# IPv6 Addressing



# Addressing scheme

- **RFC 3513** defines IPv6 addressing scheme
- **RFC 3587** defines IPv6 global unicast address format
- 128 bit long addresses
  - Allow hierarchy
  - Flexibility for network evolutions
- Use CIDR principles:
  - Prefix / prefix length
    - 2001:660:3003::/48
    - 2001:660:3003:2:a00:20ff:fe18:964c/64
  - Aggregation reduces routing table size
- Hexadecimal representation
- Interfaces have several IPv6 addresses

# Textual Address Format

- Base format (a 16-byte **Global IPv6 Address**) :

2001:0660:3003:0001:0000:0000:6543:210F

- Compact Format:

2001:660:3003:1::6543:210F

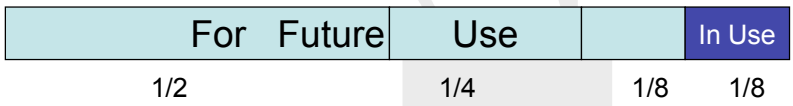
- Litteral representation

[2001:660:3003:2:a00:20ff:fe18:964c]



# IPv6 Address Space
## (RFC 3513)

| | | |
|---|---|---|
| **Aggregatable Global Unicast Addresses** | 001 | **1/8** |
| **Unique Local Unicast addresses** | 1111 1110 00 | **1/128** |
| *[RFC-ietf-ipv6-unique-local-addr-09.txt]* | | |
| **Link-Local Unicast Addresses** | 1111 1110 10 | **1/1024** |
| **Multicast Addresses** | 1111 1111 | **1/256** |




More info : http://www.iana.org/assignments/ipv6-address-space

# IPv6 Addresses

- Loopback ::1
- **Link local** FE80:....
- Site local FEC0:...
- Global
  - 6bone: 3FFE:...
  - Official: 2001:...

- **IPv4 mapped**
- **6to4**: 2002::...

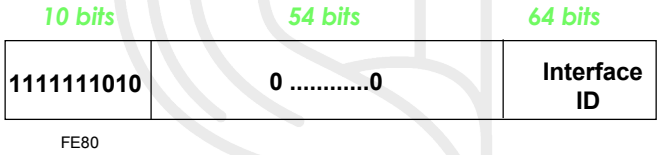
- Unicast
- Multicast
- **Anycast**

**specific to IPv4/IPv6 integration**

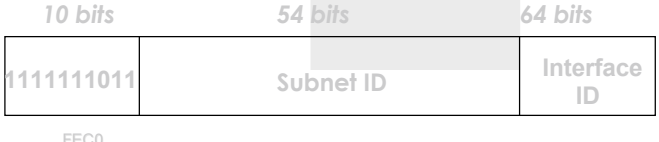


# Local Addresses

**Link-local**

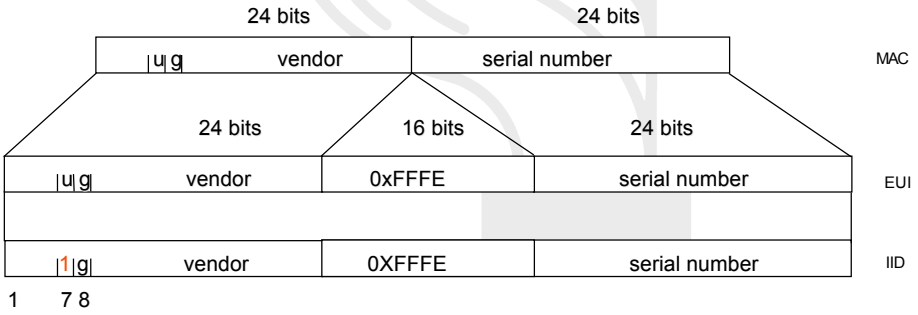



**Site-local** (in the process of being deprecated)



# Interface Identifier

- 64 bits to be compatible with IEEE 1394 (FireWire)
- Eases auto-configuration
- IEEE defines the mechanism to create an EUI-64 from IEEE 802 MAC addresses (Ethernet, FDDI)






# Interface Identifier (2)

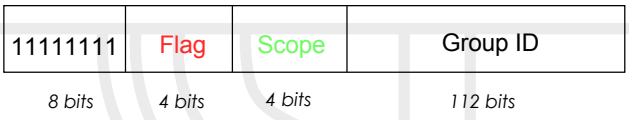
- Links with non global identifier (e.g., the Localtalk 8 bit node identifier) → fill first left bits with 0
- For links without identifiers, there are different ways to proceed (e.g., tunnels, PPP):
  - Choose the identifier of another interface
  - Random number
  - Manual configuration
- **THEN :** Invert IEEE EUI-64 "u" bit to become an "interface identifier"

# Interface Identifier (3)
## (Privacy issues)

- IEEE 24 bit OUI can be used to identify HW:
  - http://standards.ieee.org/regauth/oui/oui.txt
- Interface Identifier can be used to trace a user:
  - The prefix changes, but the interface ID remains the same,
  - Psychological issue.
- Possibility to change Interface ID (RFC 3041 PS):
  - If local storage, use MD5 algorithm
  - Otherwise draw a random number



# Multicast Addresses




Flag bits: 0 R P T

T = 0 *permanent addresses (managed by IANA)*

T = 1 *transient multicast addresses*
- P = 1 *derived from unicast prefix (RFC3306)*
  - R = 1 *embedded RP addresses (RFC 3956)*

Scope
0 : Reserved
1 : Interface-local
2 : Link-local
3 : Subnet-local
4 : Admin-local
5 : Site-local
8 : Organization-local
E : Global
F : Reserved

# Anycast Addresses (RFC 3513)

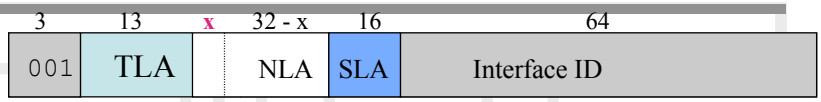
- « Anycast addresses allow a packet to be **routed to one of a number** of different nodes all responding to the same address »
- « (they) are allocated from the unicast address space, using any of the defined unicast address formats »

⇒ **It cannot be distinguished from a Unicast address**

- « it may be assigned to an IPv6 router only »
- Reserved anycast addresses are defined in RFC 2526
- Subnet anycast router address is :




# RFC 2471: Aggregatable Test Addresses




- Used in the 6bone
- TLA value is 0x1FFE => Prefix = 3FFE::/16
- pTLA in the NLA part assigned by *ngtrans* wg

http://www.6bone.net/6bone_pTLA_list.html

**49 × ::/24**

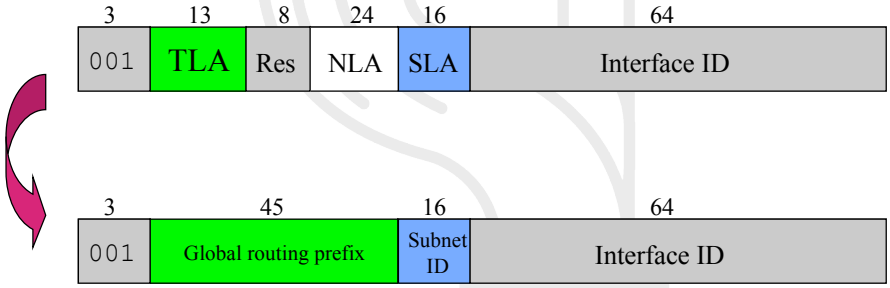
| | |
|---|---|
| INNER/US-VA | 3FFE:0000::/24 |
| TELEBIT/DK | 3FFE:0100::/24 |
| SICS/SE | 3FFE:0200::/24 |
| G6/FR | 3FFE:0300::/24 |
| JOIN/DE | 3FFE:0400::/24 |

**45 × ::/28** 3FFE:8xyz::/28

**27 × ::/32** 3FFE:4xyz::/32 (2003/11/21)

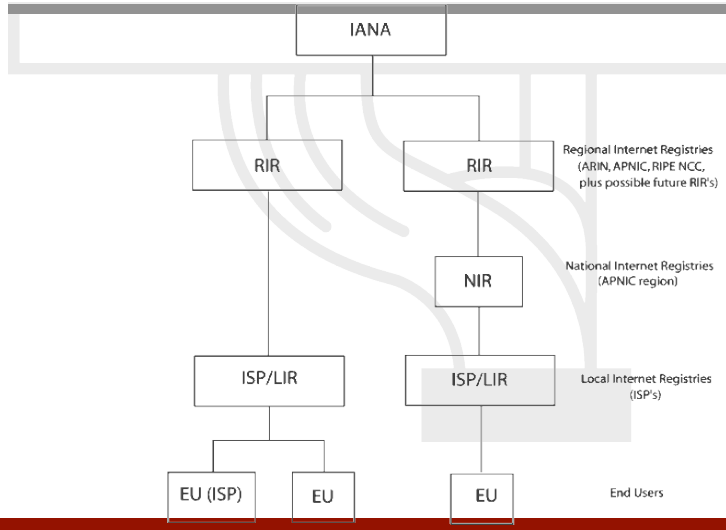
# RFC 3587: Global Unicast address format

(obsoletes RFC 2374)






# Production Addressing Scheme



# Production Addressing Scheme (2)

Source :
http://www.iana.org/assignments/ipv6-unicast-address-assignments

| IPv6 Prefix | Binary Value | Assignment |
|---|---|---|
| 2000::/16 | 0010 0000 0000 0000 | Reserved |
| 2001::/16 | 0010 0000 0000 0001 | Global Unicast Assignments [RFC3513] |
| 2002::/16 | 0010 0000 0000 0010 | 6to4 [RFC3056 et 3068] |
| 2003::/18 | 0010 0000 0000 0011 | RIPE NCC Global Unicast Assignments [RFC3513] |
| 2400::/x | | APNIC |
| 2600::/x | | ARIN |
| 2A00::/x | | RIPE NCC |
| 3FFE::/16 | 001 1 1111 1111 1110 0x1FFE | 6bone Testing [RFC2471] |
| 3FFF::/16 | 001 1 1111 1111 1111 0x1FFF | Reserved |

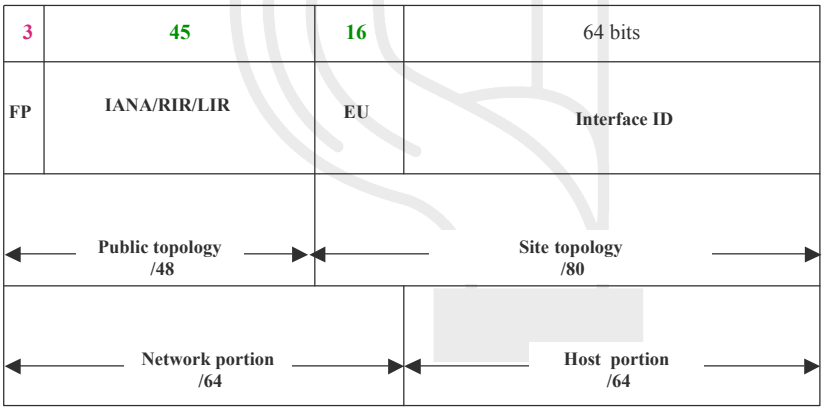


# Production Addressing Scheme (3)

| IPv6 Prefix | sub-TLA Binary Values | Allocated to | Date |
|---|---|---|---|
| 2001:0000::/23 | 0000 000X XXXX X | IANA | Jul 99 |
| 2001:0200::/23 | 0000 001X XXXX X | APNIC | Jul 99 |
| 2001:0400::/23 | 0000 010X XXXX X | ARIN | Jul 99 |
| 2001:0600::/23 | 0000 011X XXXX X | RIPE NCC | Jul 99 |
| 2001:0800::/23 | 0000 100X XXXX X | RIPE NCC | May 02 |
| 2001:0A00::/23 | 0000 101X XXXX X | RIPE NCC | Nov 02 |
| 2001:0C00::/23 | 0000 110X XXXX X | APNIC | May 02 |
| 2001:0E00::/23 | 0000 111X XXXX X | APNIC | Jan 03 |
| 2001:1000::/23 | 0001 000X XXXX X | (future assignment) | |
| 2001:1200::/23 | 0001 001X XXXX X | LACNIC | Nov 02 |
| 2001:1400::/23 | 0001 010X XXXX X | RIPE NCC | Feb 03 |
| 2001:1600::/23 | 0001 011X XXXX X | RIPE NCC | Jul 03 |
| 2001:1800::/23 | 0001 100X XXXX X | ARIN | Apr 03 |
| . . . | | | |
| . . . | | | |
| . . . | | | |
| 2001:FE00::/23 | 1111 111X XXXX X | (future assignment) | |

Where "X" indicates "0" or "1".
All other Sub-TLA ID values not listed above are reserved.

# Production Addressing Scheme (4)






# RIR allocations

- Started July '99
- New allocated prefix length since July 1th 2002, ::/32 instead of ::/35
- Allocated prefixes (*up to 10 September 2005*) = **1301**
  - http://www.ripe.net/rs/ipv6/stats/

  – *APNIC*
    - **398 prefixes**
    - **within 2001:{02, 0C, 0E, …}00::/23**

  – *ARIN*
    - **213 prefixes**
    - **within 2001:{04, 18, …}00::/23**

  – *LACNIC*
    - **33 prefixes**
    - **within 2001:1200::/23**

  – *RIPE-NCC*
    - **647 prefixes**
    - **within 2001:{06, 08, 0A, 14, 16, …}00::/23**

# Initial RIR allocation Policy & Procedure

- Get the RIPE documents [246-250, 256, 261, 267, 274, 275, 280-282]
  - http://www.ripe.net/ripe/docs/ipv6.html
- Criteria: RIPE-267
  - http://www.ripe.net/ripe/docs/ipv6policy.html
- To qualify for an initial allocation of IPv6 address space, an organization must:
  - be an LIR : *not be an end site*
  - plan to provide IPv6 connectivity to organizations to which it will assign /48s, by advertising that connectivity through its single aggregated address allocation (/32 prefix)

  **and**
  - have a plan for making at least 200 x /48 assignments to other organizations within two years.