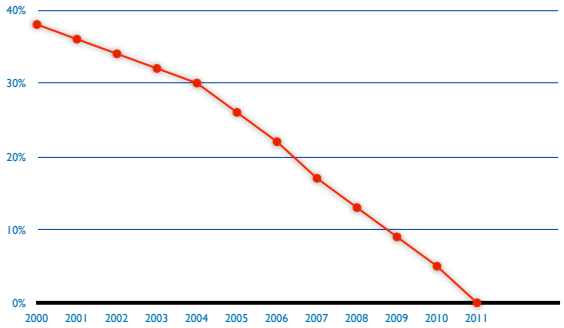
IANA IPv4 Pool



IPv6 Tutorial

RIPE 62

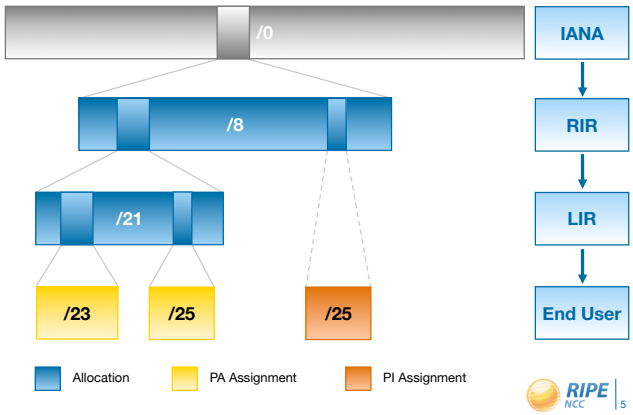
Ferenc Csorba and Marco Hogewoning

Agenda

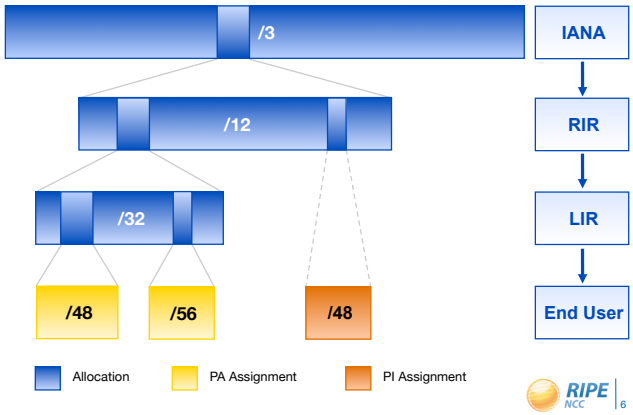
- The Registry System
- IPv4?
- IPv6 Basics
- Getting It
- Getting There
- Challenges
- Deployment Statistics
- More Information

The Registry System

IPv4 address distribution



IPv6 Address Distribution



Registration

Conservation

Aggregation

Quiz 1

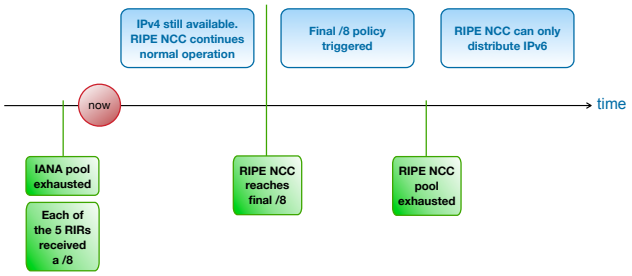
- Arrange the 3 goals of the Internet Registry System in the correct order!



Questions?

IPv4?

IPv4 exhaustion phases



"Run Out Fairly"

- Gradually reduced allocation and assignment periods
- Needs for "Entire Period" of up to...
  - 12 months (January 2010)
  - 9 months (July 2010)
  - **6 months (January 2011)**
  - 3 months (July 2011)
- 50% has to be used up by half-period

Final /8 policy

- Each LIR can get **one** /22 allocation
  - 1024 IPv4 addresses
  - New and existing members
  - As long as supplies will last
- You must meet the criteria for an (additional) allocation
- Only when you already have IPv6 addresses

Transfer of IPv4 allocations

- LIRs can transfer IPv4 address blocks:
  - To another LIR
  - Only when the block is not in use
  - Meets minimum allocation size (/21)
- Requests are evaluated by the RIPE NCC
  - Justified need
- Registered in the RIPE Database

No changes yet

- Policy will only change when the RIPE NCC's final /8 is reached
- Be aware of the shorter assignment period!
- **And start deploying IPv6 now!**

Questions?

IPv6 Basics

IPv6 Address Basics

- IPv6 address: 128 bits
  - 32 bits in IPv4
- Every subnet should be a /64
- Customer assignments (sites) between:
  - /64 (1 subnet)
  - /48 (65,536 subnets)
- Minimum allocation size /32
  - 65,536 /48s
  - 16,777,216 /56s

Address Notation

2001:0610:003e:ef11:0000:0000:c100:004d

2001:0610:003e:ef11:0000:0000:c100:004d

2001:610:3e:ef11:0:0:c100:4d

Quiz 2

- How do you correctly compress the following IPv6 address:

2001:0db8:0000:0000:b450:0000:0000:00b4

A 2001:db8::b450::b4
B 2001:db8::b450:0:0:b4
C 2001:db8::b45:0000:0000:b4
D 2001:db8:0:0:b450::b4

Answer

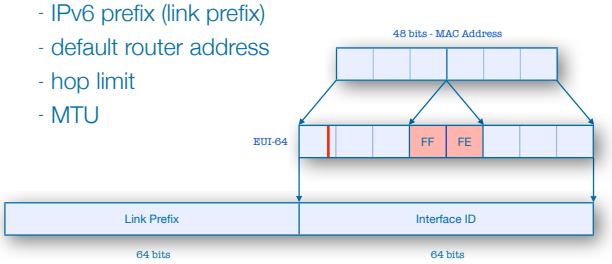
A 2001:db8::b450::b4
B 2001:db8::b450:0:0:b4
C 2001:db8::b45:0000:0000:b4
D 2001:db8:0:0:b450::b4

Multiple addresses

Addresses	Range	Scope
Loopback	::1	host
Link Local	fe80::/10	link
Unique Local	fc00::/7	site
Global Unicast	2000::/3	global
6to4	2002::/16	global
Multicast	ff00::/8	variable
Teredo	2001::/32	global

IPv6 Stateless Address Autoconfiguration

- Neighbor Discovery ICMPv6 messages
- host asks for network information:
  - IPv6 prefix (link prefix)
  - default router address
  - hop limit
  - MTU



IPv6 Stateful Configuration

- DHCPv6
  - used if no router is found
  - or if Router Advertisement Message enables use of DHCP
- With manual configuration subnet sizes other than /64 are possible

Questions?

RIPE NCC

Getting It

RIPE NCC

Getting an IPv6 allocation

- To qualify, an organisation must:
  - Be an LIR
  - Have a plan for making assignments within two years
- Minimum allocation size /32
- Allocation size is based on customer numbers and growth, not on transition technique!

What does the first IPv6 allocation cost?

FREE

- for all
- pending General Meeting decision

or:

FREE

- for approximately 97% of the LIRs
  - more points, but not higher category!

Getting IPv6 PI address space

- To qualify, an organisation must:
  - Demonstrate it will multihome
  - Meet the contractual requirements for provider independent resources
  - LIRs must demonstrate special routing requirements
- Minimum assignment size /48
- PI space can not be used for sub-assignments

Customer assignments

- Give your customers enough addresses
  - Up to a /48
- For more addresses, send in request form
  - Alternatively, make a sub-allocation
- Every assignment must now be registered in the RIPE database

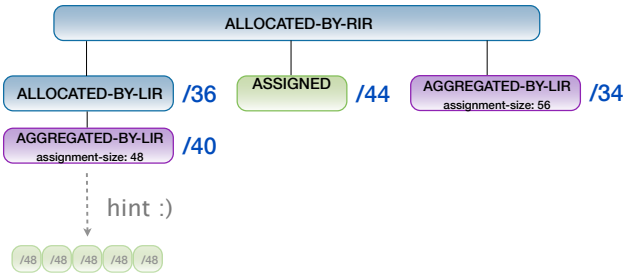
Quiz 3

- How many /64-s in a /48?
- How many /64-s in a /56?
- How many /56-s in a /48?

Answer

- How many /64-s in a /48? 65536
- How many /64-s in a /56? 256
- How many /56-s in a /48? 256

Using AGGREGATED-BY-LIR



Reverse DNS

2001:610:3e:ef11::c100:4d

Reverse DNS

2001:0610:003e:ef11:0000:0000:c100:004d

. . . . . .ip6.arpa

d.4.0.0.0.0.1.c.0.0.0.0.0.0.0.0.1.1.f.e.e.
3.0.0.0.1.6.0.1.0.0.2.ip6.arpa PTR
yourname.domain.tld

d.4.0.0.0.0.1.c.0.0.0.0.0.0.0.0.1.1.f.e.e.3.0.0.0.1.6.0.1.0.0.2.ip6.arpa PTR yourname.domain.tld

Reverse DNS in the RIPE Database

```
domain:      0.6.1.0.1.0.0.2.ipv6.arpa
descr:       Yourname Rev Domain
org:         Yourdomain Ltd
admin-c:     XY123-RIPE
tech-c:      AB321-RIPE
zone-c:      AB321-RIPE
nserver:     alpha.yourdomain.tld
nserver:     beta.yourdomain.ltd
mnt-by:      GAMMA-MNT
mnt-lower:   DELTA-MNT
changed:     joedoe@yourdomain.tld  20110428
source:      RIPE
```


IPv6 in the Routing Registry

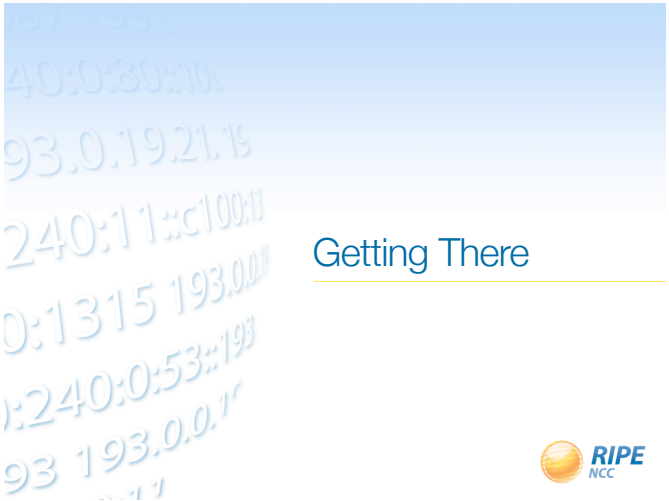
Route6 object:

```
route6:      2001:DB8::/32
origin:      AS65550
```

Aut-num object:

```
aut-num:     AS65550
mp-import:   afi ipv6.unicast from AS64496 accept ANY
mp-export:   afi ipv6.unicast to AS64496 announce AS65550
```


Questions?



Getting There

RIPE NCC

Extending the IPv4 pool

- Find unused addresses
- Use Network Address Translation (NAT)
  - Common technique in home environments
  - Machines get a ‘private IP address’
  - And share a single public IP for connections
- Do the same at the operator level
  - Customers will get a private IP
  - Carrier Grade NAT/Large Scale NAT

NAT = BAD

- Does it really scale ?
  - How many users can share a single address ?
- Who is using address X ?
  - Who am I talking to ?
  - Who to blame for abuse ?
- It doesn’t allow to offer services
- Some protocols will break
- **It does not talk to IPv6!**

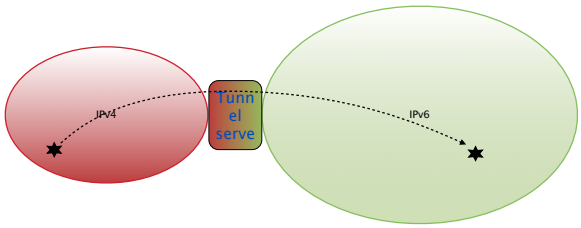
Plan B

- Technical community is very active
- Countless protocols and proposals are around
  - 6in4
  - 6to4
  - 6RD
  - TSP
  - A+P
  - 4RD
  - ...etc
- Most of them are putting X in Y

Transitioning techniques

- Most of them use ‘tunnels’
  - Put X in Y (IPv6 in IPv4)
- The end point has both protocols
- And the network in between doesn’t
- Requires assistance in the form of so called ‘tunnel servers’
  - ‘Bridge’ between the 2 worlds
  - Unpacking and repacking the data

Tunnels

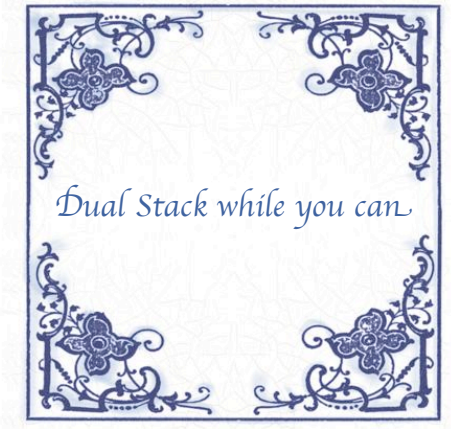


Drawbacks of tunnels

- Some still require (public) IPv4 addresses
- Most of them work one way (IPv4 -> IPv6)
  - IPv6 content ?
- Who owns the tunnel server ?
  - Does it come with some guarantee ?
  - Can you trust them ?
  - ‘man in the middle’
- Filtering prohibits tunnels

Translation (NAT64/NAT-PT)

- Alternative #3: translate IPv4 into IPv6
- Customer will only get one protocol
- Translator box sits in between
  - Talks to both IPv4 and IPv6
  - Shares addresses
- Drawbacks
  - Who is who
  - Can you trust the ‘man in the middle’
  - Breaks DNSsec



Questions?

RIPE NCC

Challenges

RIPE NCC

Best Scenario: Act Now, Phased Approach

- Change purchasing procedure (feature parity)
- Check your current hardware and software
- Plan every step and test
- One service at a time
  - face first
  - core
  - customers
- Prepare to be able to switch off IPv4

Business Case

- IPv4 is no longer equal to “the Internet”
- Avoiding the issue does not make it go away
- How much are you willing to spend now to save money later?
- Only IPv6 allows continued IP networking growth
- What do you want the Internet to be like in 5 years?

“IPv6, act now!”

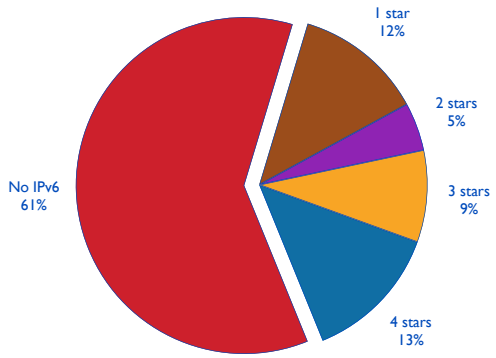
Questions?

Deployment Statistics

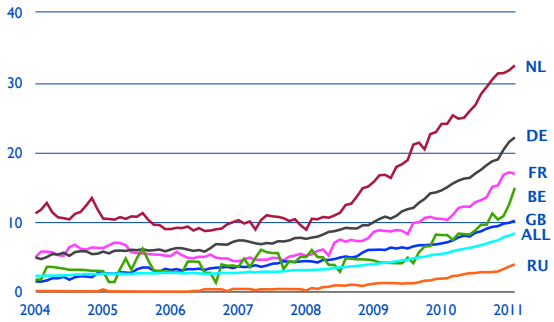
IPv6 RIPEness

- Rating system:
  - One star if the member has an IPv6 allocation
  - Additional stars if:
    - IPv6 Prefix is visible on the internet
    - A route6 object is in the RIPE Database
    - Reverse DNS is set up
  - A list of all 4 star LIRs: http://ripeness.ripe.net/

IPv6 RIPEness: 7433 LIRs



IPv6 enabled ASNs



Questions?

RIPE NCC

More Information

RIPE NCC

Customer Premises Equipment Survey

- CPE devices that support IPv6
- Based on feedback from users
- Use it as a guide
- labs.ripe.net: search for 'IPv6 CPE'
- Take part in the new survey

Also useful

Websites

- http://www.ipv6actnow.org/
- http://datatracker.ietf.org/wg/v6ops/

Mailing lists

- http://lists.cluenet.de/mailman/listinfo/ipv6-ops
- http://www.ripe.net/mailman/listinfo/ipv6-wg

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The End!

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