Computer Networks

IPv6 Addressing

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Outline

- IPv6 Addressing
- IPv6 Address Types
- Provided Materials

IPv6 Addressing

- IPv6 addressing is a fundamental aspect of the Internet Protocol version 6, designed to replace IPv4 and accommodate the growing number of devices connected to the internet.
- **Length:** An IPv6 address is 128 bits long, compared to 32 bits in IPv4. This allows for a vastly larger address space, specifically 2^{128} possible addresses.
- **Format:** IPv6 addresses are represented in hexadecimal format, divided into eight groups of 16 bits each. Each group is expressed as four hexadecimal digits and separated by colons.
- **Omission of Leading Zeros:** Leading zeros in each group can be omitted for brevity, and consecutive groups of zeros can be replaced with a double colon (::) once in an address.

IPv6 Address Types

- IPv6 defines several types of addresses.
- **Unicast:** Identifies a single interface; packets sent to a unicast address are delivered to that specific interface.
- **Multicast:** Addresses a group of interfaces; packets sent to a multicast address are delivered to all interfaces in the group.
- **Anycast:** Assigned to multiple interfaces but delivers packets to only one, typically the nearest one according to routing protocols.
- **No Broadcast Messages:** IPv6 eliminates the concept of broadcast messages entirely. This decision was made to enhance network efficiency and reduce unnecessary traffic, as broadcast messages send data to all devices on a network indiscriminately, which can lead to performance issues.

Provided Materials

Measurement of 128 bit

Examples:

2001:0211:00AB:0000:0000:0000:0000:0001

Working in the 1st Hextet we can see

2 = 0010 (4-bit)

0 = 0000 (4-bit)

0 = 0000 (4-bit)

1 = 0001 (4-bit)

= Total 16 bit in One Hextet.

In total :- 16 bit * 8 Hextet = 128 bit.

How to Shorten IPv6 Address

1. Leading Zero Can be Omitted.
2. Consecutive Hexted of Zeros can be represented/replaced by double colon (::).
3. Double colon can only be used once in an IPv6 Address.

2001:0211:00AB:0000:0000:0000:0000:0001

=According to the rules, we can write

i. 2001:211:AB:0:0:0:0:1 -Leading 0's are omitted
ii. 2001:211:AB::1 - Consecutive 0 means (::)
iii. Already Used one double colon.

Final Shorten IP address:- 2001:211:AB::1

Problem Set

Show the unabbreviated colon hex notation for the following IPv6 addresses.

a. An address with 64 0s followed by 64 1s.
b. An address with 128 0s.
c. An address with 128 1s.
d. An address with 128 alternative 1s and 0s.

Solution:-

a. 0000:0000:0000:0000:FFFF:FFFF:FFFF:FFFF
b. 0000:0000:0000:0000:0000:0000:0000:0000
c. FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF
d. AAAA:AAAA:AAAA:AAAA:AAAA:AAAA:AAAA:AAAA

Problem Set

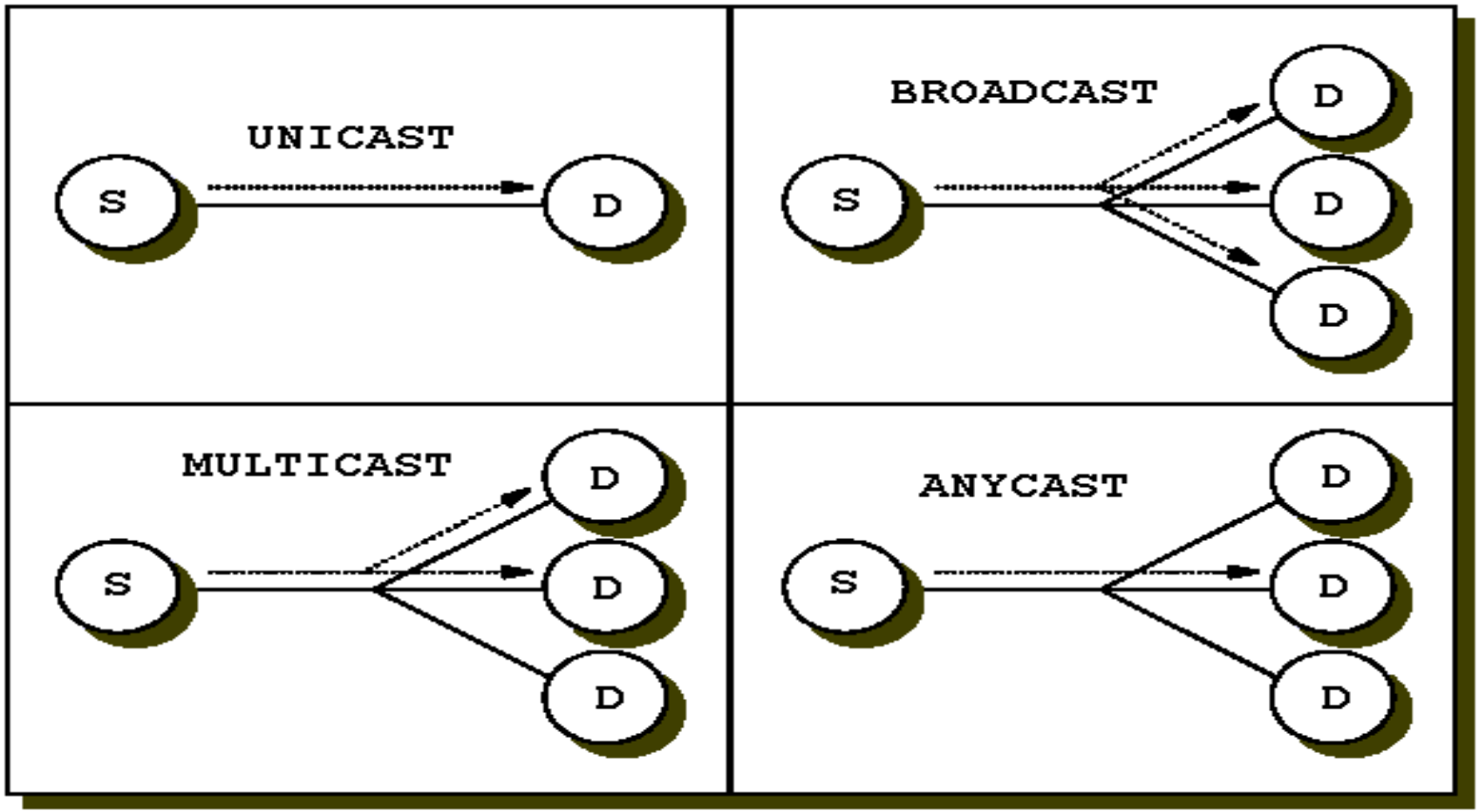
Show abbreviations for the following addresses:

- a. 0000:0000:FFFF:0000:0000:0000:0000:0000
- b. 1234:2346:0000:0000:0000:0000:0000:1111
- c. 0000:0001:0000:0000:0000:0000:1200:1000
- d. 0000:0000:0000:0000:0000:FFFF:24.123.12.6

Solution

- ✓a. 0:0:FFFF::
- ✓b. 1234:2346::1111
- ✓c. 0:1::1200:1000
- ✓d. ::FFFF:24.123.12.6

Types of ipv6 Address



Types of ipv6 Address

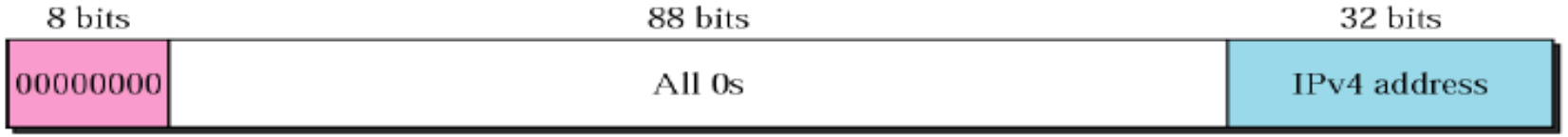
- Like IPv4…
  - Unicast
    - An identifier for a single interface. A packet sent to a unicast address is delivered to the interface identified by that address.
  - Multicast
    - An identifier for a set of interfaces (typically belonging to different nodes). A packet sent to a multicast address is delivered to all interfaces joined to that group address.
  - Anycast
    - An identifier for a set of interfaces (typically belonging to different nodes). A packet sent to an anycast address is delivered to one of the interfaces identified by that address (the "nearest" one, according to the routing protocols' measure of distance).

What is removed in ipv6

What is not in IPv6

- Broadcast
  - There is no broadcast in IPv6.
  - This functionality is taken over by multicast.
  - Helps mitigate some DDoS attacks.

Convert IPv4 to IPv6



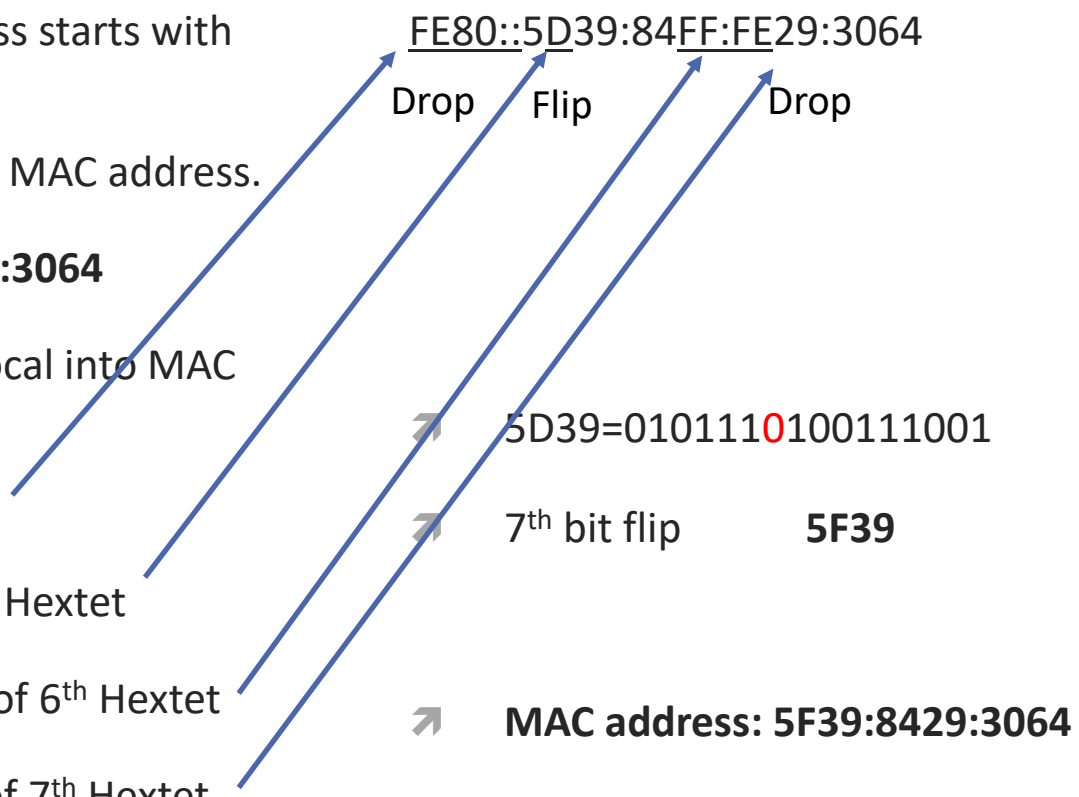
First 8 bits 0, following 88 bits will also be zero, last 32 bits will be the IPv4 address.

IPv4 address: 192.168.10.62
Convert it into IPv6
Representing each octet with 8 bits binary:
192 = 1100 0000 = C0
168 = 1001 0100 = 94
10 = 0000 1010 = 0A
62 = 0011 1110 = 3E

IPv6 address will be→ 0:0:0:0:0:0:C094:0A3E → ::C094:A3E

IPv6: Link Local to MAC

- All the link local address starts with FE80.
- It is used for retrieving MAC address.
- **FE80::5D39:84FF:FE29:3064**
- Rules to convert link local into MAC Address:
- i) Drop the 1st Hextet
- ii) Flip the 7th bit of 5th Hextet
- iii) Drop the 2nd Octet of 6th Hextet
- iv) Drop the 1st Octet of 7th Hextet



- 5D39=0101110100111001
- 7th bit flip **5F39**
- **MAC address: 5F39:8429:3064**

References

1. **Data Communications and Networking**, *B. A. Forouzan*, McGraw-Hill, Inc., Fourth Edition, 2007, USA.
2. https://www.geeksforgeeks.org/basics-computer-networking/
3. https://www.tutorialspoint.com/computer_fundamentals/computer_networking.htm

Books

1. **Data Communications and Networking**, *B. A. Forouzan*, McGraw-Hill, Inc., Fourth Edition, 2007, USA.
2. **Computer Networking: A Top-Down Approach**, *J. F., Kurose, K. W. Ross*, Pearson Education, Inc., Sixth Edition, USA.
3. **Official Cert Guide CCNA 200-301 , vol. 1**, *W. Odom*, Cisco Press, First Edition, 2019, USA.
4. **CCNA Routing and Switching**, *T. Lammle*, John Wily & Sons, Second Edition, 2016, USA.
5. **TCP/IP Protocol Suite**, *B. A. Forouzan*, McGraw-Hill, Inc., Fourth Edition, 2009, USA.
6. **Data and Computer Communication**, *W. Stallings*, Pearson Education, Inc., 10th Education, 2013, USA.

References

- Online Website Research.
- This is the Provided Materials.