

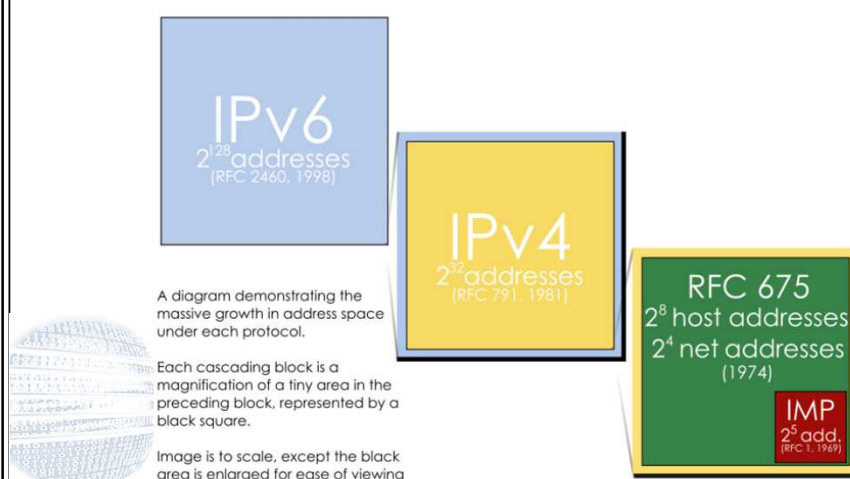
# Lecture 15: Internet Protocol Version 6 (IPv6)

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EE426: Communication Networks

## IPv6 addressing

- IPv4 uses **32 bit = 4 bytes** addresses, IPv6 uses **128 bit = 16 bytes** addresses.



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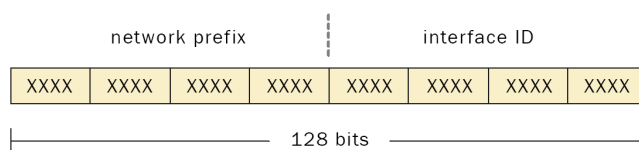
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IPv6 is described in RFC 8200. The IPv6 addressing architecture is described in RFC 3513 and RFC 4193. The 128-bit-long addresses are represented in **hexadecimal** format:

**xxxx : xxxx : xxxx : xxxx : xxxx : xxxx : xxxx : xxxx**

where xxxx is a 16-bit hex field. Notice that a total of 8 fields results in 16 bytes = 128 bits.



XXXX = 0000 through FFFF

Examples:

**2001:0DB8:C003:0001:0000:0000:F00D**

**2001:0db8:85a3:0000:0000:8a2e:0370:7334**

**2001:0db8:0000:0000:0000:0000:1428:57ab**

## Short-hand notation

Remove leading zeros; double-colon :: option *only once*:

**2001:DB8:C003:1:0:0:F00D**

**2001:db8:85a3:0:0:8a2e:370:7334**

**2001:db8:0:0:0:0:1428:57ab**

**2001:DB8:C003:1::F00D**

**2001:db8:85a3::8a2e:370:7334**

**2001:db8::1428:57ab**

**::1**

## Address Types

**Unicast:** one-to-one (global, link local, unique local, compatible)

**Anycast:** one-to-nearest (allocated from Unicast)

**Multicast:** one-to-many (also replaces broadcast addresses)

Type	Binary	Hex
Aggregatable Global Unicast	001	2000::/3
Link-Local Unicast	1111 1110 10	FE80::/10
Unique Local Unicast	1111 1100 1111 1101	FC00::/8 FD00::/8
Multicast	1111 1111	FF00::/8

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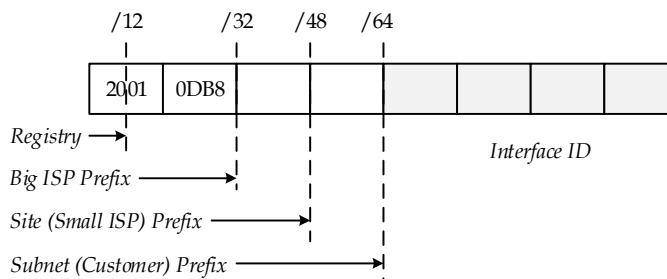
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## Address Allocation & Aggregation

ICANN allocates address space  
to each regional registry:

- RIPE NCC (EMEA)
- APNIC (Asia Pacific)
- ARIN (North America)
- LACNIC (Latin America)
- AfriNIC (African Region)

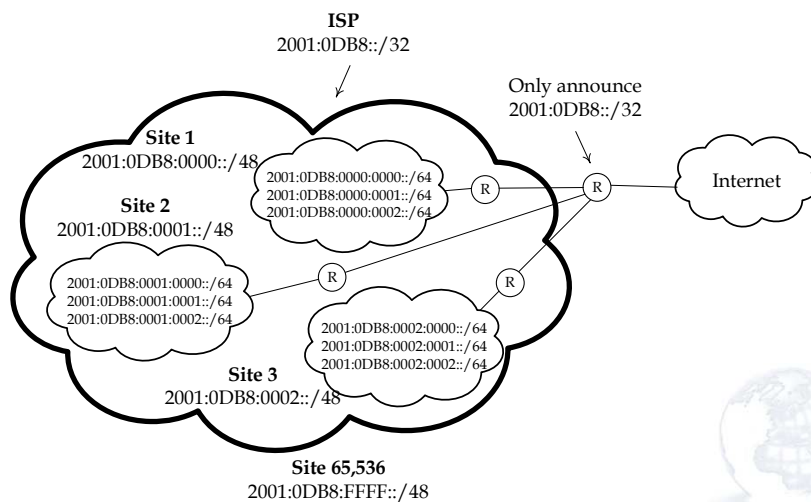


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# Allocation & Aggregation Example



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# IPv6 Header Format (RFC 2460)

IPv4 Header					IPv6 Header			
Version	IHL	Type of Service	Total Length		Version	Traffic Class	Flow Label	
Identification			Flags	Fragment Offset	Payload Length		Next Header	Hop Limit
Time to Live	Protocol	Header Checksum			Source Address			
Source Address					Destination Address			
Destination Address								
Options				Padding				

- Field's name kept from IPv4 to IPv6
- Fields not kept in IPv6
- Name and position changed in IPv6
- New field in IPv6

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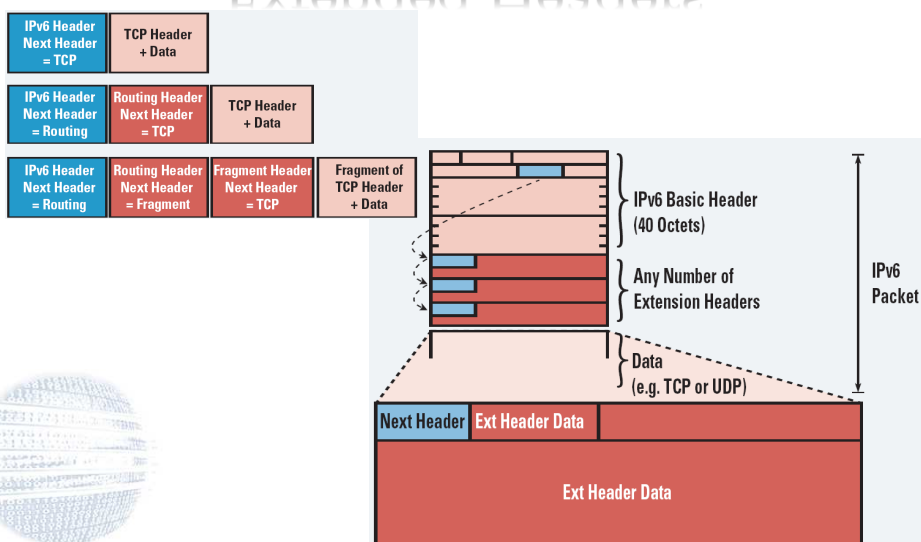
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## Changes to the Heade

- Revised
  - Time To Live -> Hop Limit
  - Protocol -> Next Header
  - Precedence and TOS -> Traffic class
  - Addresses increased 32 bits -> 128 bits
- Extended
  - Flow Label field added.
- Removed:
  - Header length field eliminated
  - Header checksum eliminated
- Streamlined (using the idea of extended headers):
  - Fragmentation fields moved out of base header
  - IP options moved out of base header
  - Length field excludes IPv6 header
  - Alignment changed from 32 to 64 bits



## Extended Headers



## Extended Headers (Cont.)

**Table 1.** Summary of Header Types and Values

Header Type	Next Header Value
Hop-by-Hop Options Header	0
Destination Option Header	60
Routing Header	43
Fragment Header	44
Authentication Header (RFC 1826) and ESP Header (RFC 1827)	51
Upper-Layer Header	6 (TCP) 17 (UDP)
Mobility Header	135



## Extended Headers (Cont.)

- When more than one extension header is used in the same packet, it is recommended that those headers appear in the following order:
  - IPv6 header
  - Hop-by-hop options header
  - Destination options header (routing header associations)
  - Routing header
  - Fragment header
  - Authentication header
  - Encapsulating security payload header
  - Destination options header (options processed by final destination)
  - Upper-layer header

