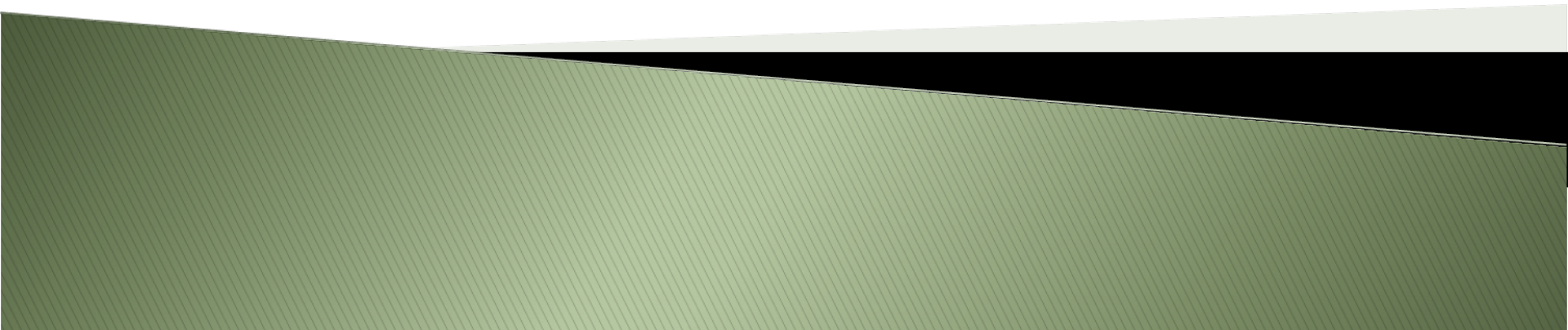


An Introduction to IPv6

By Jim Johnston



Bits bits bits

- ▶ IPv4 – 32 bits, 4 octets separated by . (period)
 - Possible hosts 2^{32}
 - Written in decimal (base 10)
- ▶ IPv6 – 128 bits, 8 groupings of 16 bits separated by : (colon)
 - Possible hosts 2^{128}
 - Written in hexadecimal (base 16)

Example Comparison

▶ IPv4

- 65.10.5.15/28 (Public Address)
- 192.168.100.1/24 (Private Address)
- 0.0.0.0/0 (Default Route)

▶ IPv6

- FF01::1
- 3FFE:501:8::260:97EF:FE40:EFAB
- :: (Unspecified Address)

IPv6 Representation

Example 1

- ▶ 2031:0000:130F:0000:0000:09C0:876A:130B
 - Drop all leading 0's
 - 2031:0:130F:0:0:9C0:876A:130B
 - Drop consecutive groups of 0's (once per address)
 - 2031:0:130F::9C0:876A:130B

IPv6 Representation

Example 2

- ▶ FF01:0000:0000:0000:0000:0000:0000:1
 - Drop all leading 0's
 - FF01:0:0:0:0:0:0:1
 - Drop consecutive groups of 0's (once per address)
 - FF01::1

IPv6 Representation

Example 3

- ▶ 0000:0000:0000:0000:0000:0000:0000:0000
 - Drop all leading 0's
 - 0:0:0:0:0:0:0:0
 - Drop consecutive groups of 0's (once per address)
 - ::

Global Unicast Addresses

- ▶ 48 bit global routing prefix
 - Registry
 - ISP
 - Site
- ▶ 16 bit subnet field
 - Allows for up to 65535 subnets per site

Special Addressing

- ▶ Reserved Addresses
 - Represents 1 / 256 of all IPv6 addresses
- ▶ Private Addresses
 - Similar use as IPv4 Private Addressing
 - First octet begins with FE8x – FEFx
 - Site–local (deprecated by RFC 3879)
 - Begins with FECx – FEFx
 - Link–local
 - Begins with FE8x – FEBx
 - Represents a physical network and will not be routed, used for automatic addressing and similar services as well as by routing protocols.

Special Addressing

▶ Loopback Address

- As with IPv4 there is a loopback address that can be used for testing.
- Unlike IPv4 an entire network is not wasted.
- IPv6 loopback address is `::1`

▶ Unspecified Address

- A host that does not know it's address will place all 0's in the source field. This address is written as `::`.

Interface Identifiers

- ▶ IPv6 uses interface identifiers (host ID) on a link.
 - Unique on specific links
 - 64 bits
 - Can be dynamically derived from L2 MAC address

Static vs. Dynamic Assignment

- ▶ **Static**
 - Manual Interface ID assignment
 - EUI-64 Interface ID assignment
- ▶ **Dynamic**
 - Stateless Autoconfiguration
 - DHCPv6 (stateful)

Cisco Router Configuration

▶ Static Configuration

- Enter interface
- Router(config-if):ipv6 address 2001:DB8:2222:7272::72/64

▶ EUI-64

- Enter interface
- Router(config-if):ipv6 address 2001:DB8:2222:7272::/64 eui-64
- Notice you only configure the prefix, while eui-64 will use the 48 bit MAC address to assign an unique identifier.

EUI-64

- ▶ How does the EUI-64 protocol convert MAC addresses to 64 bits?
 - 48 bit MAC address – 00:19:7E:B8:C6:F5
 - EUI-64 inserts FFFE in between the OUI and the organizations physical address assignment.
 - Our original example becomes
 - 0019:7EFF:FEB8:C6F5

IPv6 Transition

- ▶ “Dual stack where you can, tunnel where you must.”
- ▶ Dual Stacking
 - Implement both IPv4 and IPv6 concurrently
 - Routers and switches configured for both protocols but prefer IPv6
- ▶ Tunneling
 - IPv6 packets are encapsulated into IPv4 packets, requires dual-stack routers

Cisco IOS Dual Stack

- ▶ To dual-stack a router you must apply both an IPv4 and IPv6 address on an interface.
- ▶ You must also enable IPv6 routing.

- ▶ Example

```
config t
```

```
ipv6 unicast-routing
```

```
int fa0
```

```
ip address 192.168.10.1 255.255.255.0
```

```
ipv6 address 3ffe:b00:c18:1::3/127
```

IPv6 Tunneling

- ▶ IPv4 sets protocol type as 41
- ▶ Packet includes
 - 20 byte IPv4 header
 - IPv6 header
 - Payload
- ▶ Tunneling is an intermediate integration technique and transition technique. It is not the final solution of a native IPv6 architecture.

IPv6 Name Resolution

- ▶ You have the option to manually map names to IPv6 addresses or point the router at up to six DNS servers.

Examples

```
Router# config t
```

```
Router(config)# ipv6 host NJ 3ffe:b00:f:eb::1
```

Or

```
Router# config t
```

```
Router(config)# ip name-server <some IPv4 or IPv6 address>
```

RIP next generation (ng)

- ▶ RIPng defined by RFC 2080
 - Similar to RIPv2 only for IPv6
 - Distance vector routing protocol
 - Max 15 hops
 - Uses split-horizon and poison reverse to prevent routing loops
 - Uses multicast address FF02::9 as destination address for updates (no more broadcast addresses)
 - Updates on UDP port 521
 - Note: Dual-stacked environment requires both RIP and RIPng

RIPng Configuration

```
Router# config t
Router(config)# ipv6 unicast-routing
Router(config)# ipv6 router rip name
Router(config)# int fa0/0
Router(config-if)# ipv6 rip name enable
Router(config-if)# exit
Router(config)# int s0/0
Router(config-if)# ipv6 rip name enable
Router(config-if)# exit
```

IPv6 Status Commands

- ▶ show ipv6 interface
- ▶ show ipv6 neighbors
- ▶ show ipv6 protocols
- ▶ show ipv6 rip
- ▶ show ipv6 route

Works Cited

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