Date: 30-04-2024

CSE421 – Computer Networks – SFS

Lecture 14 – IPv6 [Network layer]

* Simpler header – speed for processing/forwarding ↑
* header Δs to facilitate QoS
* a lot of IPs → IPv6 has 16 octets – 128 bits → 3.4×10^{38} IP Addresses

(*) Header information –

* 40 bytes of fixed length (base header)
* no fragmentation allowed
  ↳ does not mean MTU = Datapacket
* Traffic class – similar to IPv4 TOS
* Flow label – new field
* Payload length – total data + extension header length (65535 bytes) [does not include the header]
* Next header – new field similar to IPv4 Protocol field
* Hop limit – TTL
* Source Address (16 bytes)
* Destination Address (16 bytes)

(*) Extension Headers –

* Linked-list vibes
* additional information that does not fit in 40 byte fixed header can be stored in extension header.
* which type of header/extra information is being linked
* payload comes after extension header
* Next header – type of header

Slide 06

(*) IPv6 Address – 128 bits → 16 blocks → Hexadecimal
(16 bits)

1 hex → 4 binary digits

16 x 8 → 8 octets of 16 bits → String Notation

1211:2001:0000:3238:AED1:0000:0000:1008

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✱ IPv6 Representation—

Rule 01- omit leading zeroes (0). [shorten]

2031:0000:130F:0000:0000:09C0:876A:130B

⇒ 2031:0:130F:0:0:9C0:876A:130B

⇒ missing digits are assumed to be leading zeroes.

Rule 02— single contiguous string of one/more 16bit blocks consisting of all zeroes can be represented as ::.

1080:0:0:0:800:200C:417A → 1080::8:800:200C:417A

0:0:0:0:0:0:0:1 → ::1

* Unacceptable case — set of more than 1 ::

↳ rule is to use :: only once.

1843::f01::22::fa ✗

* No more net masks

↳ represented by "prefix len"

↳ router can distinguish how many bits are network bits and how many are host bits by looking at the input IPv6 address.

2001:db8:abcd:001::0/64

↳ N.A — 2001:db8:abcd:001

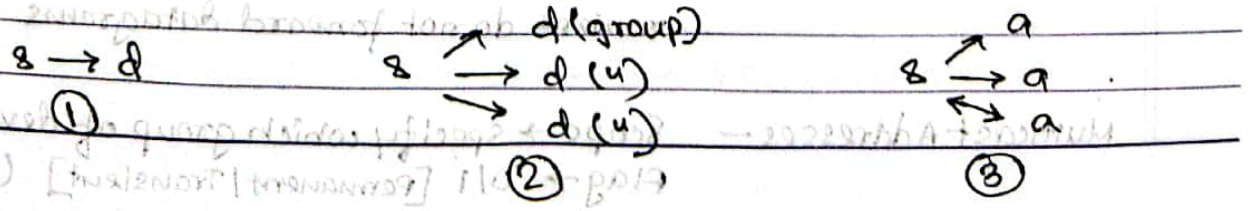
Host — ::0

range → 2001:db8:abcd:001:0000:....:0000

to 2001:db8:abcd:001:f:....:f

✱ Types of IPv6 addresses—

1. Unicast (one to one)
2. Multicast (group of devices; can be tweaked to serve as broadcast)
3. Anycast (one source to multiple devices but reply comes from closest device)



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* No broadcast address
  ↳ has an "all nodes multicast" which serves the same purpose.
* Public networks — Unicast Global Address
  ↳ 2000::/3

Prefix	CIDR	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

(globally unique / local comm)

Unicast Global — 64 bits N.A. → Global Routing Prefix (48) + Subnet ID (16) ↳ future proofing
64 bits Interface ID (Host)
↳ 48 bit interface MAC + identifier from EUI-64 Address + manually configured address

Special Addresses — (a) Unspecified Address — ::/128 (Host itself)
* assigns an address to itself when it does not know its own address
* addressing purposes within a software
(b) Loopback Development — ::1/128
* one address not a whole block for loopback functions, creates a server for itself to get responses.

Link local Unicast — particular physical network + local comm^n routers do not forward datagrams using this.

Multicast Addresses — Scope → specify which group of devices (Hex)
Flag → 0/1 [Permanent / Transient] (Hex)

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* Anycast addresses — same as unicast addresses
  — created automatically when a unicast address is assigned to more than one interface.
* Static Address Management —
  ipv6 address ____ / prefixless

* EUI-64 interfacing —
  EUI → Extended Unique Identifier
  * stretches 48 bit MAC to 64 bit IP Address.
  48 MAC + 16 = 64 bits
  [Host]
  * insert 16-bit FFFE in the middle at 24th bit of MAC address.

MAC Address —

00 90 27 | 17 FC 0F
24 24

00 90 27 FFFE 17 FC 0F = 64 bits
16 [Host]

0090:27FF:FE17:FC0F

0000
0010 → 2

∴ 0290:27FF:FE17:FC0F = 64 bits
[Interface ID]

Given, link local unicast —
→ FE80::/10 [64 bit N.A.]

Full IP address — N.A. + Host
FE80::0290:27FF:FE17:FC0F/10 → 128 bits

Subnet of 1000 given.
FE80::1000:0290....:FC0F/10 → 128 bits

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(*) Transition Techniques — one interface has two addresses

(i) Dual stack — router can handle both IPv4 and IPv6 packets.

(ii) Tunneling — ipv6 packet is encapsulated in ipv4 packet and vice versa.

(iii) Translation — NAT protocol translation

needs dual stack routers

ipv4 host → removes ipv4 header → attaches ipv6 header → forwards to ipv6 server

NAT-PT

attach a ipv4 header on ipv6 packet

vice versa for the response from ipv6 server to ipv4 host.