IPv6 Tutorial

RIPE61, Rome

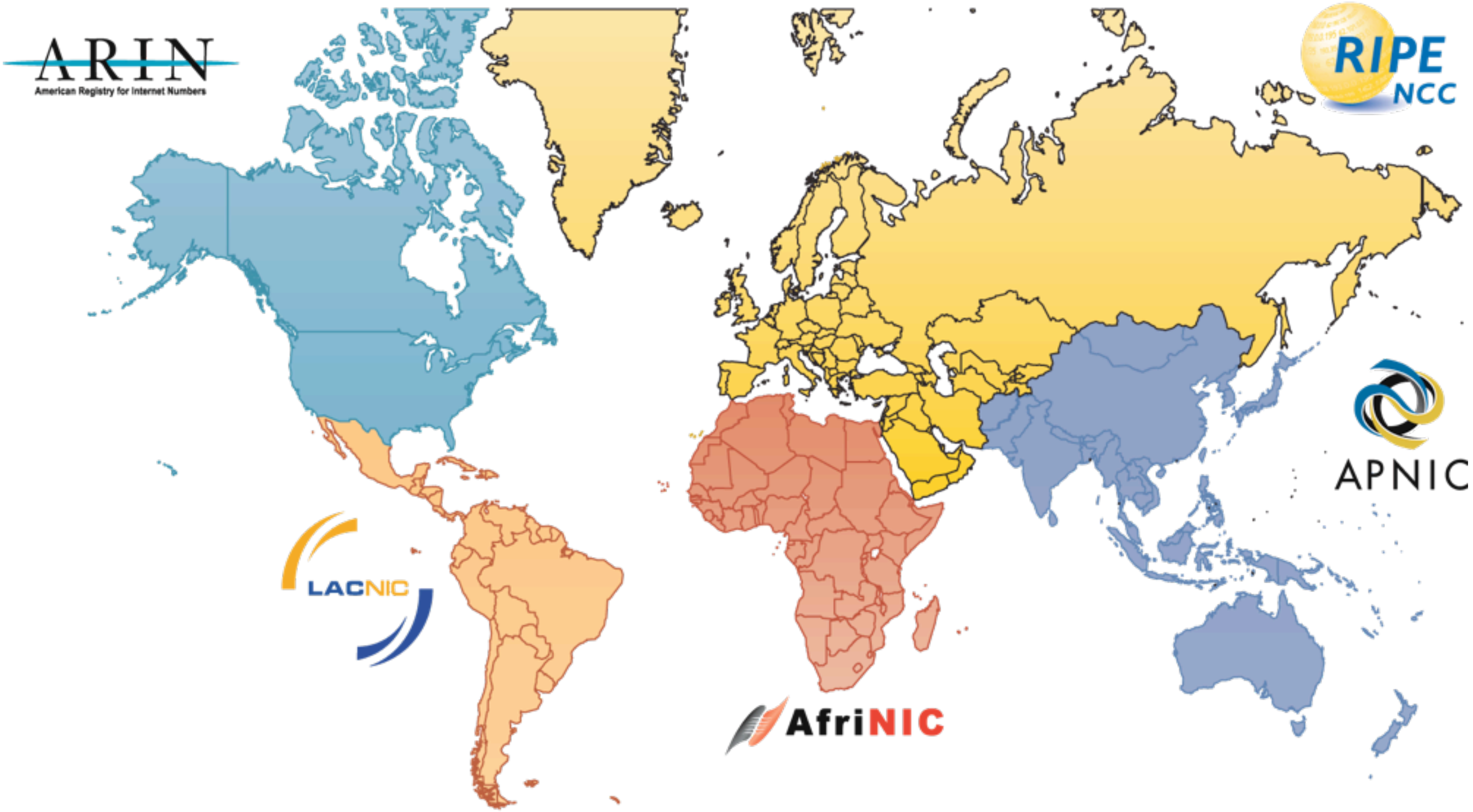
RIPE NCC

RIPE NCC

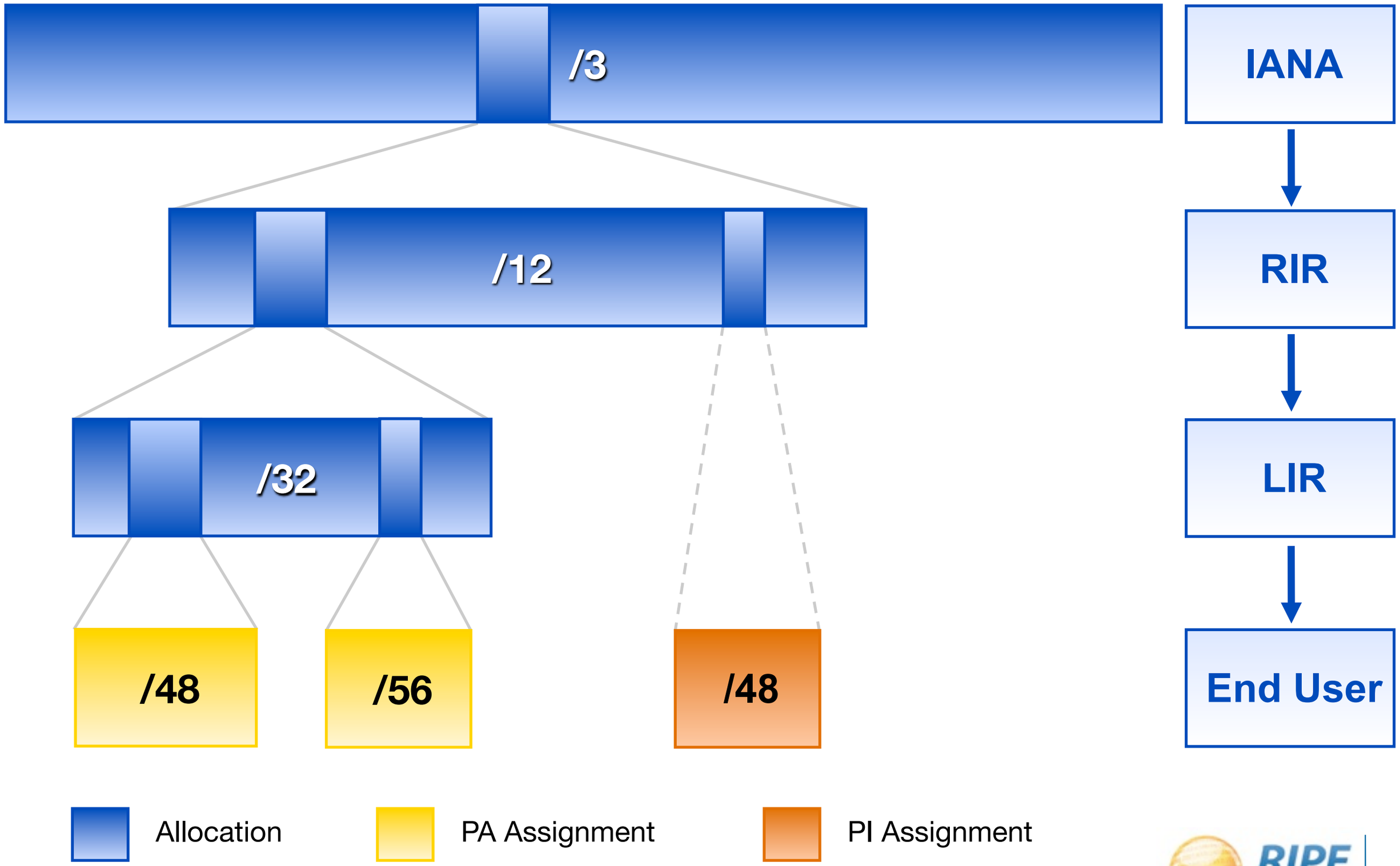
- One of the five Regional Internet Registries
- Support coordination of Internet operations
- Not for profit membership organisation
- Over 7000 active members
  - 650 new members in 2009

- Neutral, Impartial, Open, Transparent

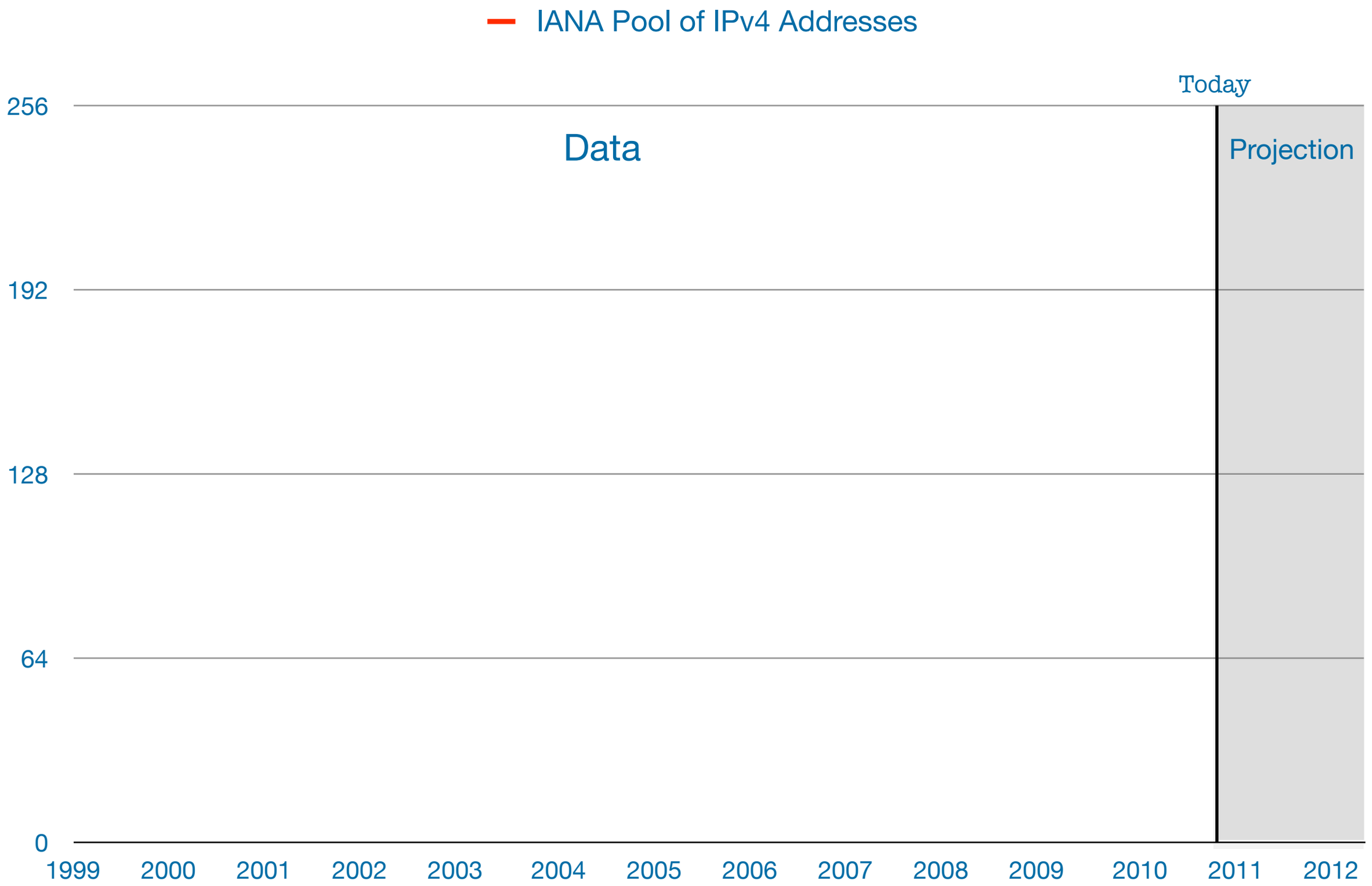
The 5 RIRs


ARIN
American Registry for Internet Numbers
RIPE NCC
APNIC
LACNIC
AfriNIC

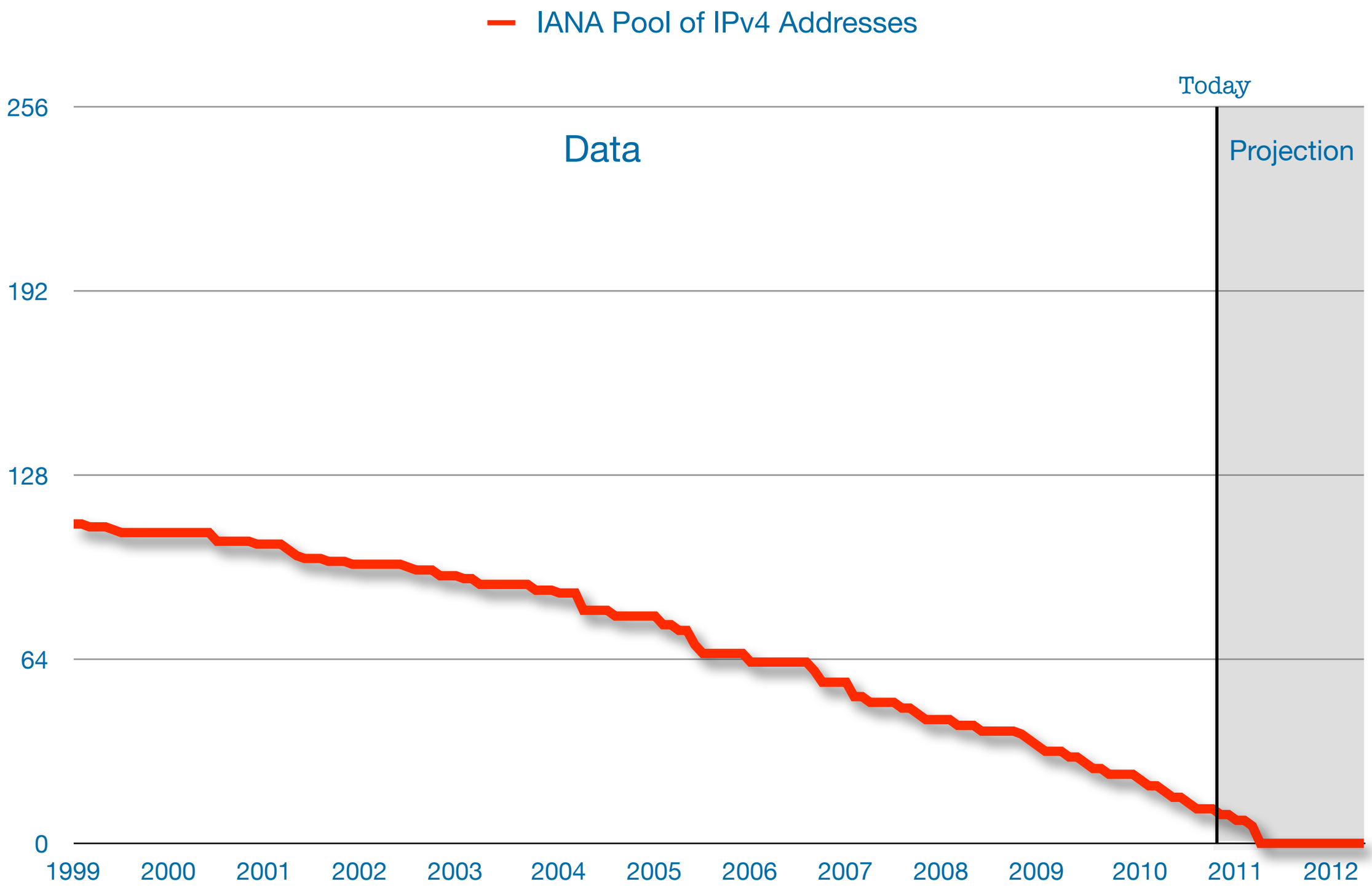
IP Address Distribution



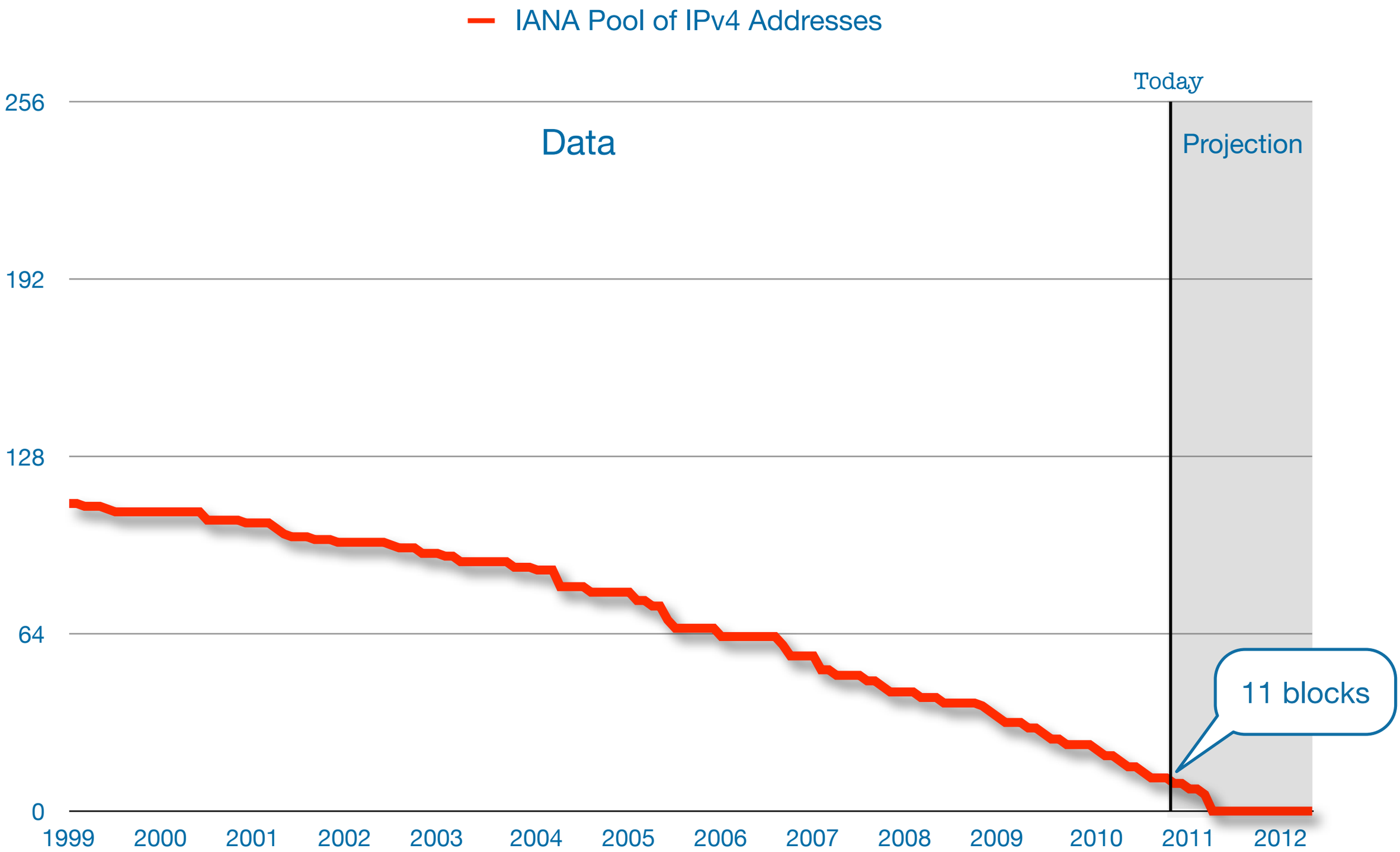
IPv4 Allocation Timeline



IPv4 Allocation Timeline

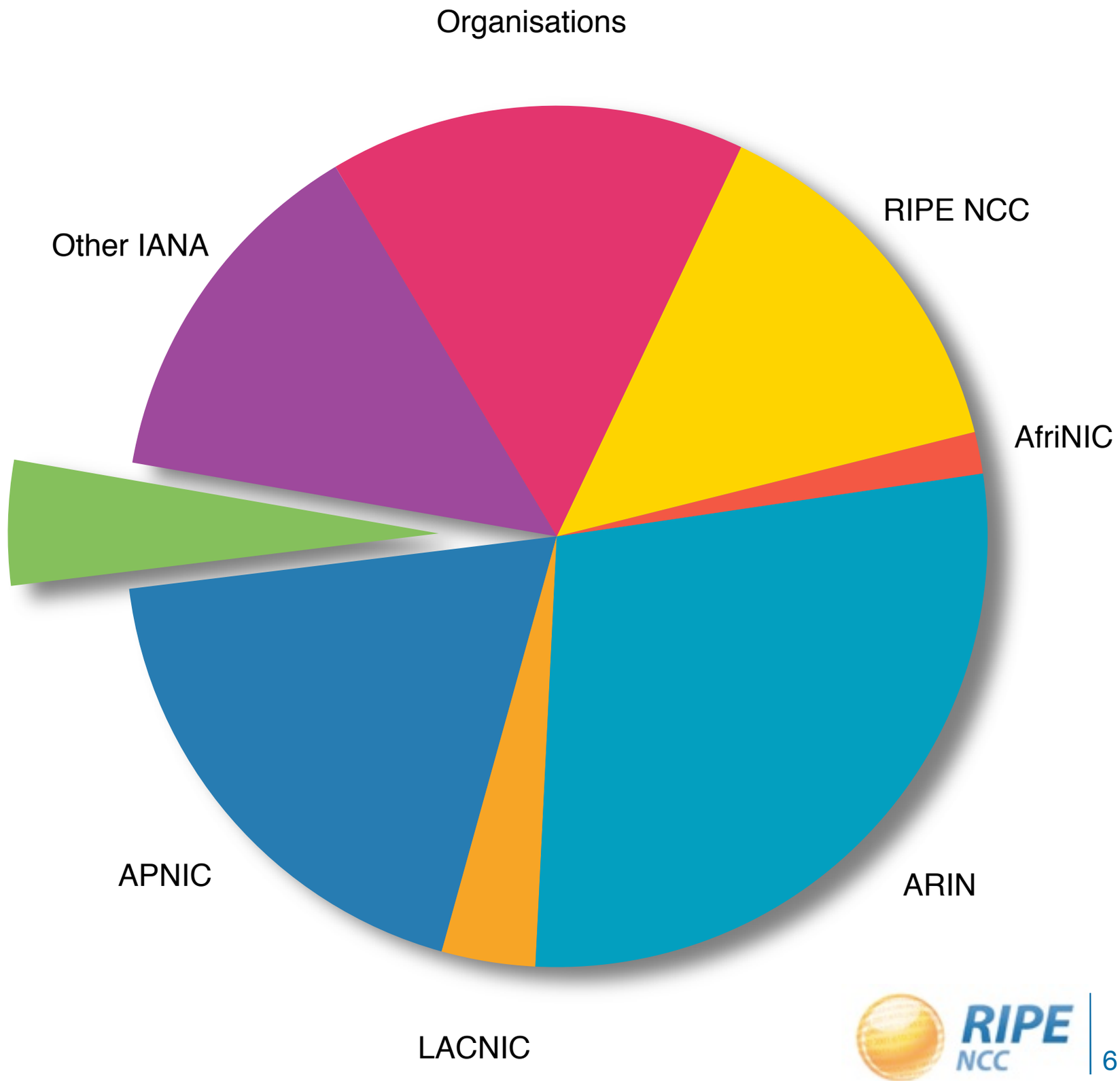


IPv4 Allocation Timeline



IPv4 Address Pool

4%
available



Reaching the next billion

- Around 1.9 billion Internet users now
  - five times as many as there were in the year 2000
  - around 29% of all people

- Mobile phones are becoming Internet devices

- The Internet of things

Wait and See?

Reduced Assignment Periods

- Used to be: 24 months
- January 2010: 12 months
- July 2010: 9 months
- January 2011: 6 months
- July 2011: 3 months

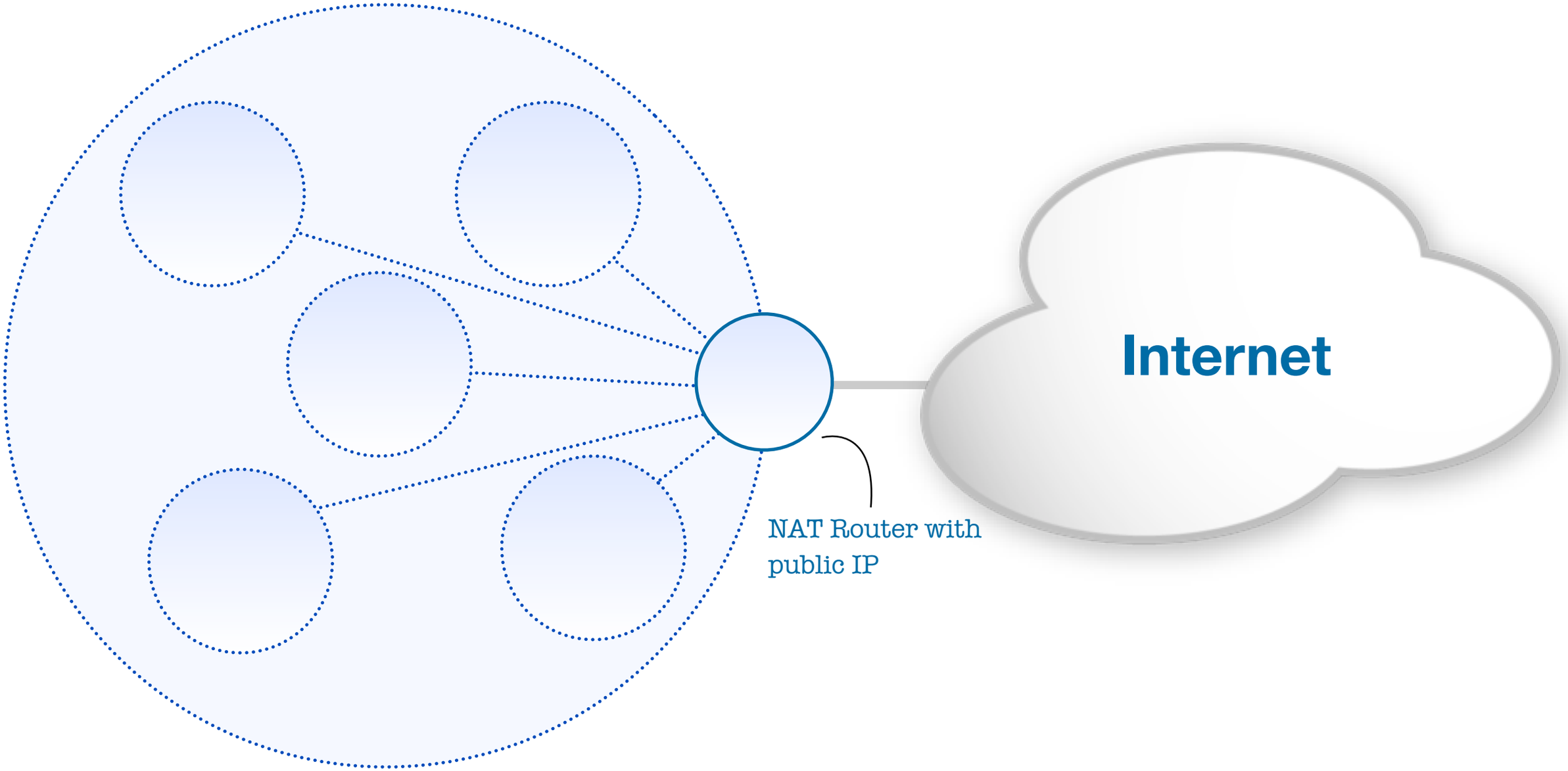
Hot IPv4 / IPv6 Policy Topics

- Ensuring efficient use of historical IPv4 Resources (2008-07)
  - On hold for now because there is no proposer

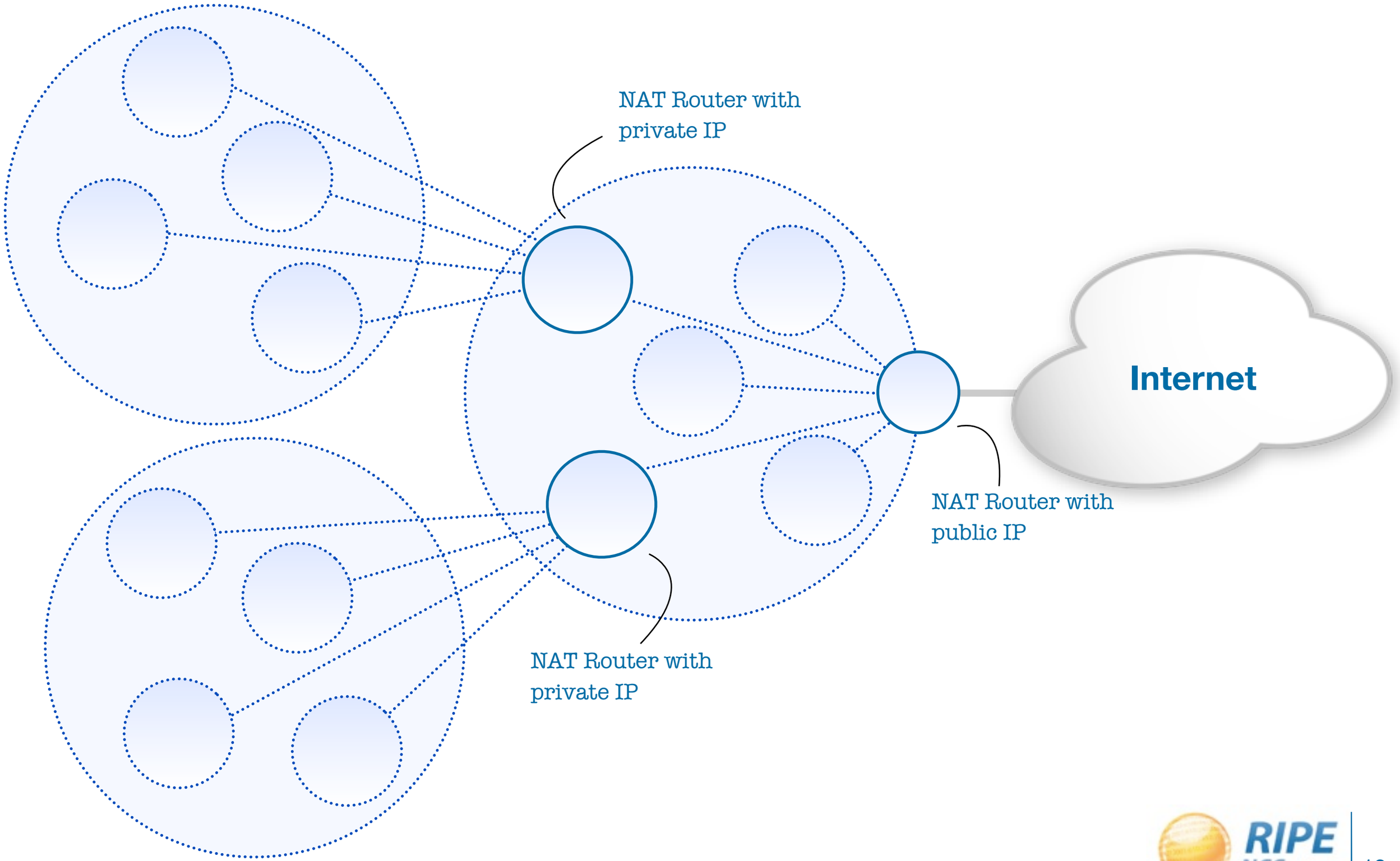
- Allocations from the last /8 (2010-02)
  - New and existing LIRs can receive only one /22 allocation
  - only if they already have IPv6 space!

Network Address Translation = Bad

Network Address Translation = Bad



NAT behind NAT = Worse



IPv6 Basics

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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

Address Notation

2001:0610:003E:EF11:0000:0000:C100:004D

2001:610:3E:EF11:0:0:C100:4D

Address Notation

2001:0610:003E:EF11:0000:0000:C100:004D

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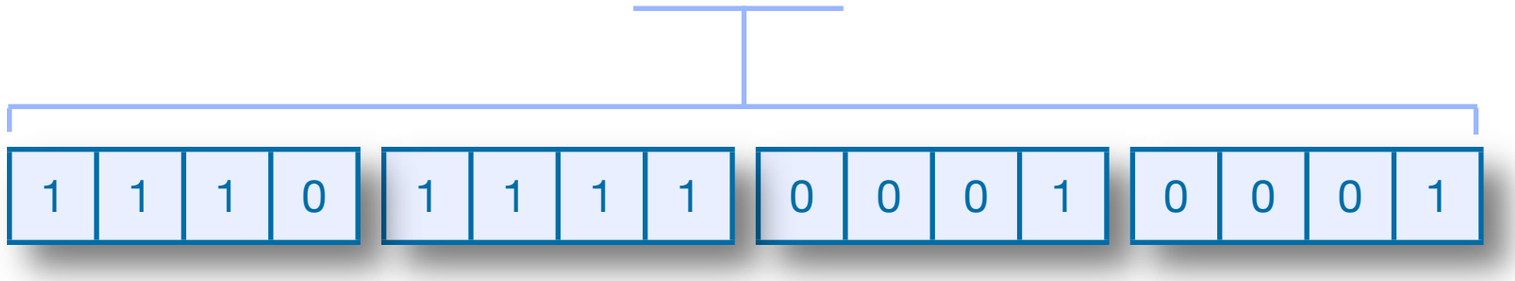
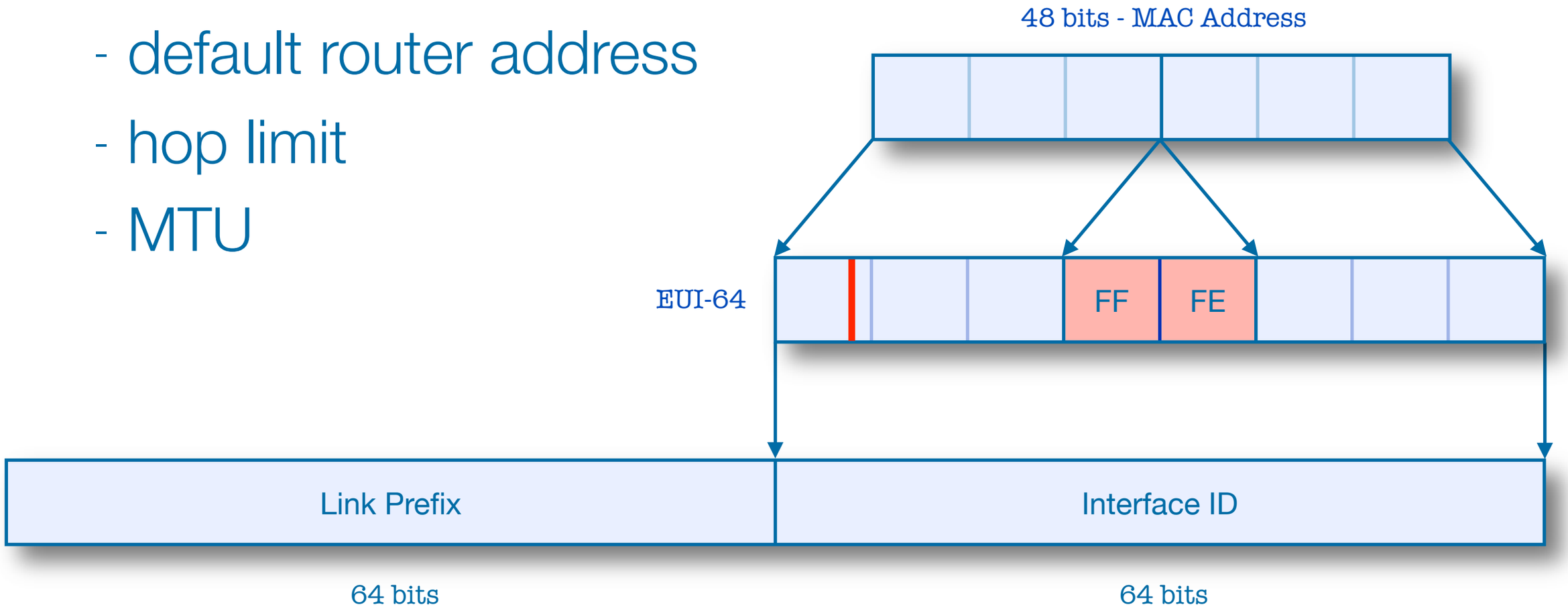


Multiple addresses

Addresses	Range	Scope
Loopback	::1	machine
Link Local	FE80::/10	link layer
Unique Local	FC00::/7	site
Global Unicast	2000::/3	global
6to4	2002::/16	global
Multicast	FF00::/8	variable

IPv6 Stateless Autoconfiguration

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



IPv6 Stateful Autoconfiguration

- 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

Training from scratch is needed?

- IPv4 skills translate well to IPv6 skills
- Concepts have not changed
  - more addresses
  - slightly different features in some parts

- Problems are more psychological than technical!

“96 More Bits, No Magic”

- Gaurab Upadhaya

Addressing Plan

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Addressing Plan

- Things to consider
  - administrative ease!
  - use assignments on 4 bit boundary

Addressing Plans

- Number of hosts is irrelevant
- Multiple /48s per pop can be used
  - seperate blocks for infrastructure and customers
  - document address needs for allocation criteria
- Use one /64 block per site for loopbacks
- /64 for all subnets
  - autoconfiguration works
  - renumbering easier
  - less typo errors because of simplicity

More On Addressing Plans

- For private networks, get ULA
- For servers you want manual config
- Use port numbers for addresses
  - pop server 2001:db8:1::110
  - dns server 2001:db8:1::53
  - etc...

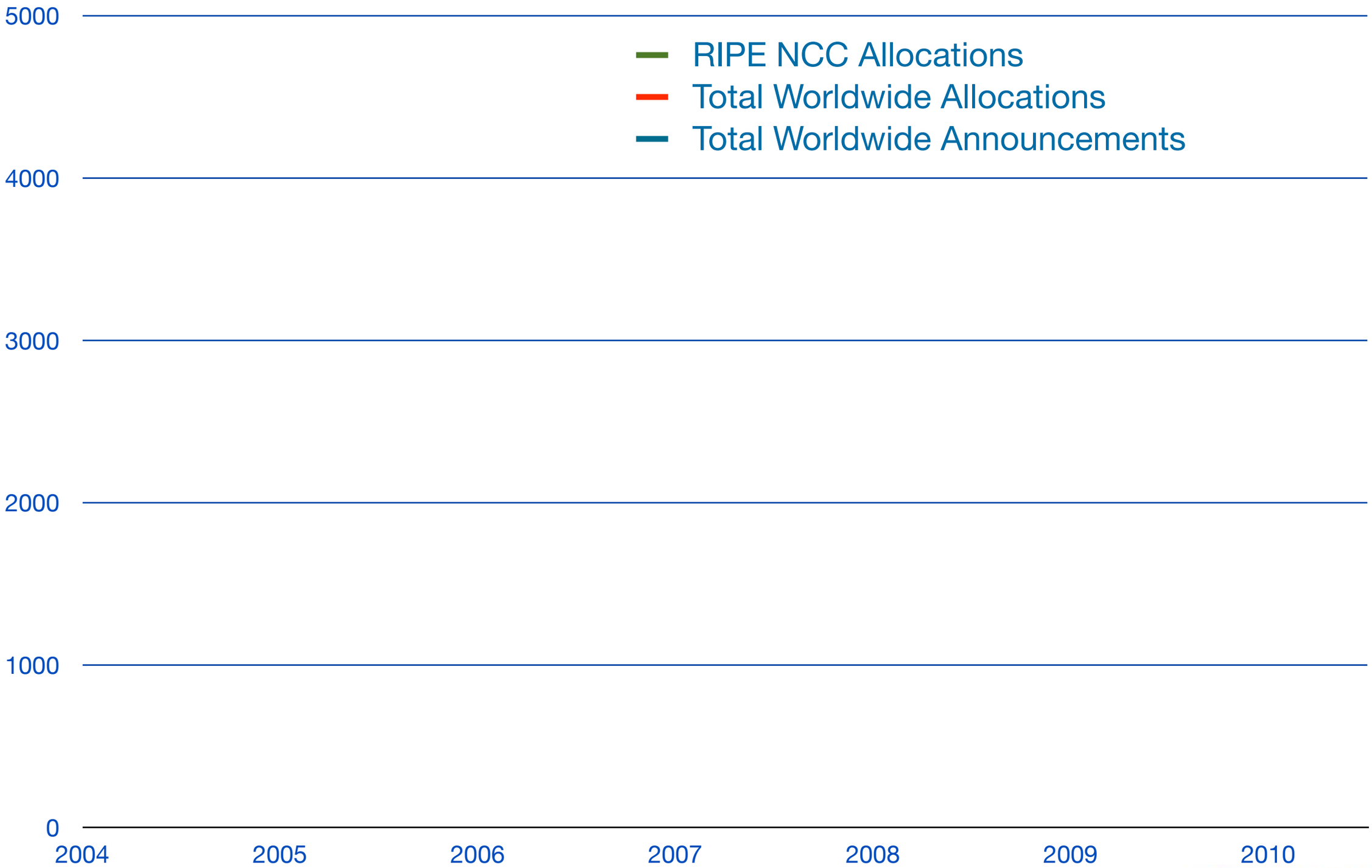
Getting it

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

IPv6 Allocations and Announcements



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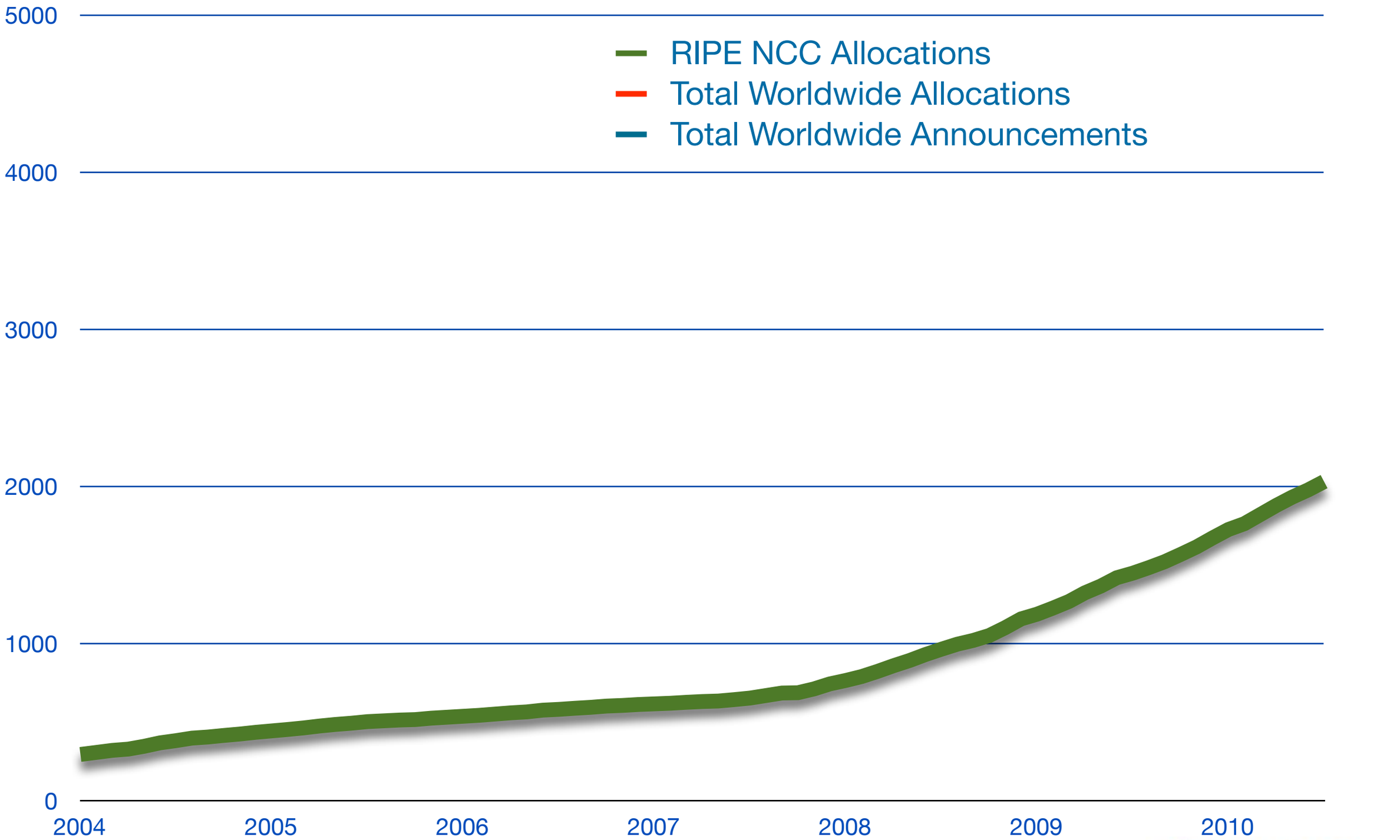

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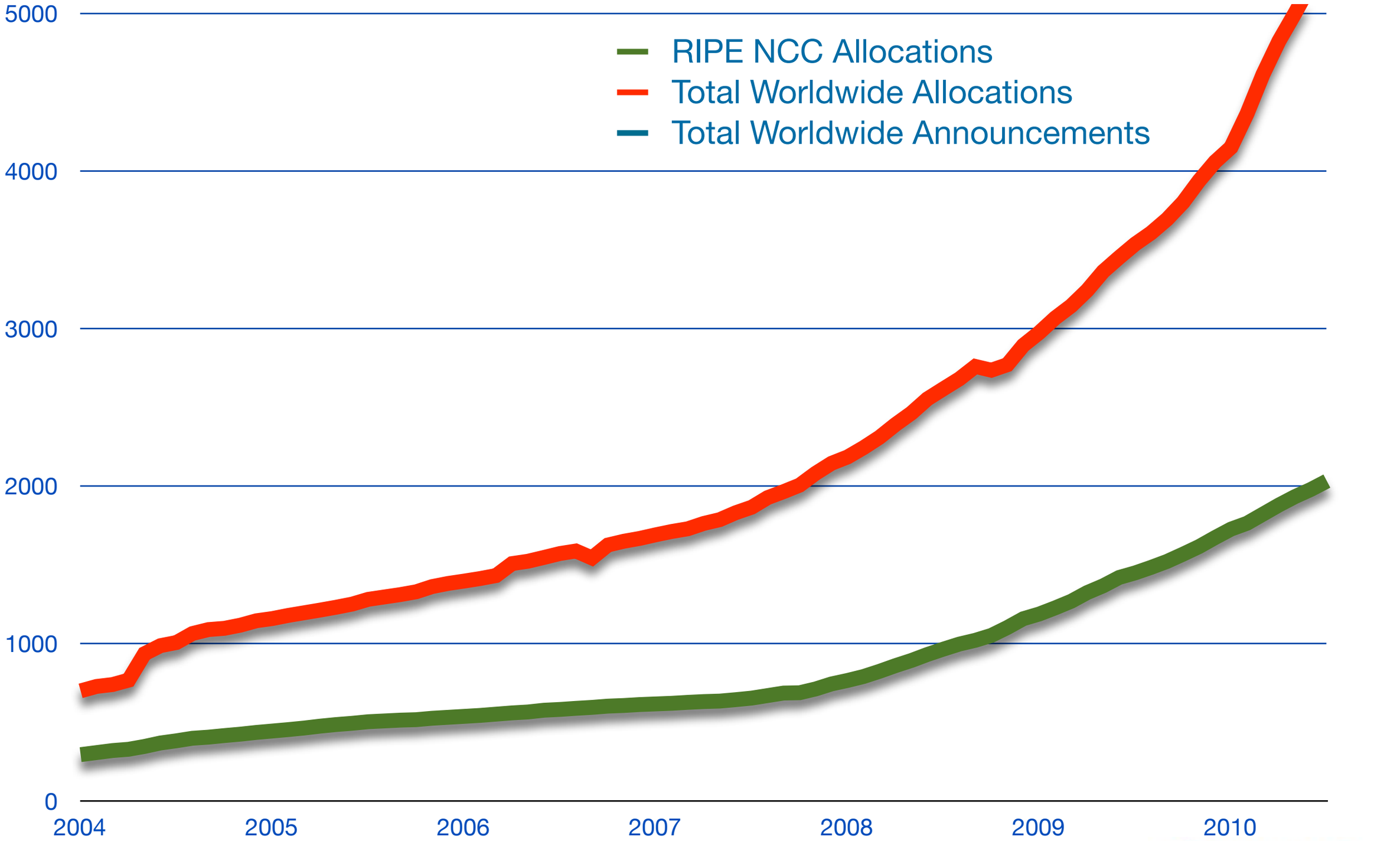

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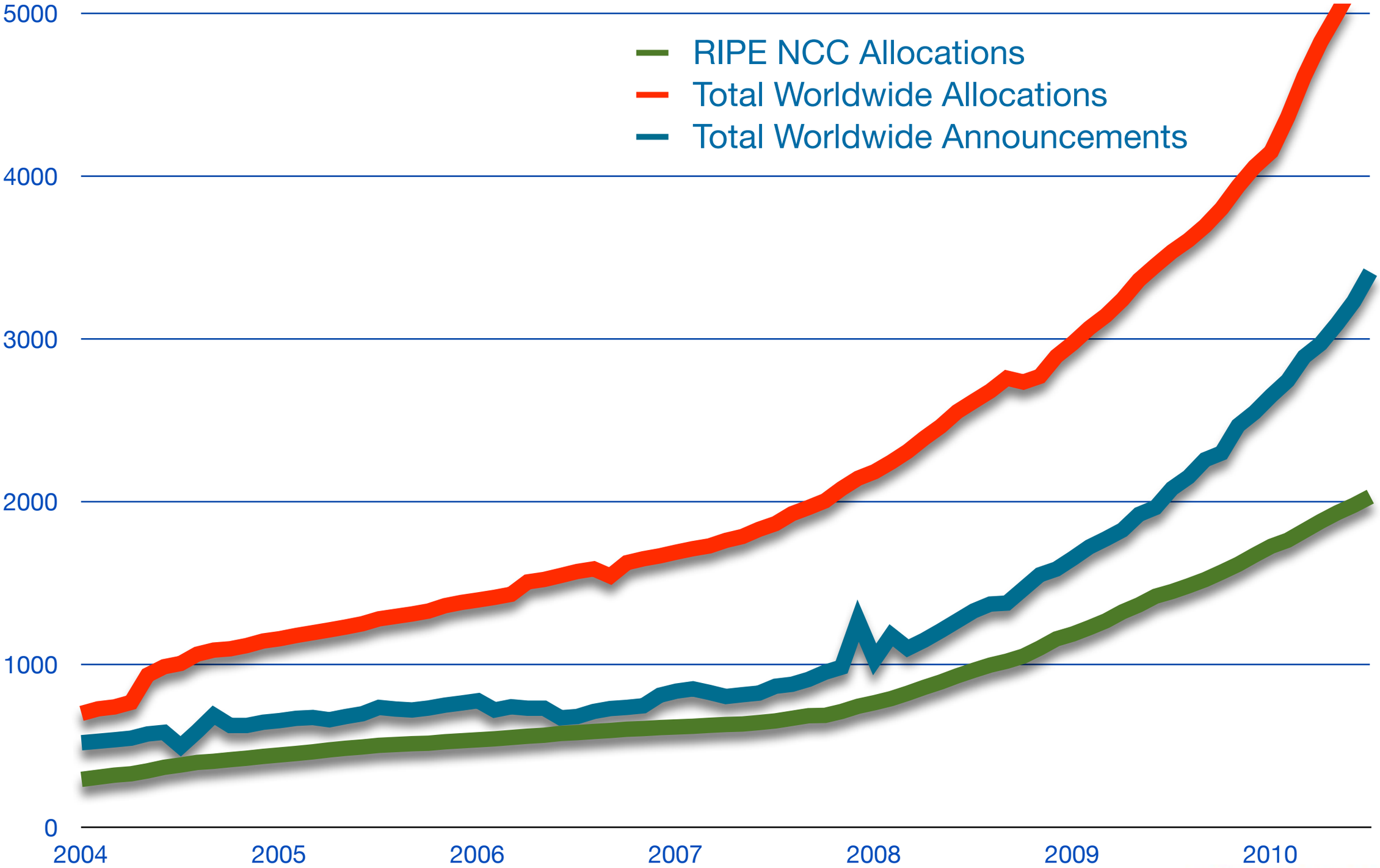
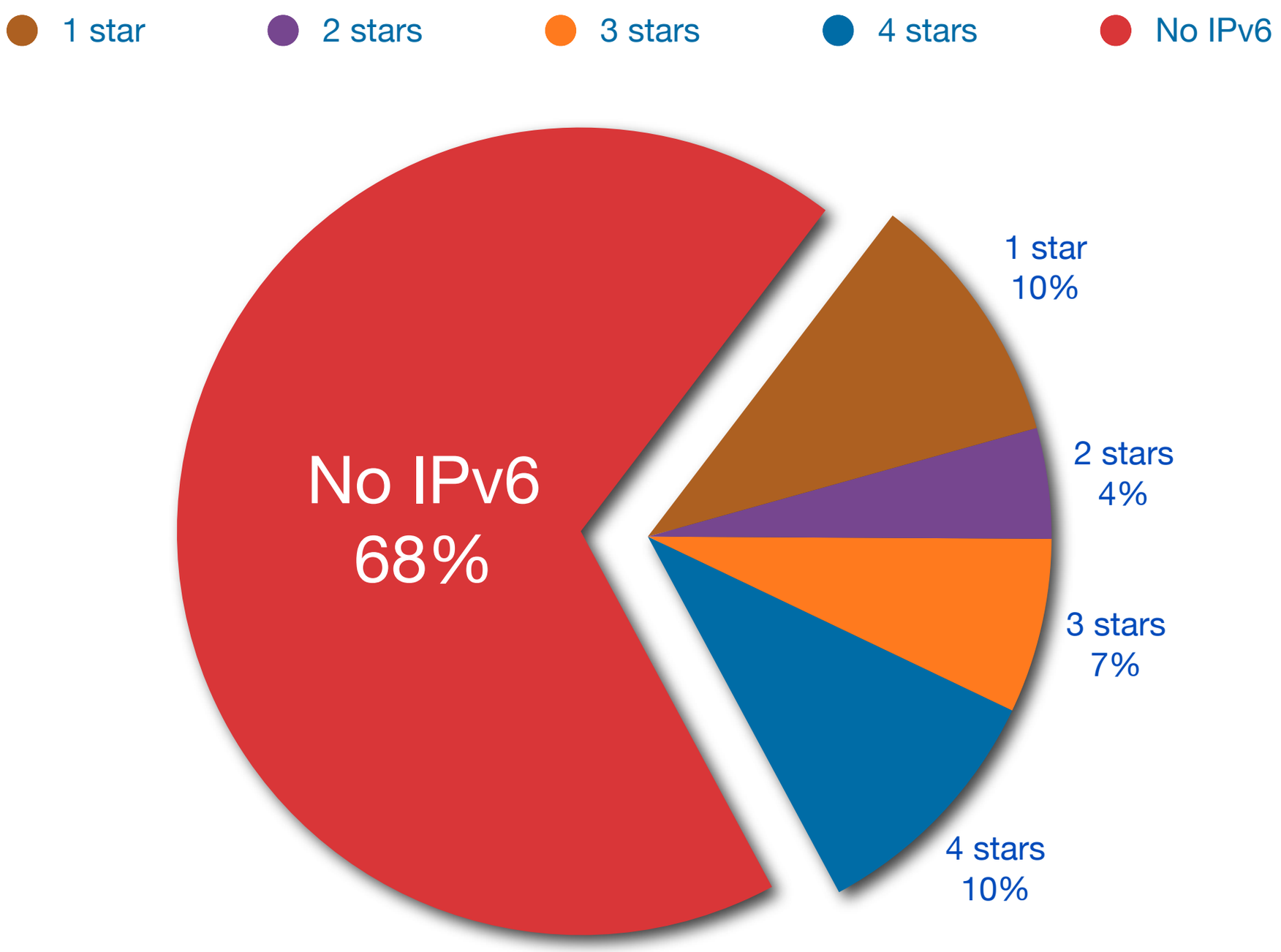


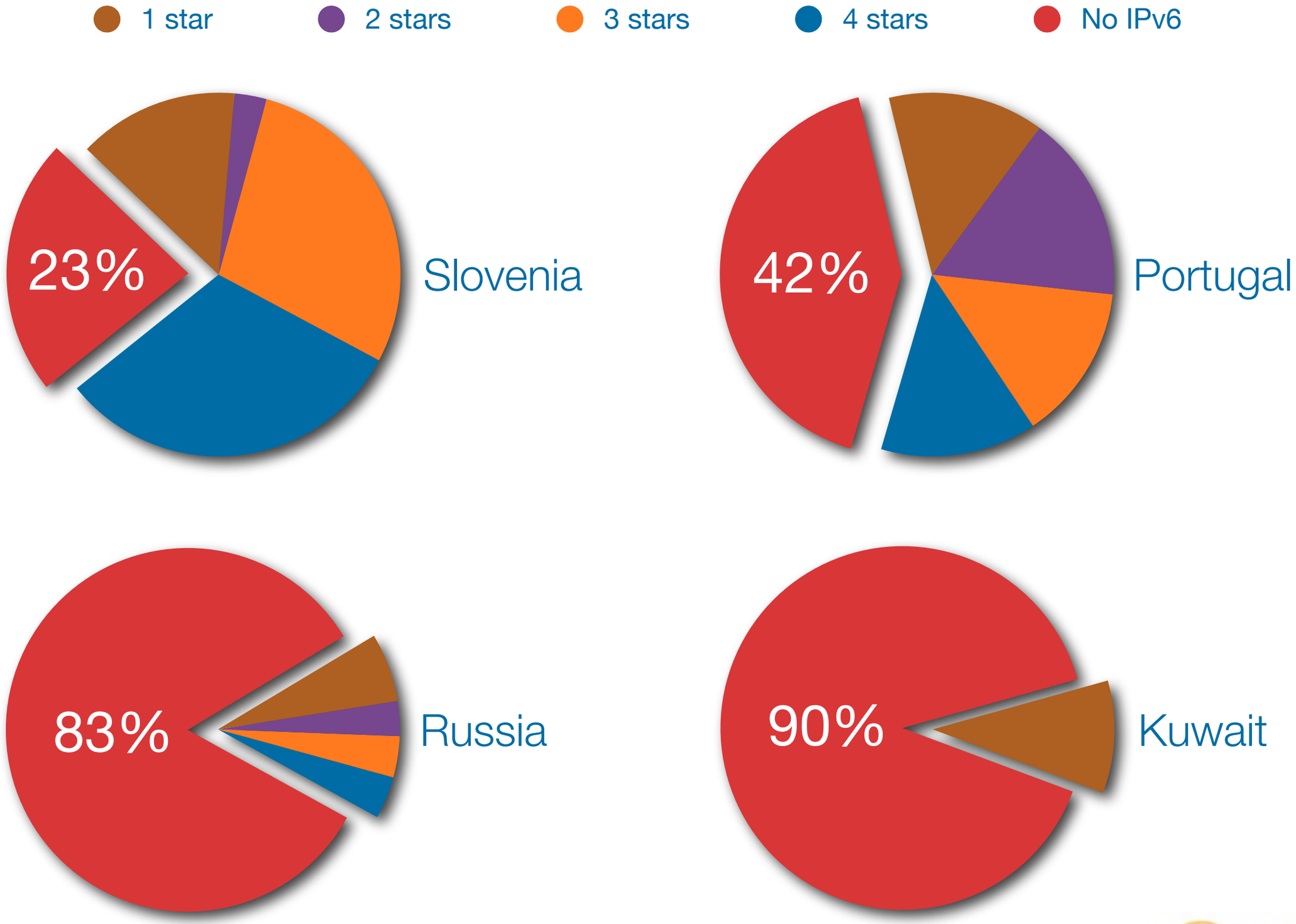
IPv6 Ripeness

- Rating system:
  - One star if the LIR has an IPv6 allocation
  - Additional stars if:
    - IPv6 Prefix is announced on router
    - A route6 object is in the RIPE Database
    - Reverse DNS is set up

IPv6 RIPEness – Total Membership



IPv6 RIPEness – Around The Region



Customer assignments

- Give your customers enough addresses
  - Up to a /48

- For more addresses, send in request form
  - Alternatively, make a sub-allocation

- Register sub-allocations in the RIPE DB
  - Put Assignments in a database accessible by the RIPE NCC

What does an IPv6 allocation cost?

- /32 = 1 scoring unit
- /31 = 2 scoring units
- points = ∑(2010-1992)x(scoring unit) =18x1+...

Category	Points	Fee 2010
Extra Small	0 - 16	€ 1300
Small	- 111	€ 1800
Medium	- 936	€ 2550
Large	- 7116	€ 4100
Extra Large	> 7116	€ 5500

What does an IPv6 allocation cost?

- /32 = 1 scoring unit
- /31 = 2 scoring units
- points = ∑(2010-1992)x1+(2010-1993)x1+(2010-1994)x1+(2010-1995)x1+(2010-1996)x1+(2010-1997)x1+(2010-1998)x1+...

gory	Fee
E	16
Sr	€ 1800
Me	- 936 € 2550
Large	- 7116 € 4100
Extra L	> 7116 € 5500

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

DNS in IPv6 is difficult?

- DNS is not IP layer dependent
- A record for IPv4
- AAAA record for IPv6
- Don't answer based on incoming protocol
- Only challenges are for translations
  - NAT64, proxies

Reverse DNS

2001:610:3E:EF11::C100:4D

Reverse DNS

2001: 610: 3E:EF11: :C100: 4D

Reverse DNS

2001:0610:003E:EF11:0000:0000:C100:004D

Reverse DNS

2001:0610:003E:EF11:0000:0000:C100:004D

0.1.6.0.1.0.0.2.ip6.arpa

Reverse DNS

2001:0610:003E:EF11:0000:0000:C100:004D

0.1.6.0.1.0.0.2.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

Reverse DNS

2001:0610:003E:EF11:0000:0000:C100:004D

0.1.6.0.1.0.0.2.ip6.arpa

d.4.0.0.0.0.1.c.0.0.0.0.0.0.0.0.0.0.1.1.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.0.0.0.0.0.0.0.0.0.0.1.1.f.e.e.3.0.0.0.1.6.0.1.0.0.2.ip6.arpa PTR yourname.domain.tld

IPv6 in the Routing Registry

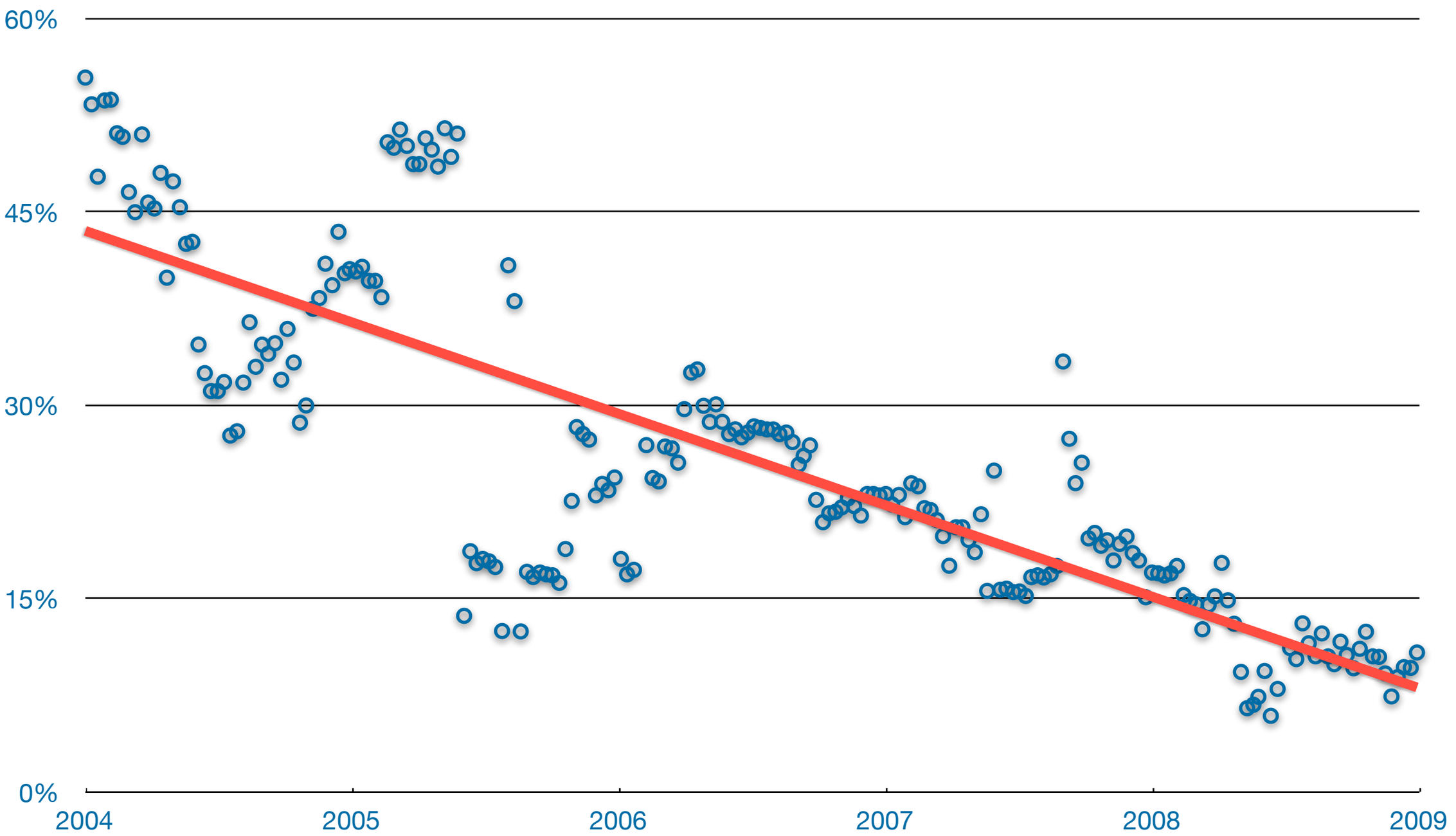
Route object:

```
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
```

IPv6 routing is tunnel hell?



Deploying

Scenario: Do Nothing

- No problems for next few years
- Some people won't be able to use your services
- No extra costs
  - until you hit the wall

- High costs for quick implementation
- Short planning times will mean some things go wrong

Scenario: Do It All Now!

- Hardware may have to be changed
- High investment in time and resources
- No direct return
- High costs for quick implementation
- Short planning times will mean some things go wrong

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

Change your face first

- Web
- Authoritative DNS
- Mail servers

- Outsiders see these services
- Multiple mature implementations exist

Don'ts

- Don't separate IPv6 features from IPv4

- Don't do everything in one go

- Don't appoint an IPv6 specialist
  - do you have an IPv4 specialist?

- Don't see IPv6 as a product
  - the Internet is the product

Do

- Phased approach
- Change requirements for new hardware
- Work outside-in, then inside-out
- Feature parity
- Dual stack
- Think about possible future renumbering

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!”

Follow us!

@TrainingRIPENCC

The End!

Край

Y Diwedd

Fí

Finis

النهاية

Соңы

Վերջ

Liðugt

Ende

Finvezh

Kінець

Konec

Kraj

Ënn

Fund

پایان

Son

Kpaj

Lõpp

Beigas

Vége

An Críoch

הסוף

Endir

Fine

Sfârşit

Fin

Τέλος

Einde

Конец

Slut

Slutt

დასასრული

Pabaiga

Tmiem

Koniec

Fim

Amaia

Loppu