Networking Essentials
ITC 2243

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IPv6 Addressing

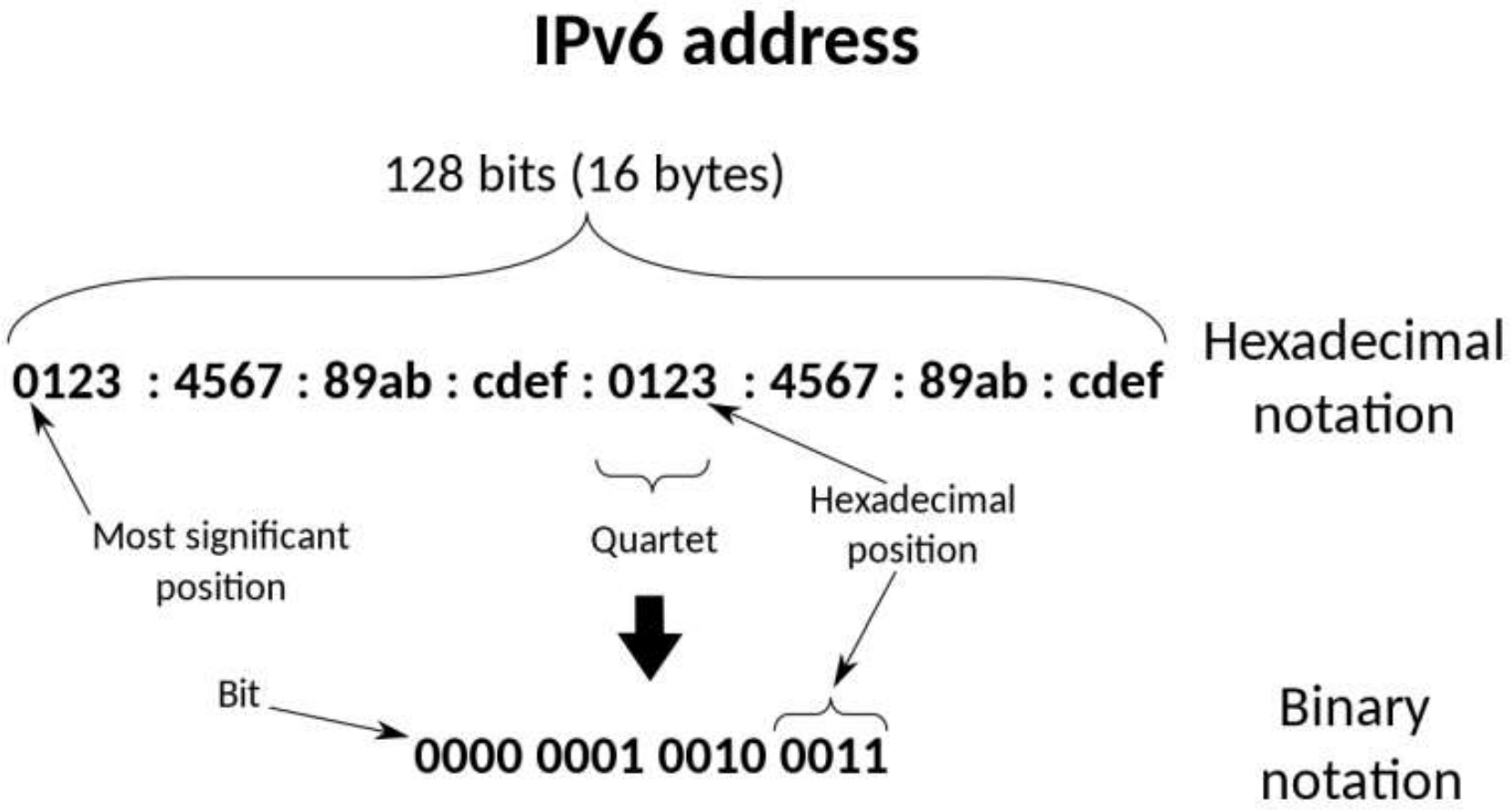
- Internet Protocol version 6 (IPv6) is the most recent version of the Internet Protocol (IP), the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet.

- **Larger IP address space -** IPv4 uses only 32 bits for IP address space, IPv6 allows 128 bits for IP address space.
- **Autoconfiguration -** With IPv4, DHCP exists but is optional. With IPv6, this mechanism is almost mandatory.
- **Security -** With IPv4, IPsec is optional and you need to ask the peer if it supports IPsec. With IPv6, IPsec support is mandatory. By mandating IPsec, we can assume that you can secure your IP communication whenever you talk to IPv6 devices.

IPv6 Addressing

- **Multicast -** Multicast is mandatory in IPv6, which was optional in IPv4.
- **Simplified header structures -** IPv6 has simpler packet header structures than IPv4. It will allow future vendors to implement hardware acceleration for IPv6 routers easier.
- **Header Checksum -** IPv4 header includes a checksum where as IPv6 header does not include a checksum.
- Designed for less operation cost in routers
- Only needs software update in most cases (You do not need to buy new routers)

IPv6 Addressing



IPv6 Addressing

IPv6 address can be compressed (Optimizations):

- Since many addresses will have many zeros inside them, some optimizations have been authorized. First, leading zeros within a group can be omitted, so 0123 can be written as 123. Second, one or more groups of 16 zero bits can be replaced by a pair of colons. Thus the above address now becomes:
- Example: 2001:0db8:0cab:0000:0000:0000:0001:0000

  2001:db8:cab::1:0

  fd00:0000:0000:0000:1234:0000:0000:0000

  fd00::1234:0:0:0

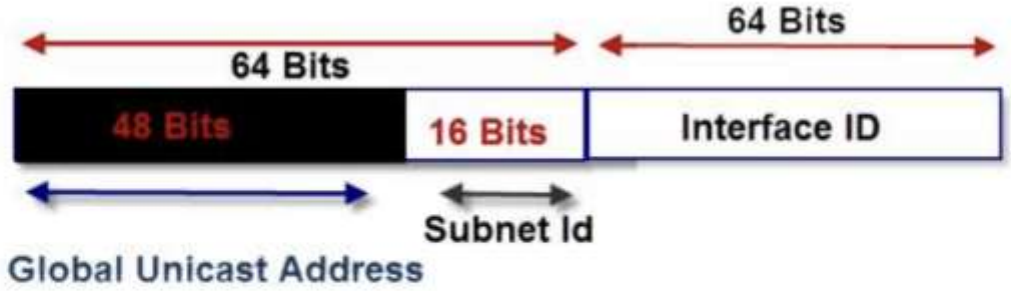
IPv6 Addressing

- In IPv4 an address is split into two components a network component and a node component. In IPv6 we do the same. The first step is to split the address into two parts. The address is split into 2 64 bit segments the top 64 bits is the network part and the lower 64 bits the node part:

IPv6 Address Network and Node

- The upper 64 bits are used for routing. The lower 64 bits identify the address of the interface or node, and is derived from the actual physical or MAC address

IPv6 Addressing



- If we look at the upper 64 bits in more detail we can see that it is split into 2 blocks of 48 and 16 bits respectively the lower 16 bits are used for subnets on an internal networks, and are controlled by a network administrator.
- The upper 48 bits are used for the global network addresses and are for routing over the internet

IPv6 Addressing

- Global Unicast address - Scope Internet. Global addresses are routable on the internet. Are the equivalent of the public addresses of IPv4 networks. Start with 2000 to 3fff.
- Unique Local - Scope Internal Network, but Not routed on Internet. Starts with fc00 to fdff
- Link Local - Scope network link- Not Routed internally or externally. It is equivalent to the IPv4 address 169.254.0.0/16 which is allocated on an IPv4 network when no DHCP server is found. Starts with fe80 to febf
- Loopback - An address not assigned to any physical interface that can be used for a host to send an IPv6 packet to itself. (::1)
- Unspecified address - Is an all-0s address. An unspecified unicast address is used as a source address to indicate the absence of an address. (0:0:0:0:0:0:0:0 or ::)
- IPv4 embedded - An IPv6 address that carries an IPv4 address in the low-order 32 bits of the address. (0:0:0:0:0:0:ffff:192.168.10.10 or ::ffff:192.168.10.10)
- IPv6 Multicast address - ff00

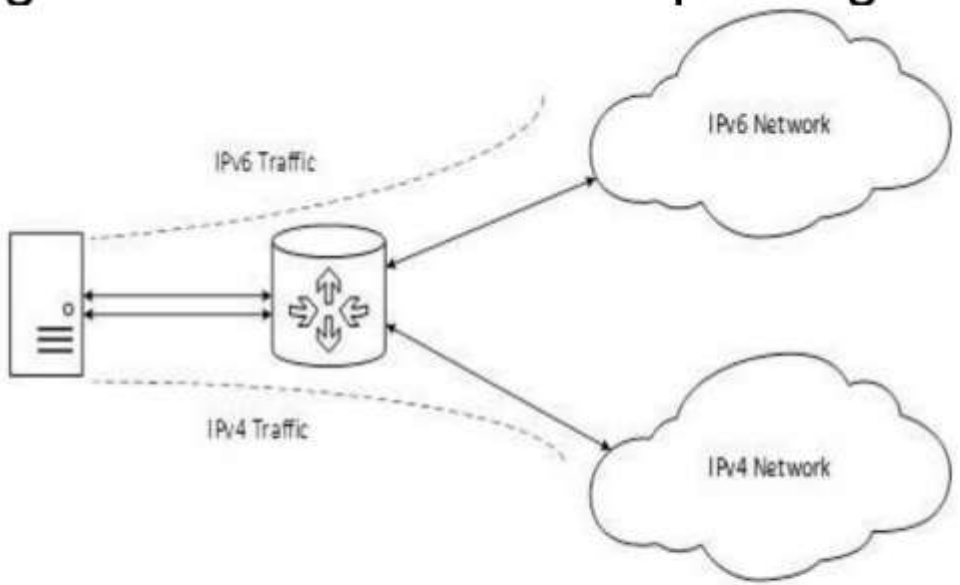
Transition from IPv4 to IPv6

Complete transition from IPv4 to IPv6 might not be possible because IPv6 is not backward compatible. To overcome this short-coming, we have a few technologies that can be used to ensure a smooth transition from IPv4 to IPv6.

- Dual Stack (Dual Stack Router)
- Tunneling
- NAT PT (NAT Protocol Translation)

Transition from IPv4 to IPv6

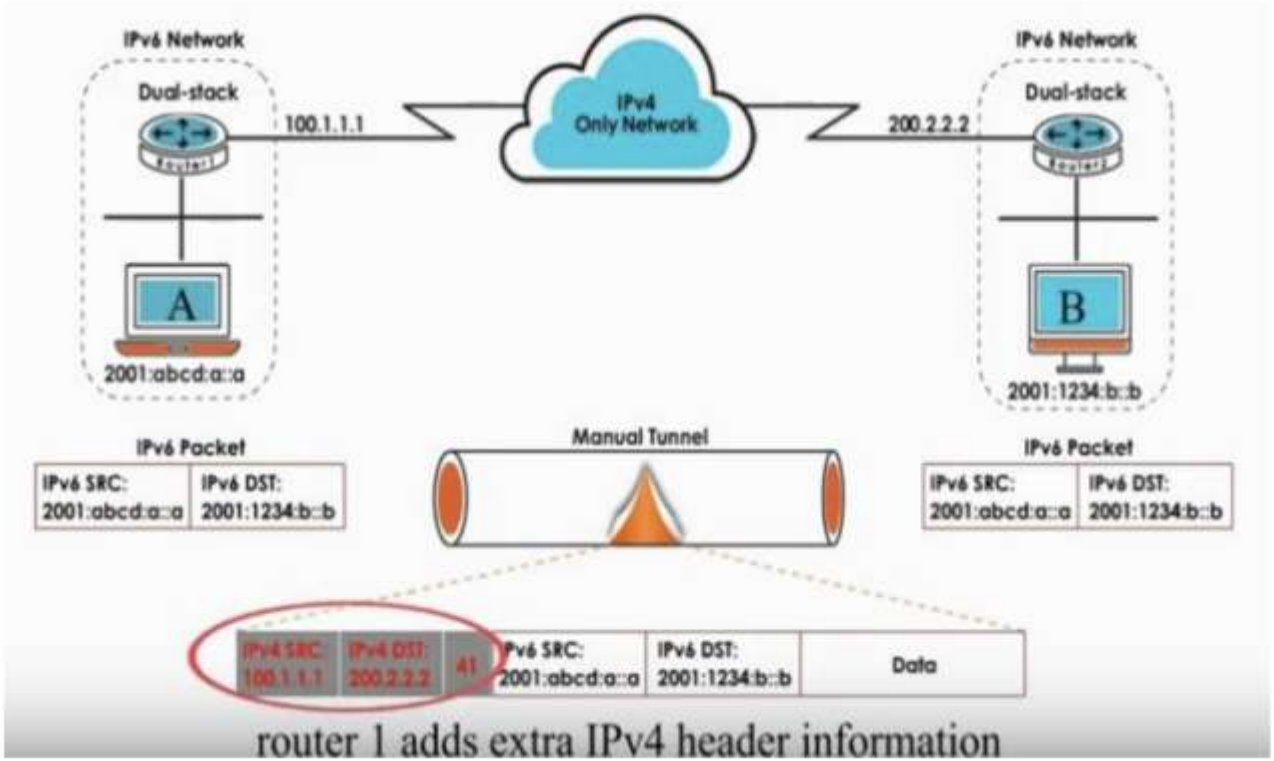
- **Dual Stack (Dual Stack Router)** - A router can be installed with both IPv4 and IPv6 addresses configured on its interfaces pointing to the network of relevant IP scheme.



- In the above diagram, a server having IPv4 as well as IPv6 address configured for it can now speak with all the hosts on both the IPv4 as well as the IPv6 networks with the help of a Dual Stack Router.

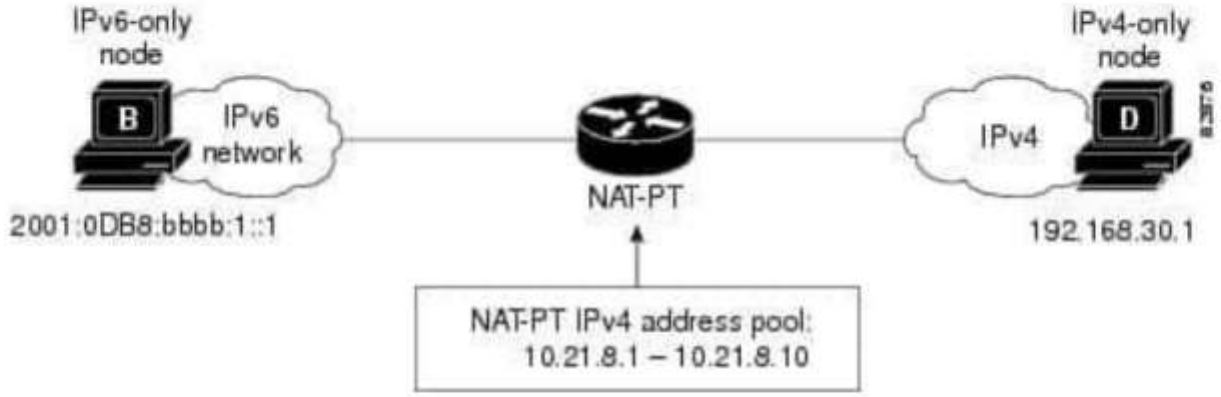
Transition from IPv4 to IPv6

- **Tunneling** - In a scenario where different IP versions exist on intermediate path or transit networks, tunneling provides a better solution where user's data can pass through a non-supported IP version.



Transition from IPv4 to IPv6

- **NAT PT (NAT Protocol Translation)** - Dynamic NAT-PT allows multiple mappings by allocating addresses from a pool of addresses.



The IPv6-only node B can communicate with the IPv4-only node D using dynamic NAT-PT. The NAT-PT device is configured with an IPv6 access list to determine which packets are to be translated by NAT-PT, a pool of IPv4 addresses--10.21.8.1 to 10.21.8.10 is also configured. When an IPv6 packet is to be translated, NAT-PT uses the configured mapping rules and assigns a temporary IPv4 address from the configured pool of IPv4 addresses and sends the packet.

Thank you!!!