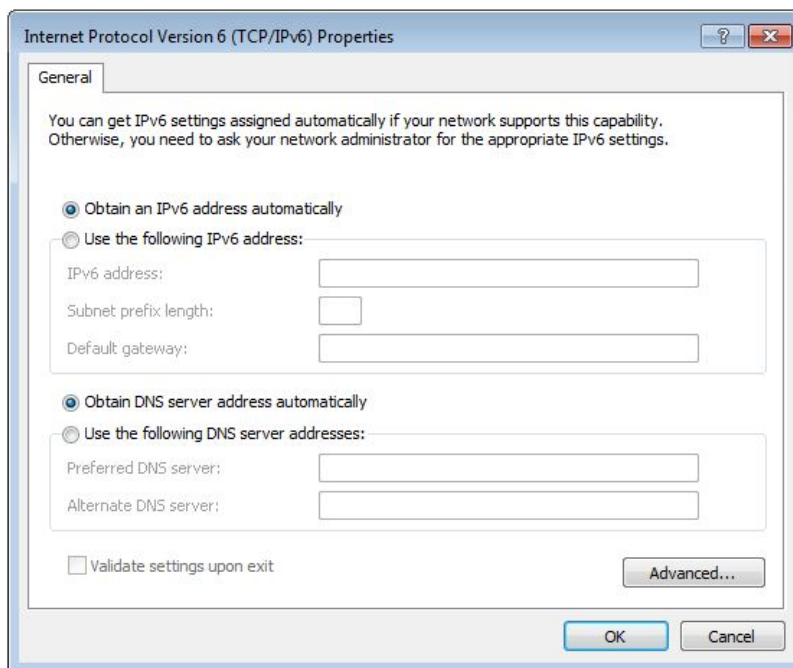In Part 2, you will check the IPv6 network settings of your PC to identify your network interface IPv6 address.

Step 1: Check your PC IPv6 network address settings.

a. Verify that the IPv6 protocol is installed and active on your PC-A (check your Local Area Connection settings).

b. Click the Windows **Start** button and then **Control Panel** and change **View by: Category** to **View by: Small icons**.

c. Click the **Network and Sharing Center** icon.

d. On the left side of the window, click **Change adapter settings**. You should now see icons representing your installed network adapters. Right-click your active network interface (it may be a **Local Area Connection** or a **Wireless Network Connection**), and then click **Properties**.

e. You should now see your Network Connection Properties window. Scroll through the list of items to determine whether IPv6 is present, which indicates that it is installed, and if it is also check marked, which indicates that it is active.

f. Select the item **Internet Protocol Version 6 (TCP/IPv6)** and click **Properties**. You should see the IPv6 settings for your network interface. Your IPv6 properties window is likely set to **Obtain an IPv6 address automatically**. This does not mean that IPv6 relies on the Dynamic Host Configuration Protocol (DHCP). Instead of using DHCP, IPv6 looks to the local router for IPv6 network information and then auto-configures its own IPv6 addresses. To manually configure IPv6, you must provide the IPv6 address, the subnet prefix length, and the default gateway.

Note: The local router can refer host requests for IPv6 information, especially Domain Name System (DNS) information, to a DHCPv6 server on the network.

g. After you have verified that IPv6 is installed and active on your PC, you should check your IPv6 address information. To do this, click the **Start** button, type **cmd** in the *Search programs and files* form box, and press Enter. This opens a Windows command prompt window.

h. Type **ipconfig /all** and press Enter. Your output may look similar to this:

```
C:\Users\user> ipconfig /all


Windows IP Configuration


<output omitted>


Wireless LAN adapter Wireless Network Connection:

    Connection-specific DNS Suffix  . :
    Description . . . . . . . . . . . : Intel(R) Centrino(R) Advanced-N 6200 AGN
    Physical Address. . . . . . . . . : 02-37-10-41-FB-48
    DHCP Enabled. . . . . . . . . . . : Yes
    Autoconfiguration Enabled . . . . : Yes
    Link-local IPv6 Address . . . . . : fe80::8d4f:4f4d:3237:95e2%14(Preferred)
    IPv4 Address. . . . . . . . . . . : 192.168.2.106(Preferred)
    Subnet Mask . . . . . . . . . . . : 255.255.255.0
    Lease Obtained. . . . . . . . . . : Sunday, January 06, 2013 9:47:36 AM
    Lease Expires . . . . . . . . . . : Monday, January 07, 2013 9:47:38 AM
    Default Gateway . . . . . . . . . : 192.168.2.1
    DHCP Server . . . . . . . . . . . : 192.168.2.1
    DHCPv6 IAID . . . . . . . . . . . : 335554320
    DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-14-57-84-B1-1C-C1-DE-91-C3-5D

    DNS Servers . . . . . . . . . . . : 192.168.1.1
```

```
                              8.8.4.4
        <output omitted>
```

i. You can see from the output that the client PC has an IPv6 link-local address with a randomly generated interface ID. What does it indicate about the network regarding IPv6 global unicast address, IPv6 unique-local address, or IPv6 gateway address?

   Self-study, no need to submit this answer.

j. What kind of IPv6 addresses do you find when using **ipconfig /all** on your laptop?

   Self-study, no need to submit this answer.

   (This is a sample output if you are connected to the college wifi)

```
Wireless LAN adapter Wireless Network Connection:

   Connection-specific DNS Suffix  . : ottawa.ad.algonquincollege.com
   Description . . . . . . . . . . . : Intel(R) Centrino(R) Advanced-N 6235
   Physical Address. . . . . . . . . : B4-B6-76-6B-17-78
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::a53f:38d8:f605:74ad%13(Preferred)
   IPv4 Address. . . . . . . . . . . : 10.70.192.160(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.224.0
   Lease Obtained. . . . . . . . . . : Thursday, June 25, 2015 2:35:38 PM
   Lease Expires . . . . . . . . . . : Thursday, June 25, 2015 4:35:52 PM
   Default Gateway . . . . . . . . . : 10.70.192.1
   DHCP Server . . . . . . . . . . . : 10.254.21.73
   DHCPv6 IAID . . . . . . . . . . . : 297055862
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-1D-16-D6-10-B4-B6-76-6B-17-78

   DNS Servers . . . . . . . . . . . : 10.254.21.77
                                       10.254.21.78
   Primary WINS Server . . . . . . . : 10.254.21.73
   Secondary WINS Server . . . . . . : 10.254.21.74
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

Part 3: Practice IPv6 Address Abbreviation

In Part 3, you will study and review rules for IPv6 address abbreviation to correctly compress and decompress IPv6 addresses.

Rule 1: In an IPv6 address, a string of four zeros (0s) in a hextet can be abbreviated as a single zero.

> 2001:0404:0001:1000:**0000:0000**:0EF0:BC00

> 2001:0404:0001:1000:**0:0**:0EF0:BC00 (abbreviated with single zeros)

Rule 2: In an IPv6 address, the leading zeros in each hextet can be omitted, trailing zeros cannot be omitted.

> 2001:**0**404:**000**1:1000:0000:0000:**0**EF0:BC00

> 2001:404:1:1000:0:0:EF0:BC00 (abbreviated with leading zeros omitted)

Rule 3: In an IPv6 address, a single continuous string of four or more zeros can be abbreviated as a double colon (::). The double colon abbreviation can only be used one time in an IP address.

> 2001:0404:0001:1000:**0000:0000:**0EF0:BC00

> 2001:404:1:1000**::**EF0:BC00 (abbreviated with leading zeroes omitted and continuous zeros replaced with a double colon)

The image below illustrates these rules of IPv6 address abbreviation:

```
  FF01:0000:0000:0000:0000:0000:0000:1
= FF01:0:0:0:0:0:0:1
= FF01::1
```

```
  E3D7:0000:0000:0000:51F4:00C8:C0A8:6420
= E3D7::51F4:C8:C0A8:6420
```

```
  3FFE:0501:0008:0000:0260:97FF:FE40:EFAB
= 3FFE:501:8:0:260:97FF:FE40:EFAB
= 3FFE:501:8::260:97FF:FE40:EFAB
```