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]:

- Compact Format:
  2001:660:3003:1::6543:210F

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

### IPv6 Address Space

(RFC 3513)

<table>
<thead>
<tr>
<th>Category</th>
<th>Prefix</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregatable Global Unicast Addresses</td>
<td>001</td>
<td>1/8</td>
</tr>
<tr>
<td>Unique Local Unicast addresses</td>
<td>1111 1110 00</td>
<td>1/128</td>
</tr>
<tr>
<td>Link-Local Unicast Addresses</td>
<td>1111 1110 10</td>
<td>1/1024</td>
</tr>
<tr>
<td>Multicast Addresses</td>
<td>1111 1111</td>
<td>1/256</td>
</tr>
</tbody>
</table>

For Future | Use | In Use
--- | --- | ---
1/2 | 1/4 | 1/8 | 1/8

More info: [http://www.iana.org/assignments/ipv6-address-space](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**

### Local Addresses

**Link-local**

- 10 bits
- 54 bits
- 64 bits

```
1111111010 0 ......... 0
```

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

- 10 bits
- 54 bits
- 64 bits

```
1111111011 
```
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)

![Diagram of Interface Identifier]

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:
- 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

<table>
<thead>
<tr>
<th>Flag</th>
<th>Scope</th>
<th>Group ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 bits</td>
<td>4 bits</td>
<td>112 bits</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Subnet Prefix</th>
<th>00..00</th>
</tr>
</thead>
</table>

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)

<table>
<thead>
<tr>
<th>3</th>
<th>13</th>
<th>8</th>
<th>24</th>
<th>16</th>
<th>64</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>TLA</td>
<td>Res</td>
<td>NLA</td>
<td>SLA</td>
<td>Interface ID</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>45</th>
<th>16</th>
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<tbody>
<tr>
<td>001</td>
<td>Global routing prefix</td>
<td>Subnet ID</td>
<td>Interface ID</td>
</tr>
</tbody>
</table>

Production Addressing Scheme

IANA

Regional Internet Registries (RIRs, ARIN, APNIC, RIPE NCC, others provide future RIRs)

National and Interests Registries (APNIC regions)

Local Internet Registries (ISPs)

EU (ISP) EU (ISP) EU (ISP)
# Production Addressing Scheme

## (2)

Source: [http://www.iana.org/assignments/ipv6-unicast-address-assignments](http://www.iana.org/assignments/ipv6-unicast-address-assignments)

<table>
<thead>
<tr>
<th>IPv6 Prefix</th>
<th>Binary Value</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000::/16</td>
<td>0010 0000 0000 0000</td>
<td>Reserved</td>
</tr>
<tr>
<td>2001::/16</td>
<td>0010 0000 0000 0001</td>
<td>Global Unicast Assignments [RFC3513]</td>
</tr>
<tr>
<td>2002::/16</td>
<td>0010 0000 0000 0010</td>
<td>6to4 [RFC3056 et 3068]</td>
</tr>
<tr>
<td>2003::/18</td>
<td>0010 0000 0000 0011</td>
<td>RIPE NCC Global Unicast Assignments [RFC3513]</td>
</tr>
<tr>
<td>2400::/x</td>
<td></td>
<td>APNIC</td>
</tr>
<tr>
<td>2600::/x</td>
<td></td>
<td>ARIN</td>
</tr>
<tr>
<td>2A00::/x</td>
<td></td>
<td>RIPE NCC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IPv6 Prefix sub-TLA Binary Values</th>
<th>Allocated to</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001:0000::/23</td>
<td>IANA</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0020::/23</td>
<td>APNIC</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0040::/23</td>
<td>ARIN</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0060::/23</td>
<td>RIPE NCC</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0080::/23</td>
<td>RIPE NCC</td>
<td>May 02</td>
</tr>
<tr>
<td>2001:00A0::/23</td>
<td>RIPE NCC</td>
<td>Nov 02</td>
</tr>
<tr>
<td>2001:00C0::/23</td>
<td>APNIC</td>
<td>May 02</td>
</tr>
<tr>
<td>2001:00E0::/23</td>
<td>APNIC</td>
<td>Jan 03</td>
</tr>
<tr>
<td>2001:1000::/23</td>
<td>(future assignment)</td>
<td></td>
</tr>
<tr>
<td>2001:1020::/23</td>
<td>LACNIC</td>
<td>Nov 02</td>
</tr>
<tr>
<td>2001:1040::/23</td>
<td>RIPE NCC</td>
<td>Feb 03</td>
</tr>
<tr>
<td>2001:1060::/23</td>
<td>RIPE NCC</td>
<td>Jul 03</td>
</tr>
<tr>
<td>2001:1080::/23</td>
<td>ARIN</td>
<td>Apr 03</td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001:FE00::/23</td>
<td>(future assignment)</td>
<td></td>
</tr>
</tbody>
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Where "X" indicates "0" or "1".
All other Sub-TLA ID values not listed above are reserved.

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DITCHE, Port Elizabeth, Sep. 2005
IPv6SS seminar and exploitation

8
Production Addressing Scheme

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<th>FP</th>
<th>IANA/RIR/LIR</th>
<th>EU</th>
<th>Interface ID</th>
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<tr>
<td>3</td>
<td>45</td>
<td>16</td>
<td>64 bits</td>
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Public topology
/48

Site topology
/80

Network portion
/64

Host portion
/64

RIR allocations

- Started July '99
- New allocated prefix length since July 1st 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)
  - have a plan for making at least 200 x /48 assignments to other organizations within two years.