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

- **Litteral representation**

  [2001:660:3003:2:a00:20ff:fe18:964c]
## IPv6 Address Space

(RFC 3513)

<table>
<thead>
<tr>
<th>Type</th>
<th>Prefix</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregatable Global Unicast Addresses</td>
<td>001</td>
<td></td>
</tr>
<tr>
<td>Unique Local Unicast addresses</td>
<td>1111 1110 00</td>
<td>1/128</td>
</tr>
<tr>
<td>[RFC-ietf-ipv6-unique-local-addr-09.txt]</td>
<td></td>
<td></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>

<table>
<thead>
<tr>
<th>For Future</th>
<th>Use</th>
<th>In Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>1/4</td>
<td>1/8</td>
</tr>
<tr>
<td>1/8</td>
<td></td>
<td>1/8</td>
</tr>
</tbody>
</table>

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:....

- **Unicast**
- Multicast
- Anycast

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

specific to IPv4/IPv6 integration

Where and when?
Local Addresses

Link-local

<table>
<thead>
<tr>
<th>10 bits</th>
<th>54 bits</th>
<th>64 bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1111111010</td>
<td>0 ...........0</td>
<td>Interface ID</td>
</tr>
</tbody>
</table>

FE80

Site-local (in the process of being deprecated)

<table>
<thead>
<tr>
<th>10 bits</th>
<th>54 bits</th>
<th>64 bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1111111011</td>
<td>Subnet ID</td>
<td>Interface ID</td>
</tr>
</tbody>
</table>

FEC0

Where and when?
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)

```
24 bits          24 bits
\|\| g
vendor          serial number
```

```
24 bits     16 bits     24 bits
\|\| g
vendor     0xFFFFE
serial number
```

```
1 7 8
```

Where and when?
# 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

## Multicast Address Structure

<table>
<thead>
<tr>
<th>Flag</th>
<th>Scope</th>
<th>Group ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>11111111</td>
<td>8 bits</td>
<td>112 bits</td>
</tr>
<tr>
<td><strong>Flag</strong></td>
<td><strong>Scope</strong></td>
<td><strong>Group ID</strong></td>
</tr>
<tr>
<td>8 bits</td>
<td>4 bits</td>
<td>112 bits</td>
</tr>
</tbody>
</table>
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:

\[
\begin{array}{c|c}
\text{Subnet Prefix} & 00..00 \\
\end{array}
\]
RFC 3587: Global Unicast address format

(obsoletes RFC 2374)
Production Addressing Scheme

Where and when?
### Production Addressing Scheme (2)

<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>
<tr>
<td>3FFE::/16</td>
<td>001 1 1111 1111 1110 0x1FFE</td>
<td>6bone Testing [RFC2471]</td>
</tr>
<tr>
<td>3FFF::/16</td>
<td>001 1 1111 1111 1111 0x1FFF</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

Source:
http://www.iana.org/assignments/ipv6-unicast-address-assignments
### Production Addressing Scheme (3)

<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 0000 000X XXXX X</td>
<td>IANA</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0200::/23 0000 001X XXXX X</td>
<td>APNIC</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0400::/23 0000 010X XXXX X</td>
<td>ARIN</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0600::/23 0000 011X XXXX X</td>
<td>RIPE NCC</td>
<td>Jul 99</td>
</tr>
<tr>
<td>2001:0800::/23 0000 100X XXXX X</td>
<td>RIPE NCC</td>
<td>May 02</td>
</tr>
<tr>
<td>2001:0A00::/23 0000 101X XXXX X</td>
<td>RIPE NCC</td>
<td>Nov 02</td>
</tr>
<tr>
<td>2001:0C00::/23 0000 110X XXXX X</td>
<td>APNIC</td>
<td>May 02</td>
</tr>
<tr>
<td>2001:0E00::/23 0000 111X XXXX X</td>
<td>APNIC</td>
<td>Jan 03</td>
</tr>
<tr>
<td>2001:1000::/23 0001 000X XXXX X</td>
<td>(future assignment)</td>
<td></td>
</tr>
<tr>
<td>2001:1200::/23 0001 001X XXXX X</td>
<td>LACNIC</td>
<td>Nov 02</td>
</tr>
<tr>
<td>2001:1400::/23 0001 010X XXXX X</td>
<td>RIPE NCC</td>
<td>Feb 03</td>
</tr>
<tr>
<td>2001:1600::/23 0001 011X XXXX X</td>
<td>RIPE NCC</td>
<td>Jul 03</td>
</tr>
<tr>
<td>2001:1800::/23 0001 100X XXXX X</td>
<td>ARIN</td>
<td>Apr 03</td>
</tr>
<tr>
<td>2001:FE00::/23 1111 111X XXXX X</td>
<td>(future assignment)</td>
<td></td>
</tr>
</tbody>
</table>

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

- Started July ’99
- New allocated prefix length since July 1\textsuperscript{st} 2002, $::/32$ instead of $::/35$
- Allocated prefixes \textit{(up to 10 September 2005)} = 1301
  - \texttt{http://www.ripe.net/rs/ipv6/stats/}
    - APNIC
      - 398 prefixes
      - within $2001:\{02, 0C, 0E, \ldots\}00: /23$
    - ARIN
      - 213 prefixes
      - within $2001:\{04, 18, \ldots\}00: /23$
    - LACNIC
      - 33 prefixes
      - within $2001:1200: /23$
    - RIPE-NCC
      - 647 prefixes
      - within $2001:\{06, 08, 0A, 14, 16, \ldots\}00: /23$

\textit{Where and when?}
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](http://www.ripe.net/ripe/docs/ipv6.html)
- Criteria: RIPE-267
  - [http://www.ripe.net/ripe/docs/ipv6policy.html](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.