SRM
Institute of Science and Technology

21CSC302J-COMPUTER NETWORKS

Unit- III

IPV6 Addressing

IPV6 Addressing

- The main reason for migration from IPv4 to IPv6 is the ***small size of the address space in IPv4.***

- An IPv6 address is ***128 bits or 16 bytes (octets) long***, four times the address length in IPv4.

Binary (128 bits)	**1111111011110110**	**...**	**1111111100000000**
Colon Hexadecimal	**FEF6:BA98:7654:3210:ADEF:BBFF:2922:FF00**		

- Binary notation is ***used when the addresses are stored in a computer.***

- The colon hexadecimal notation (or colon hex for short) divides the address into eight sections,
  - ***each made of four hexadecimal digits separated by colons.***

- Although an IPv6 address, even in hexadecimal format, is very long, many of the digits are zeros.
- The leading zeros of a section can be omitted. Using this form of abbreviation, 0074 can be written as 74, 000F as F, and 0000 as 0.
- ***often called zero compression***
- can be applied to colon hex notation if there are consecutive sections consisting of zeros only.
- We can remove all the zeros and replace them with a double semicolon.

FDEC:0:0:0:0:BBFF:0:FFFF ⟶ FDEC::BBFF:0:FFFF

Mixed Notation

- Sometimes we see a mixed representation of an IPv6 address: colon hex and dotted decimal notation.

- This is appropriate during ***the transition period in which an IPv4 address is embedded in an IPv6 address***

- Use
  - ***the colon hex notation for the leftmost six sections and***
  - ***four-byte dotted-decimal notation instead of the rightmost two sections.***

- This happens when all or most of the leftmost sections of the IPv6 address are 0s.

Mixed Notation

- For example,
  - ***The address (::130.24.24.18) is a legitimate address in IPv6,***
  - ***The zero compression shows that all 96 leftmost bits of the address are zeros.***

CIDR Notation

- IPv6 uses hierarchical addressing.
- For this reason, IPv6 allows slash or CIDR notation.
- For example, the following shows how we can define a prefix of 60 bits using CIDR.

```
FDEC::BBFF:0:FFFF/60
```

Three Address Types

- Unicast Address
- Anycast Address
- Multicast Address

Anycast Address

- ***Defines a group of computers*** **that all share a single address.**

- A packet with an anycast address is
  - ***delivered to only one member of the group,***
  - ***the most reachable one.***

- An anycast communication is used,
  - ***when there are several servers that can respond to an inquiry.***

- The request is sent to the one that is most reachable.

- The hardware and software generate only one copy of the request; the copy reaches only one of the servers.

Anycast Address

- IPv6 does not designate a block for anycasting;

- the addresses are assigned from the unicast block.

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Address Space Allocation

Block prefix	*CIDR*	*Block assignment*	*Fraction*
0000 0000	0000::/8	Special addresses	1/256
001	**2000::/3**	**Global unicast**	**1/8**
1111 110	FC00::/7	Unique local unicast	1/128
1111 1110 10	FE80::/10	Link local addresses	1/1024
1111 1111	FF00::/8	Multicast addresses	1/256

Global Unicast Addresses

- Used for unicast (one-to-one) communication between two hosts in the Internet is called the global unicast address block.

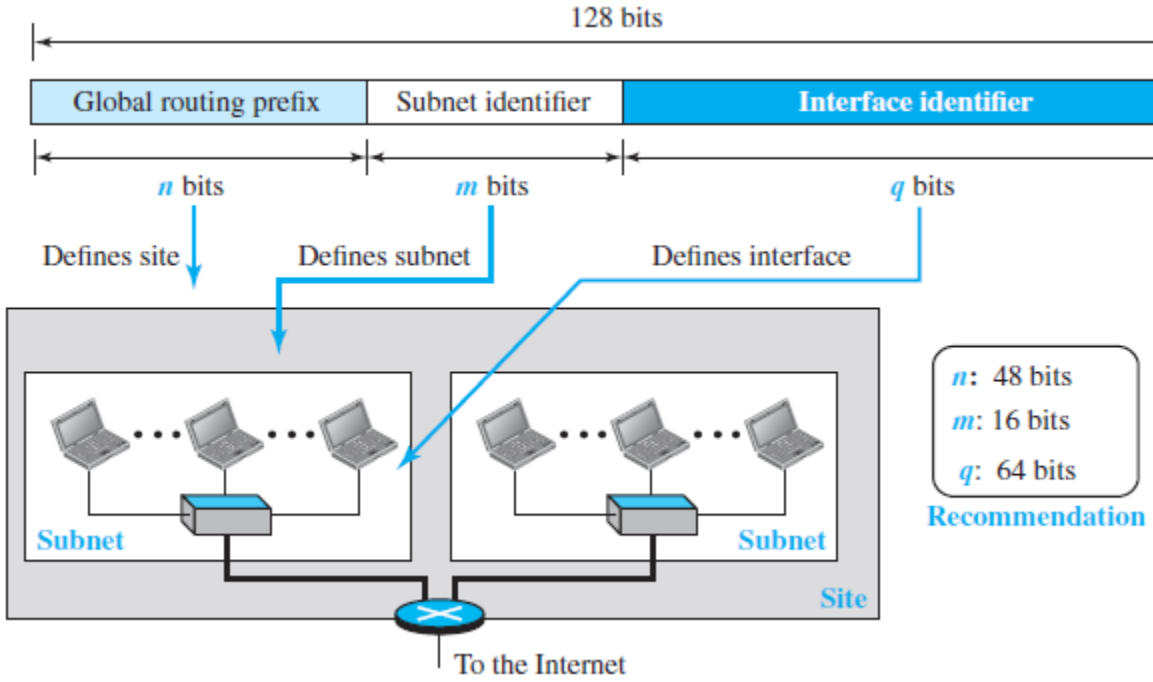
- CIDR for the block is 2000::/3,
  - ***The three leftmost bits are the same for all addresses in this block (001).***

- The size of this block is 2^{125} bits, which is more than enough for Internet expansion for many years to come.

Global Unicast Addresses

- An address in this block is divided into three parts:
  - ***global routing prefix (n bits),***
  - ***subnet identifier (m bits), and***
  - ***interface identifier (q bits)***

- The figure also shows the recommended length for each part.



Autoconfiguration

- One of the interesting features of IPv6 addressing is the autoconfiguration of hosts.
- In IPv4, the host and routers are originally configured manually by the network manager.
- DHCP, can be used to allocate an IPv4 address to a host that joins the network.
- In IPv6, ***DHCP protocol can still be used to allocate an IPv6 address to a host***, ***but a host can also configure itself.***

Autoconfiguration

- When a host in IPv6 joins a network, it can configure itself using the following process

The host first creates a link local address for itself. This is done by taking the *10-bit link local prefix (1111 1110 10), adding 54 zeros, and adding the 64-bit interface identifier,* which any host knows how to generate from its interface card. The result is a 128-bit link local address.

Autoconfiguration

The host tests to see if this link local address is unique and not used by other hosts. Since the 64-bit interface identifier is supposed to be unique, the link local address generated is unique with a high probability.

The host sends a neighbor solicitation message and waits for a neighbor advertisement message. If any host in the subnet is using this link local address, the process fails and the host cannot autoconfigure itself; it needs to use other means such as DHCP for this purpose.

Autoconfiguration

- If the uniqueness of the link local address is passed, the host stores this address as its link local address (for private communication), but it still needs a global unicast address.
- The host then sends a router solicitation to a local router.
- If there is a router running on the network, the host receives a router advertisement message that includes the global unicast prefix and the subnet prefix that the host needs to add to its interface identifier to generate its global unicast address.
- If the router cannot help the host with the configuration, it informs the host in the router advertisement message (by setting a flag).
- The host then needs to use other means for configuration.

Renumbering

- ***To allow sites to change the service provider***, renumbering of the address prefix (n) was built into IPv6 addressing.

- Each site is given a prefix by the service provider to which it is connected.

- If the site changes the provider, the address prefix needs to be changed.

- A router to which the site is connected can advertise a new prefix and let the site use the old prefix for a short time before disabling it.

Renumbering

- In other words, during the transition period, a site has two prefixes.

- The main problem in using the renumbering mechanism is the support of the DNS, which needs to propagate the new addressing associated with a domain name.

- A new protocol for DNS, called Next Generation DNS, is under study to provide support for this mechanism.

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Thank You