IPv6 Addressing

Copy …Rights

- *Looking for a contact ?*
  - *Mail to : martin.potts@martel-consulting.ch*
  - *Or bernard.tuy@renater.fr*

Gosier, La Guadeloupe -March 2007
IPv6DISSemination and Exploitation

Droits d'auteur …

- *L'ensemble des présentations utilisées dans le cadre de cet atelier est la propriété de 6DISS, représenté par ses différents partenaires.*
- *La version Powerpoint des présentations peut être réutilisée et modifiée après qu'une autorisation écrite ait été obtenue*
- *L'usage de tout ou partie de ce matériel doit mentionné que sa source est le projet 6DISS*
- *La version PDF des présentations est disponible sur www.6diss.org*
- *Pour tout contact :*
  - *Mail à Martin.Potts@martel-consulting.ch*
  - *Ou Bernard.Tuy@renater.fr*

Agenda

- IPv6 addressing scheme
- IPv6 address types
- IPv6 address formats
- IPv6 address allocation to LIRs

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:**

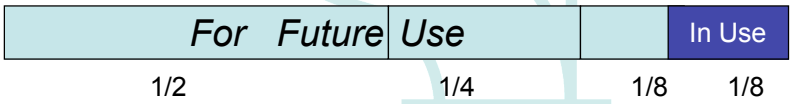
2001:660:3003:1::6543:210F

- **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
Link-Local Unicast Addresses	**1111 1110 10**	1/1024
Multicast Addresses	**1111 1111**	1/256



1/2 1/4 1/8 1/8

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:…**

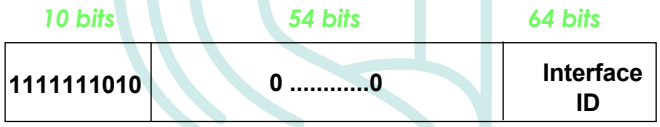
- IPv4 mapped
- 6to4**:2002::…**

specific to IPv4/IPv6 integration

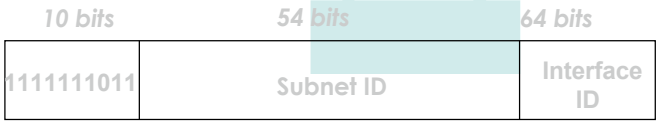
- **Unicast**
- **Multicast**
- Anycast

Local Addresses

Link-local

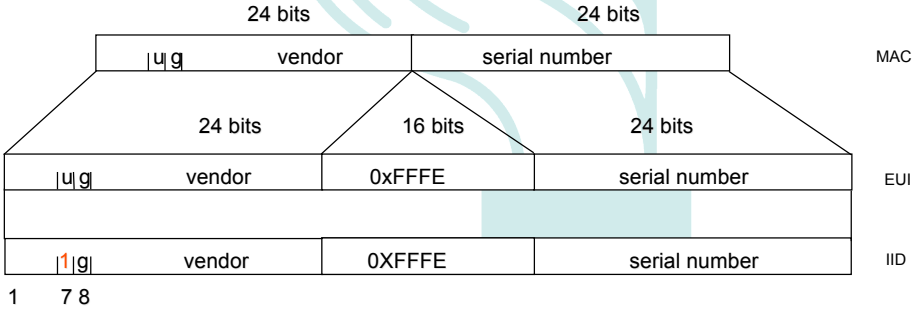


Site-local (in the process of being deprecated)



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)



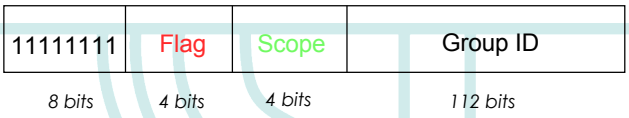
Interface Identifier (2)

- 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
4 : Admin-local
5 : Site-local
8 : Organization-local
E : Global
F : Reserved

Anycast Addresses (RFC 4291)

- « *anycast*: **an identifier for a set of interfaces (typically belonging to different nodes) »**
- **« a packet sent to an anycast address is delivered to *one* of the interface identified by that address … »**
- **« (they) are allocated from the unicast address spaces (of any scope), 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 (obsolete ?)***

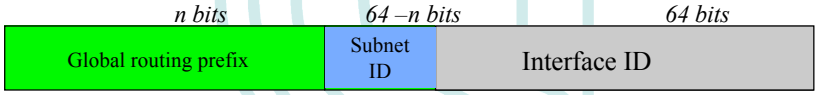
- Required **subnet router anycast address is predefined :**

Required IPv6 addresses (RFC 4291)

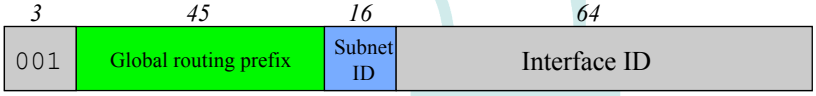
- Node
  - Link local address
    - for each interface
  - Any additional unicast and anycast addresses (manually or automatically conf)
  - Loopback address
  - The all-nodes multicast address
  - Solicited-node multicast address for each of unicast and anycast address
  - Multicast addresses of all other groups the node belongs to
- Router
  - All addresses a host must recognized
  - The subnet-router anycast addresses for all interfaces …
  - All other anycast addresses the router has been configured
  - The all-routers multicast addresses group.

RFC 3587: Global Unicast address format

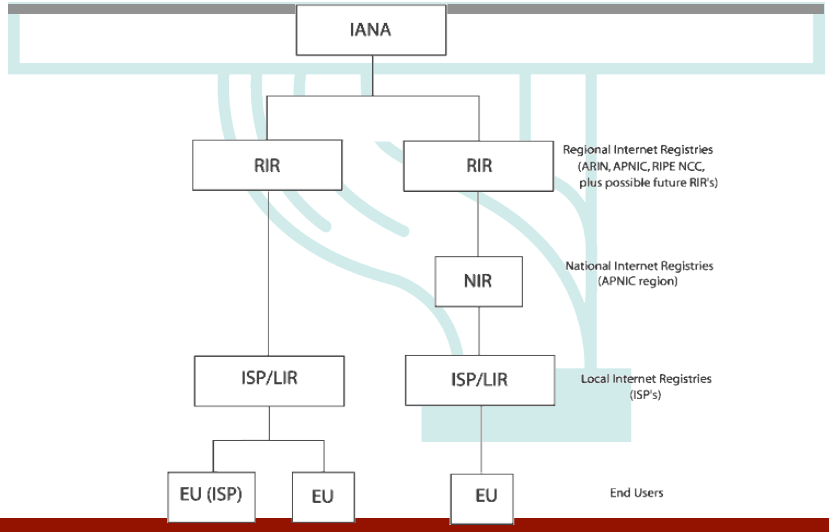
What the RFC proposes :



What the RIRs/IANA implement :



Production Addressing Scheme



Production Addressing Scheme (2)

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

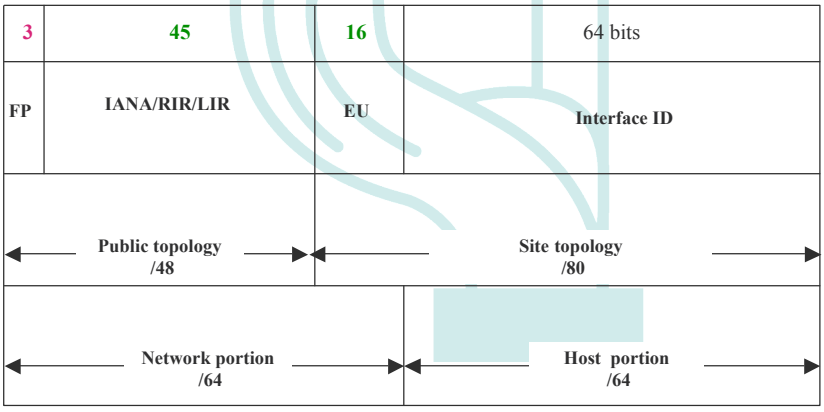
IPv6 Prefix	Binary Value		Assignment
2000::/16	0010 0000 0000 0000		Reserved
2001::/16	0010 0000 0000 0001		Global Unicast Assignments [RFC3513]
2002::/16	0010 0000 0000 0010		6to4 [RFC3056 et 3068]
2003::/18 [RFC3513]	0010 0000 0000 0011		RIPE NCC Global Unicast Assignments
2400::/x			APNIC
2600::/x			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)



IANA IPv6 Allocations to RIRs*

*number of /23s

IPv6 Allocations
RIRs to LIRs/ISPs
Yearly Comparison

IPv6 Allocations
RIRs to LIRs/ISPs
Cumulative Total (Jan 1999 – Sept 2006)

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.

Links to RIR Statistics

- **RIR Stats:**
  http://www.nro.net/statistics/

- **Raw Data/Historical RIR Allocations:**
  http://www.aso.icann.org/stats
  http://www.iana.org/assignments/ipv4-address-space
  http://www.iana.org/assignments/as-numbers
  http://www.iana.org/assignments/ipv6-unicast-address-assignments