

# Section 13:IPv6

## 102. Introduction to IPv6

IPv4 Example - 184.125.22.13

- Total address space 4 billion
- Range 000.000.000.000 - 255.255.255.255

IPv6 Example - a0f0:0001:0000:0001:0000:0001:0000:1234

- up to 128 bit address
- Each letter or number represents 4 1s or 0s
- 8 groups separated by 7 colons
- Address space  $2^{128}$  So much space that you could give every air molecule 6 ip addresses.
- IPv6 does more than just give us more IP addresses
- IPv6 does aggregation
- IPv6 is VERY fast because of aggregation (speeds up latency)
- Self configuration (NAT is dead, ARP is dead, DHCP is pretty much dead and its all replace by Neighbor Discovery Protocol (NDP)).
- NDP is a multicast based protocol where pretty much all the machines on the internet talk to each other and configure themselves.

Review:

- IPv6 are 128 bits, having a much larger address space than IPv4
- IPv6 address have 8 segments separated by 7 colons
- IPv6 allows data to move much faster through the internet

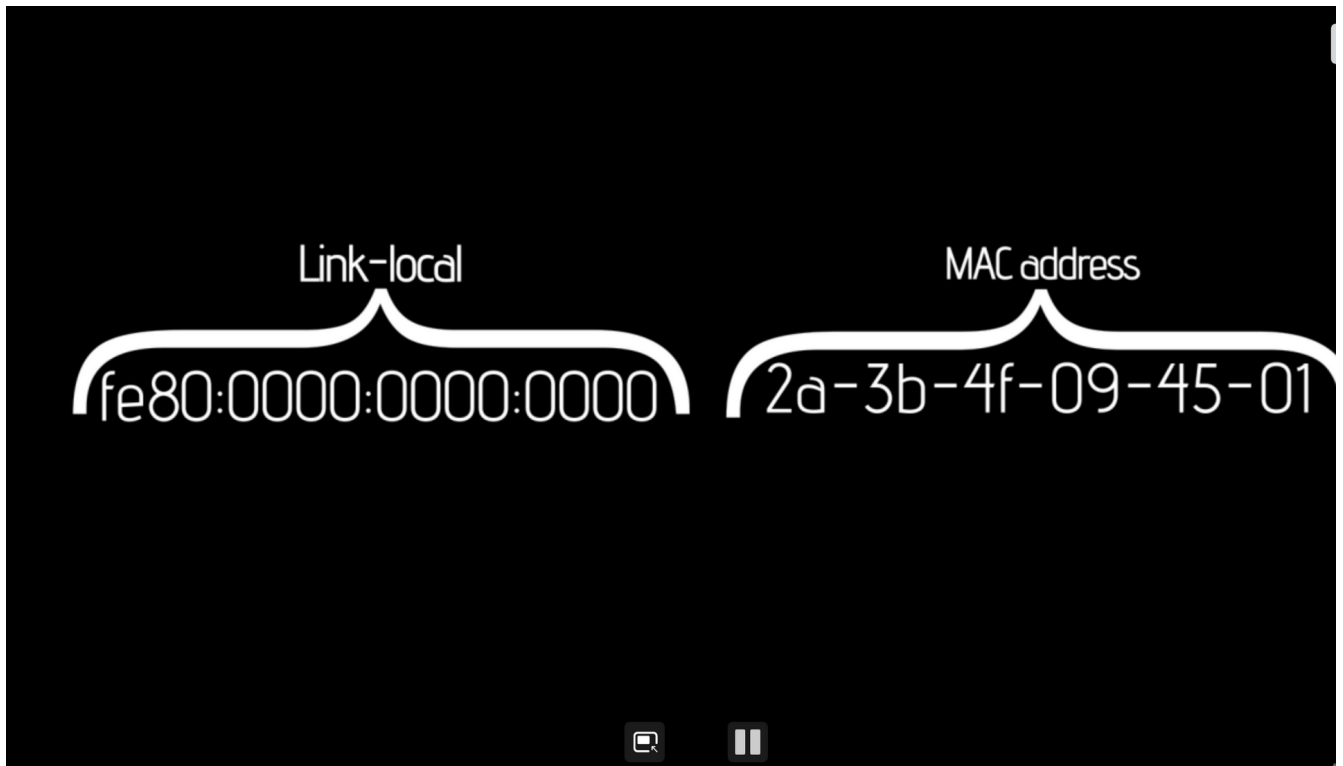
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## 104. IPv6 Addressing

IPv6 Address - fe80:0001:0243:0000:0000:0000:2a3b:44ff

- notice that it is broken up into 8 groups of 4 hexadecimal values separated by 7 colons
- shortcuts to typing in IPv6 addresses:
  1. Dump all the leading zeros if there are any  
Example 1 - fe80:0001:0243:0000:0000:0000:2a3b:44ff = fe80:1:243:0:0:0:2a3b:4ff  
Example 2 - fe80:0000:0000:1234:0000:0000:0000:1234 = fe80::1234:0:0:0:1234  
= fe80:0:0:1234::1234  
\*Cannot use :: is more than one place
- With IPv6 you don't have one IP address you actually have at least two IP addresse
  1. Link local - automatically generated by any IPv6 Host when it starts up  
Link local addresses always start with "fe80:0000:0000:0000"  
Last part of the IPv6 comes from the MAC address.

\*\*\*This is done by taking our 48 bit MAC address. The Standard "EUI-64" takes the 48 bit MAC address and splits it in two and adds "ff-fe" in the middle. Then in first 8 bits of our MAC address the 7th bit is flipped. In this example the "a" turns into a "8". So then the final address looks like the last photo. This is where your local address comes from.



# EUI-64

2a-3b-4f-ff-fe-09-45-01

# EUI-64

8-bit

2a-3b-4f-ff-fe-09-45-01

00101010

# EUI-64

# 29

00101000

# IPv6

2a-3b-4f-ff-fe-09-45-01

fe80::2a3b:4fff:fe09:4501

2. Internet Address - given to you by your gateway router.

**\*\*When talking about IPv6 the smallest subnet mask you can have is a /64 (Even with 2 computer network) EVERYTHING IS CIDR NOW. This is a massive amount of addresses.**

**\*\*Never type in a subnet mask because it's always /64 the exception is VLSMs**

**\*\*Variable length subnet masks (VLSMs) - are used for routers up on the internet that breaks things down with aggregation.**

**\*\*With IPv6 pretty much everything is handle for you. However here are some examples of situations where you might need to do some configuration.**

Dual Stack - Running IPv4 and IPv6 Simultaneously

Review:

\*IPv6 addresses can be shortened by removing leading zeros, but be familiar with the rules.

\*IPv6 addresses have two IP addresses: a link-local address and an Internet address.

\*The second part of the IPv6 address using EU1-64 is generated from the MAC address.

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## 104. IPv6 in action

EUI-64 Addressing - This is using your MAC address which allows tracability (All IPv6 addresses are public).

So, All operating systems have an alternative way of generating the last half of your IPv6 addresses. They use a Randomizer.

Network getting populated with IPv6 addresses using Neighbor Discovery Protocol (NDP):

Neighbor Solicitation - goes from the computer to the switch (not as a broadcast but as a multicast) these messages uses (ICMP v6). The computer is sending out it's MAC and its Link Local address and asks if there is anyone else out there over multicast. Then all the devices that see the advertisement send back a Neighbor Advertisement.

Neighbor Advertisement - "this is who I am", this is my mac address, this is my link local address.

Then the systems work together to resolve IPv6 addresses to MAC addresses so that they can send out ethernet.

The router responds to neighbor solicitation with neighbor advertisements which in this instance is a very specific packet called a "Router Solicitation" and then a Router Advertisement.

Stateless auto configuration provides the computers with everything they need to get on the internet. NO DHCP. This is due to good aggregation.

The individual systems will get their Internet IPv6 address, Default Gateway, DNS information.

What happens is the ISP sends a router advertisement to our individual routers and use DHCP v6 to generate Router Prefixes which lets our router determine our network ID.

Stateful DHCP v6 - acts alot like a regular DHCP server - exists for local DNS servers. Basically says "hey wait, instead of using the DNS thats coming down from the ISP, just use the DNS server that is coming from your machine."

Review:

- EUI-64 uses the MAC address to generate a unique 64-bit ID to automatically configure a host address.
- IPv6 uses router solicitations/advertisements to access internet route information
- Applications sometimes request temporary IP addresses: this is easily supported by IPv6 stateless auto configuration.

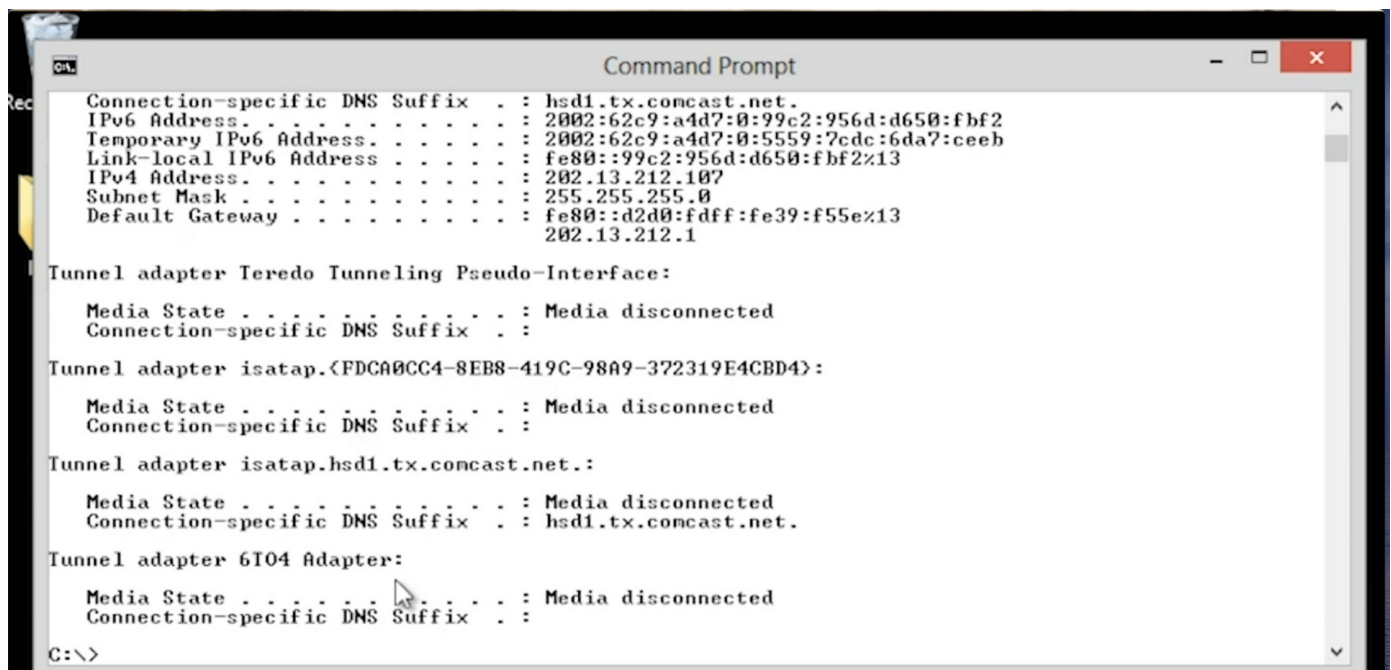
## 105. IPv4 and IPv6 Tunneling\*

To get to the IPv6 internet our packet and IPv6 data are encapsulated inside of an IPv4 Source and destination address and then at somepoint up in the web the IPv4 is stripped away and we're left with the IPv6 information.

Tunneling protocols for this are built into windows

Teredo - Slow way to connect to IPv6 (Its free)

6TO4 - Takes IPv6 packets and encapsulates them into IPv4.



```
Command Prompt

Connection-specific DNS Suffix . : hsd1.tx.comcast.net.
IPv6 Address . . . . . : 2002:62c9:a4d7:0:99c2:956d:d650:fbf2
Temporary IPv6 Address . . . . : 2002:62c9:a4d7:0:5559:7cdc:6da7:ceeb
Link-local IPv6 Address . . . . : fe80::99c2:956d:d650:fbf2%13
IPv4 Address . . . . . : 202.13.212.107
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : fe80::d2d0:fdff:fe39:f55e%13
                          202.13.212.1

Tunnel adapter Teredo Tunneling Pseudo-Interface:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 
    Tunnel adapter isatap.{FDCAB0CC4-8EB8-419C-98A9-372319E4CBD4}:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 
    Tunnel adapter isatap.hsd1.tx.comcast.net.:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : hsd1.tx.comcast.net.
    Tunnel adapter 6TO4 Adapter:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . : 
C:\>
```

Review:

- If you are on IPv4 you need a tunneling protocol to get to the IPv6 internet
- Microsoft provides some tunnels, like Toredoo and 6to4
- Try the GoGo Client from [www.gogo6.com](http://www.gogo6.com) to get on the IPv6 Internet

## QUIZ

1. Which of the following is not a characteristic of an IPv6 address?
  - a. 128 bits
  - b. Written with hexadecimal characters

**c. Groups are separated by dashes**

d. Broken up into eight groups

2. Which choice is not a valid representation of the IPv6 address:

2001:C2A:0000:0000:BB29:0000:3F00:A5B6?

a. 2001:0C2A::BB29:0000:3F00:A5B6

**b. 2001:C2A::BB29::3F00:A5B6**

c. 2001:0C2A:0000:0000:BB29:0000:3F00:A5B6

d. 2001:0C2A:0000:0000:BB29::3F00:A5B6

3. Which statement is not true of IPv6 addresses?

a. Outbound Ipv6 addresses are randomized by the operating system

b. EUI-64 can be traced back to the source computer

**c. IPv4 and IPv6 are automatically translated back and forth as required**

d. There are not private IPv6 addresses