The End of IPv4 Foretold

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About IPv4

- Main Internet protocol
- 32 bits encoded
- 2^{32} (4,294,967,296) unique addresses
- Regional management by five Regional Internet Registries (RIRs)
- Global management by Internet Assigned Numbers Authority (IANA)

About IPv4

Source: http://xkcd.com/195/

About IPv4

Source: http://xkcdsw.com/3327

About the RIPE NCC

Five Regional Internet Registries

About the RIPE NCC

- Dutch non-profit company
- Members (LIRs) are mainly the Internet Service Providers (ISPs)
- Region: Europe, Middle East, parts of Central Asia
- Regional registry for AS Numbers and IP addresses
- RIPE Database maintenance
- Other services: tools, training, statistics, meetings
- Bottom-up governance (RIPE community)

About RIPE

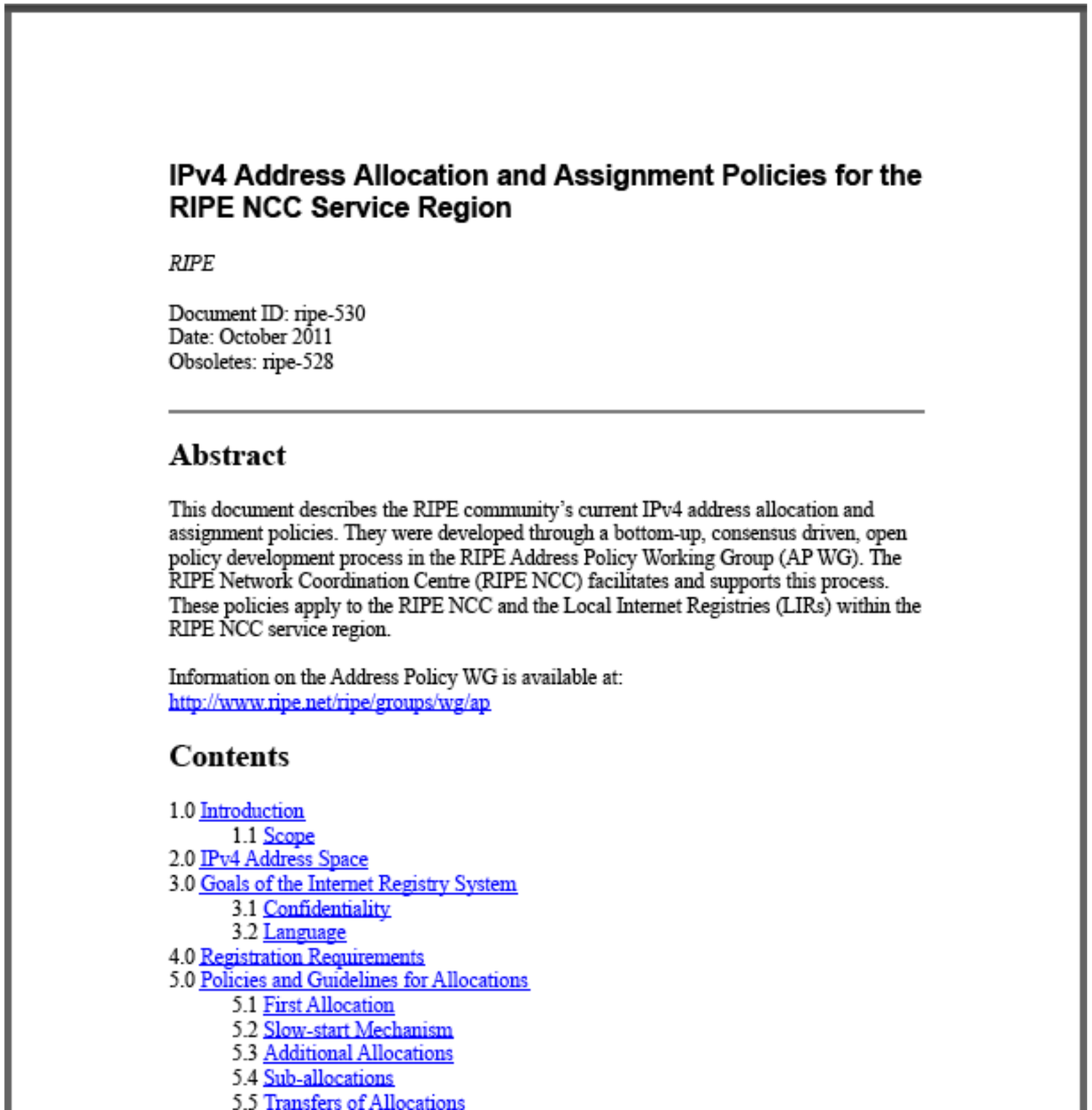
- Internet community at large
- Open to anyone interested, no structure
- Discussions on mailing lists and during RIPE Meetings
- Organised in Working Groups
- Decisions are taken by consensus
- The RIPE NCC implements decisions taken by RIPE

About RIPE: procedures

- Proposal
- Initial discussion
- Document writing
- Review
- Last call
- Consensus
- RIPE Document

More info: http://ripe.net/training/pdp

About RIPE: procedures



IPv4 Address Allocation and Assignment Policies for the RIPE NCC Service Region

RIPE

Document ID: ripe-530
Date: October 2011
Obsoletes: ripe-528

Abstract

This document describes the RIPE community's current IPv4 address allocation and assignment policies. They were developed through a bottom-up, consensus driven, open policy development process in the RIPE Address Policy Working Group (AP WG). The RIPE Network Coordination Centre (RIPE NCC) facilitates and supports this process. These policies apply to the RIPE NCC and the Local Internet Registries (LIRs) within the RIPE NCC service region.

Information on the Address Policy WG is available at:
http://www.ripe.net/ripe/groups/wg/ap

Contents

Source:
http://ripe.net/ripe/docs/ripe-530

The end of IPv4

- The end of IPv4 isn't easy to predict
- Internet growth fluctuates
- Resources attribution rate changes
- Users' reaction is unpredictable
  - Panic, rationing, hoarding...
- Procedures evolve

The end of IPv4

- The end of IPv4 isn't easy to predict
- Internet growth fluctuates
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  - Panic, rationing, hoarding...
- Procedures evolve

The end of IPv4

- 3 February 2011
- IANA's reserve was exhausted
- RIRs still have reserves
- IPv4 is still widely used

- This is not yet the end

The end of IPv4

- 3 policies aimed to be tied up with the end of IPv4
  - 3 accepted proposals
  - 3 RIPE policies
  - 3 phases of IPv4 exhaustion

The end of IPv4

- 3 policies aimed to be tied up with the end of IPv4
  - 3 accepted proposals
  - 3 RIPE policies
  - 3 phases of IPv4 exhaustion

- Global fairness (2008-03)
- Regional care (2009-03)
- Rationing (2010-02)

The end of IPv4, Global fairness (2008-03)

Name	Status	Proposal Number	Working Group	Date Archived
Global Policy for the Allocation of the Remaining IPv4 Address Space	ACCEPTED	2008-03	Address Policy	September 2008

Summary: This policy describes the process for the allocation of the remaining IPv4 space from IANA to the RIRs. When a minimum amount of available space is reached, one /8 will be allocated from IANA to each RIR, replacing the current IPv4 allocation policy.

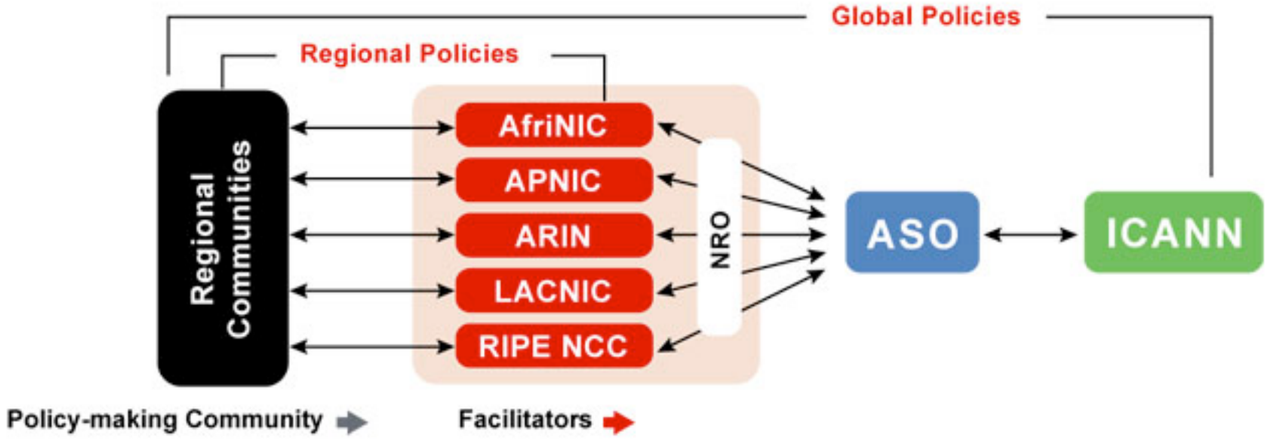
- Global Policy (all RIRs are concerned)
- IANA IPv4 allocations to the RIRs
- One of the last five /8s for each of the five RIRs

– Regions with strong growth would have enough resources to implement IPv6

– Regions with lower growth will have more time to implement IPv6

The end of IPv4, Global fairness (2008-03)

- Global policy
  - 5 regional policies
  - Same text
  - Accepted in 5 regions
  - Submitted to ICANN



Source: http://nro.net/policies/global-policies-development-process

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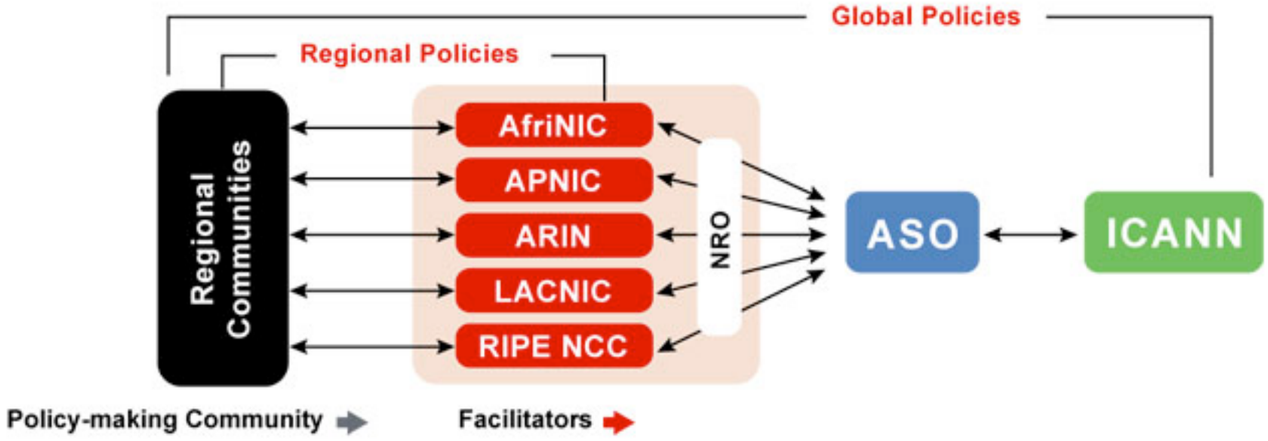


Source: http://nro.net/policies/global-policies-development-process

ripe-436

AFPUB-2009-v4-001

ARIN nrpm 10.4

apnic-086

LACNIC Policy Manual 9.2

The end of IPv4, Global fairness (2008-03)

2011
3
FÉVRIER

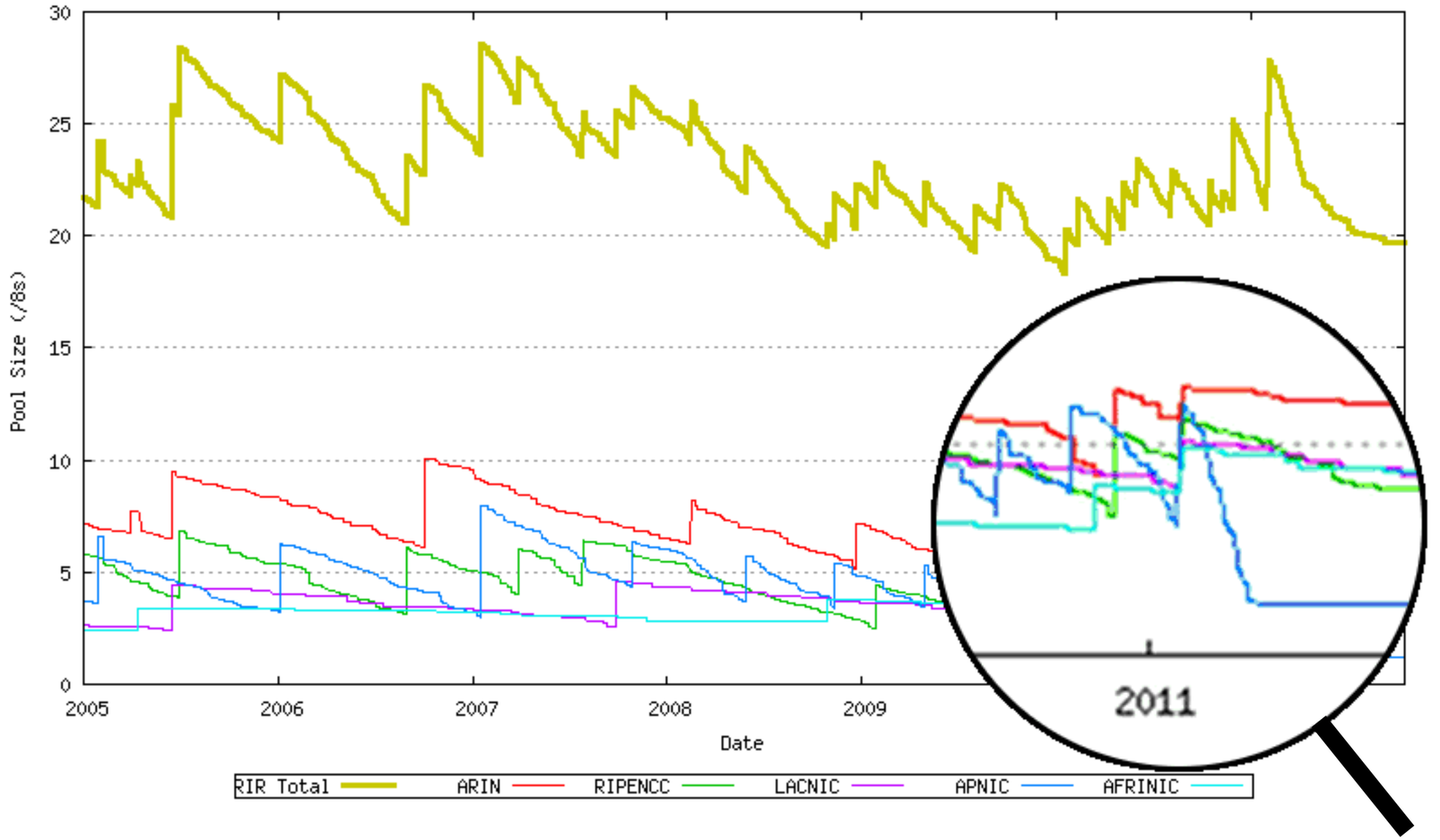
The end of IPv4, Global fairness (2008-03)

RIR Address Pool Size

Source:
http://www.potaroo.net/tools/ipv4/

The end of IPv4, Global fairness (2008-03)

RIR Address Pool Size



Source:
http://www.potaroo.net/tools/ipv4/

The end of IPv4, Regional care (2009-03)

Name	Status	Proposal Number	Working Group	Date Archived
Run Out Fairly	ACCEPTED	2009-03	Address Policy	December 2009

Summary: This is a proposal to gradually reduce the allocation and assignment periods in step with the expected life time of the IPv4 unallocated pool in order to address the perception of unfairness once the pool has run out. The proposal is not intended to stretch the lifetime of the unallocated pool. The proposal is independent of other proposals to reserve address space for transition purposes and/or new entrants. It can be implemented independently of these.

- Regional policy (only in RIPE NCC service region)
- RIPE NCC IPv4 allocations to LIRs
- Reduction of LIRs' allocation period

The end of IPv4, Regional care (2009-03)

5.0 Policies and Guidelines for Allocations

An allocation is a block of IPv4 addresses from which assignments are taken.

The RIPE NCC allocates enough address space to LIRs to meet their needs for a period of up to 12 months.

Starting on 1 July 2010, a gradual reduction in the allocation period will be applied as follows:

As of 1 July 2010, the RIPE NCC will start allocating enough address space to LIRs to meet their needs for a period of up to nine months.

As of 1 January 2011, the RIPE NCC will start allocating enough address space to LIRs to meet their needs for a period of up to six months.

As of 1 July 2011, the RIPE NCC will start allocating enough address space to LIRs to meet their needs for a period of up to three months.

All LIRs receiving address space from the RIPE NCC must adopt a set of policies that are consistent with the policies formulated by the RIPE community and described in this document.

« Run out fairly »

Trying to reduce impression of unfairness with the last allocations

July 2010 = 9 months

January 2011 = 6 months

July 2011 = 3 months

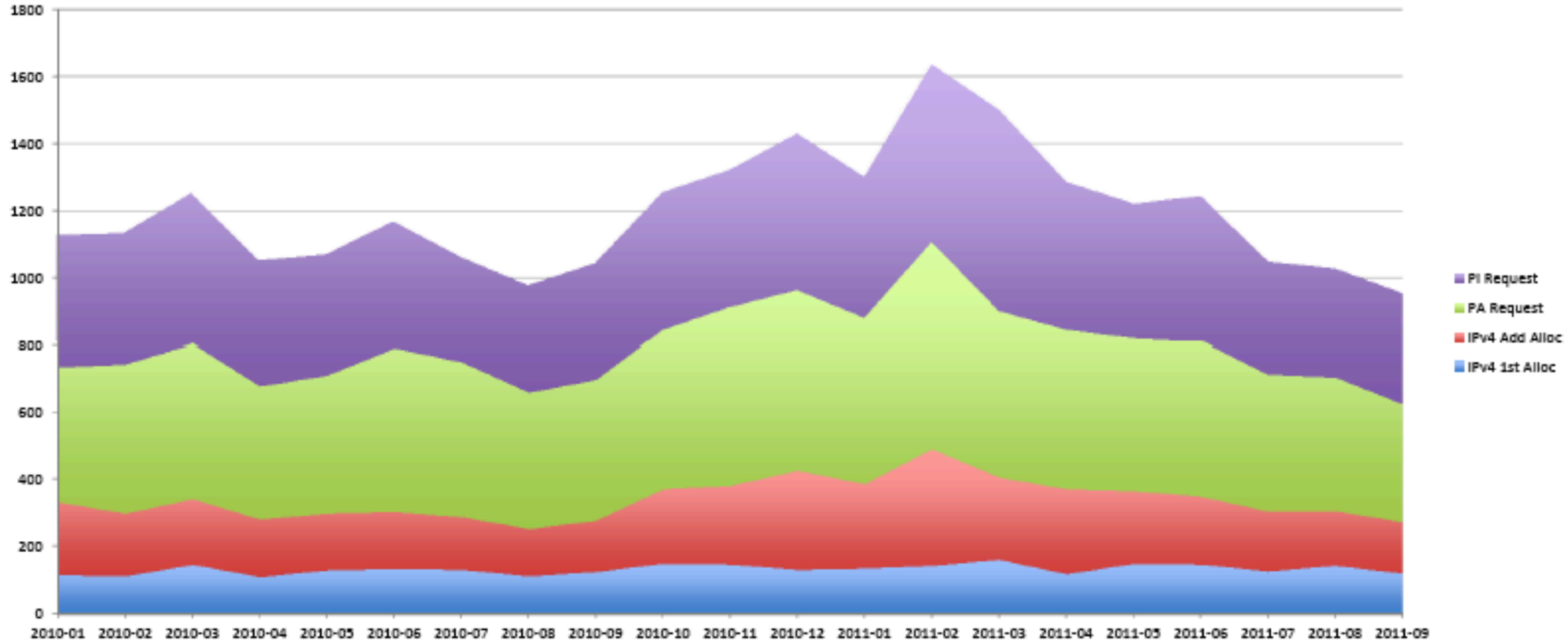
Source:
http://ripe.net/ripe/docs/ripe-530

The end of IPv4, Regional care (2009-03)

- It's too early to know if « Run out fairly » was efficient
  - IPv4 still left in RIPE NCC pool
  - All LIRs are still served according to their needs
  - but...
- APNIC reached its last /8
  - In this region, LIRs are not served according to their needs
  - No unfairness sentiment in the Asia-Pacific region

The end of IPv4, Regional care (2009-03)

IPv4 tickets managed by the RIPE NCC



The end of IPv4, Regional care (2009-03)

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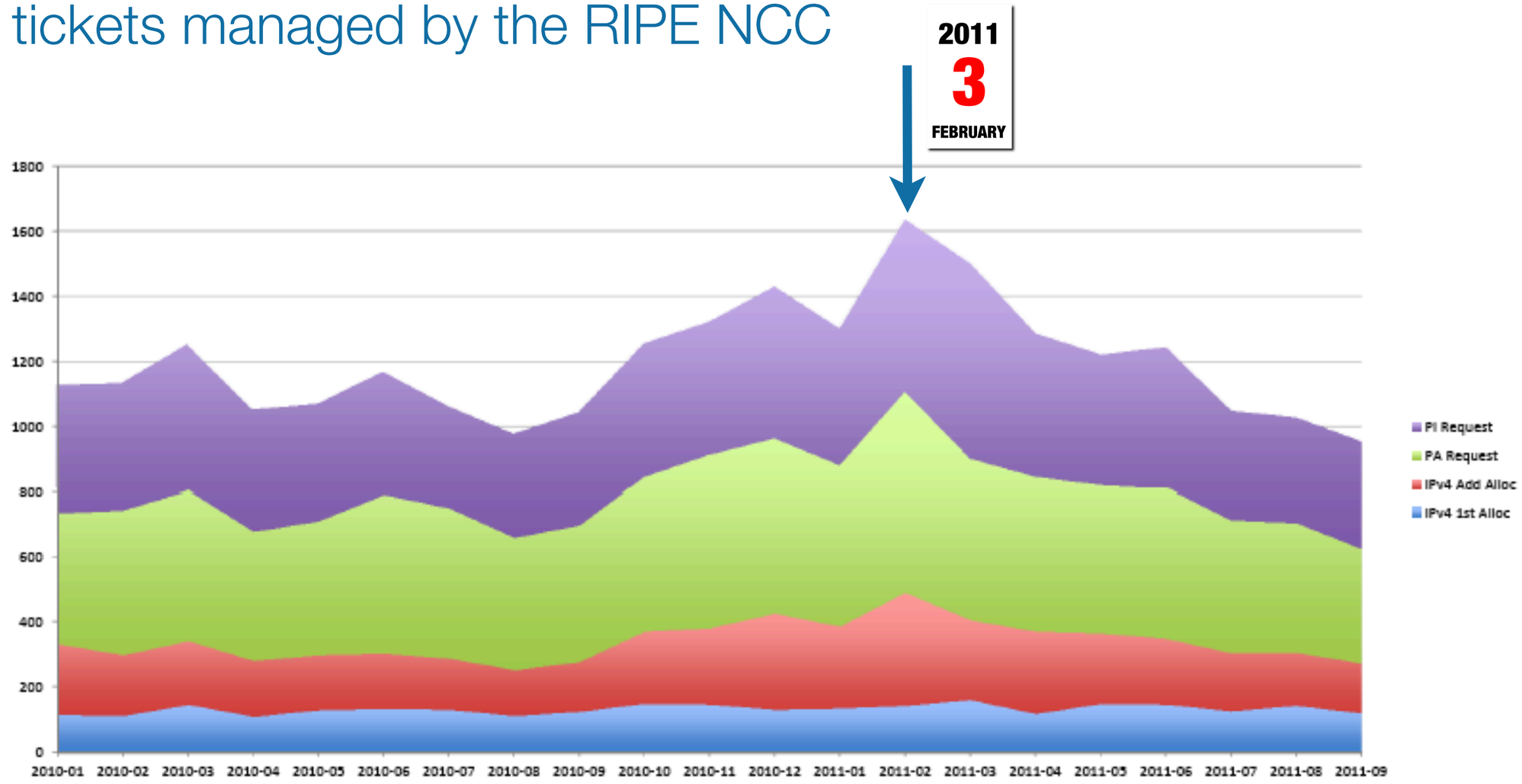

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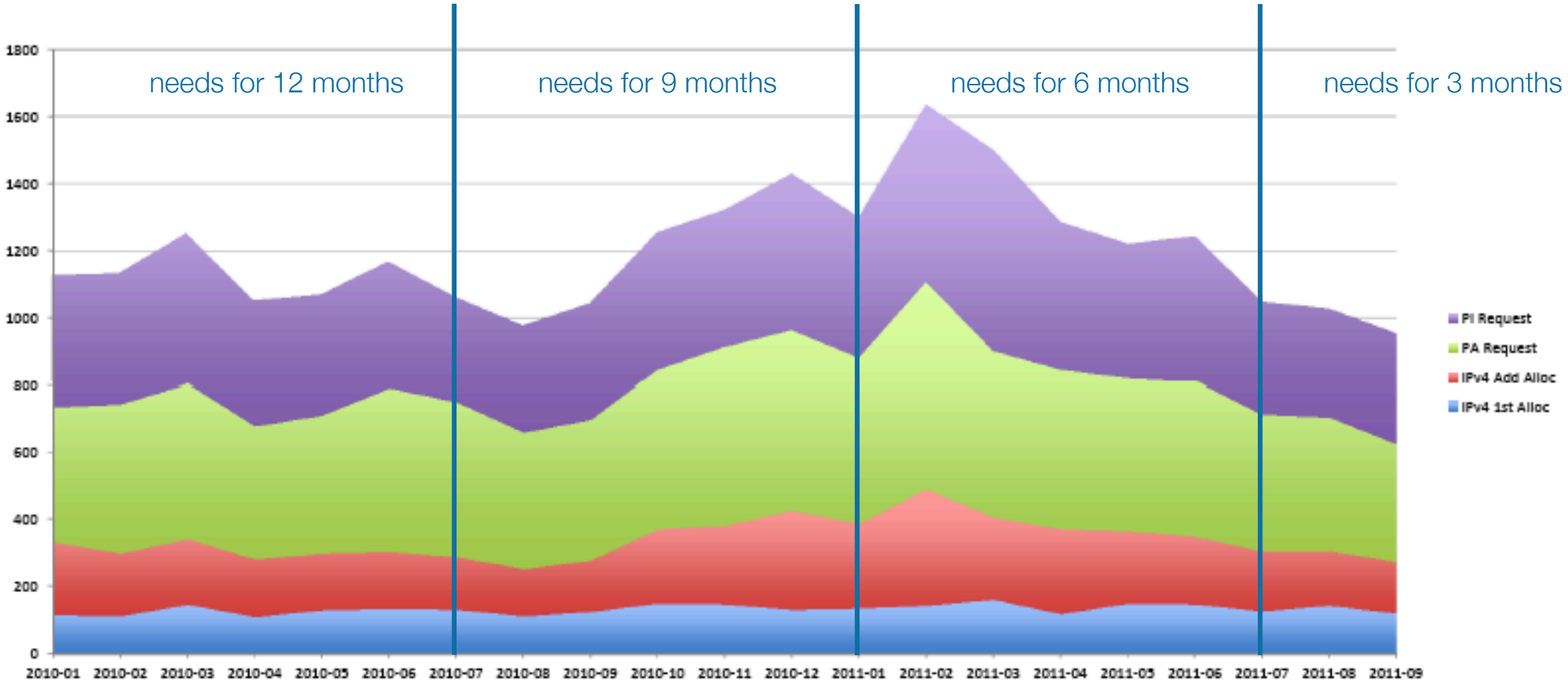

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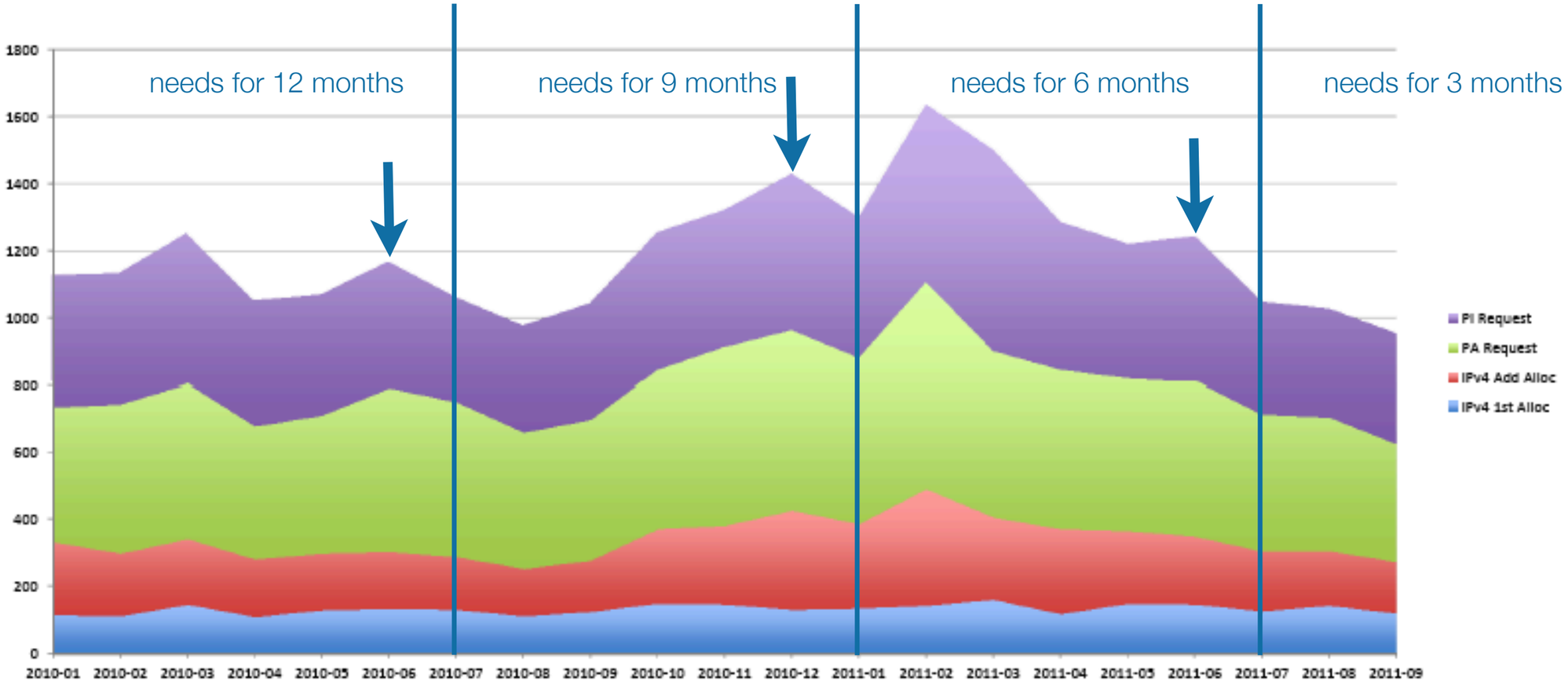

The end of IPv4, Regional care (2009-03)

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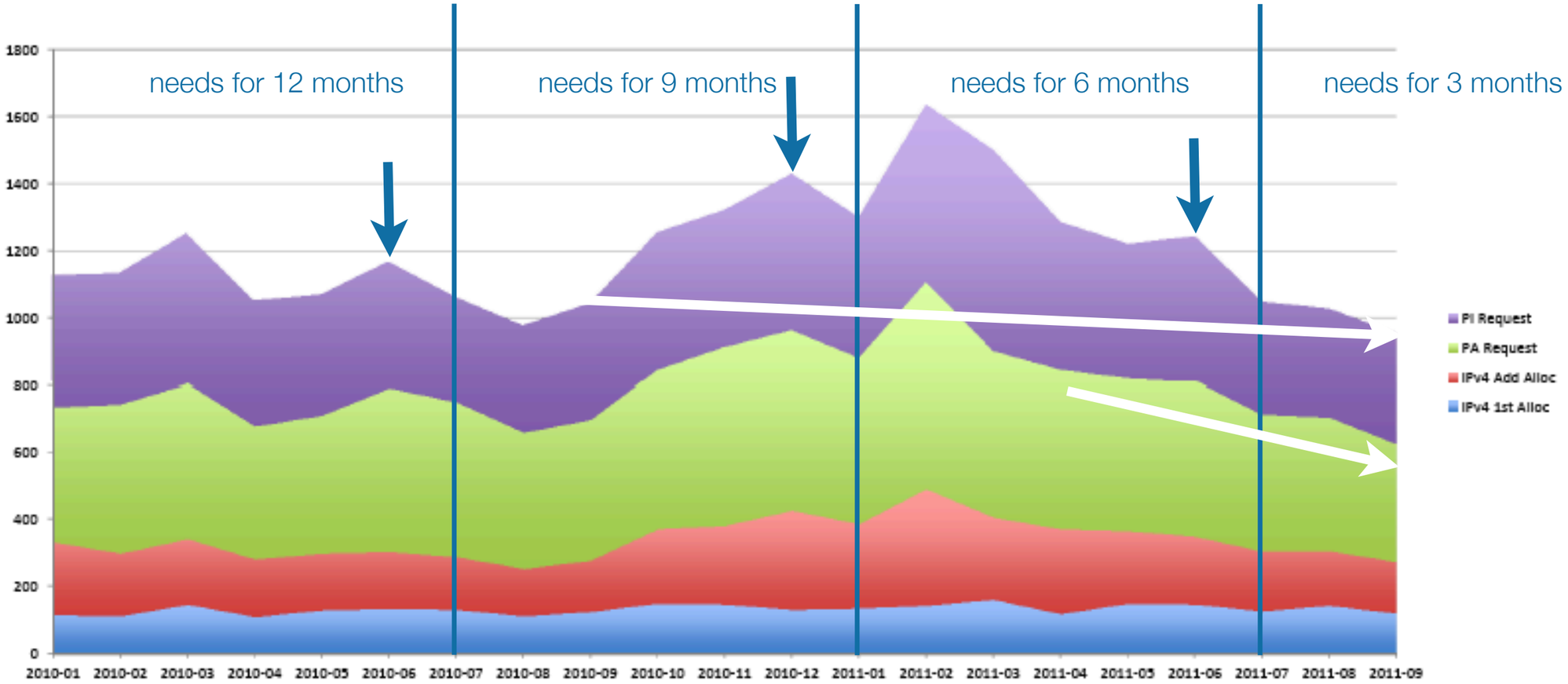
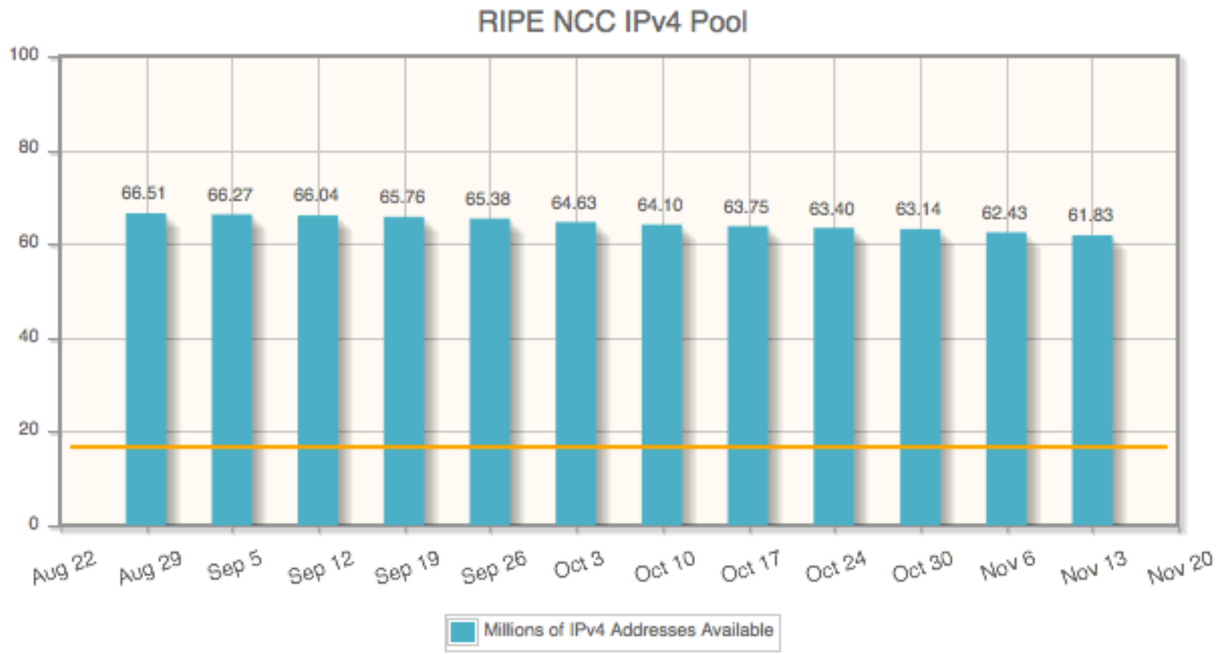


The end of IPv4, Regional care (2009-03)

RIPE NCC IPv4 pool



The end of IPv4, rationing (2010-02)

Name	Status	Proposal Number	Working Group	Date Archived
Allocations from the last /8	ACCEPTED	2010-02	Address Policy	January 2011
Summary: This proposal described how the RIPE NCC should distribute address space from its last /8 worth of IPv4 address space.				

- Regional policy (also policy in another region)
- Implemented for /8 of the pool
- LIRs will only receive one /22 once
- LIRs must deploy IPv6

The end of IPv4, rationing (2010-02)

5.6 Use of last /8 for PA Allocations

The following policies come into effect as soon as RIPE NCC is required to make allocations from the final /8 it receives from the IANA. From then on the distribution of IPv4 address space will only be done as follows:

1. Allocations for LIRs from the last /8

   On application for IPv4 resources LIRs will receive IPv4 addresses according to the following:

   a. LIRs may only receive one allocation from this /8. The size of the allocation made under this policy will be exactly one /22.
   b. LIRs receive only one /22, even if their needs justify a larger allocation.
   c. LIRs may apply for and receive this allocation once they meet the criteria to receive IPv4 address space according to the allocation policy in effect in the RIPE NCC service region at the time of application.
   d. Allocations will only be made to LIRs if they have already received an IPv6 allocation from an upstream LIR or the RIPE NCC.

2. Unforeseen circumstances

   a. A /16 will be held in reserve for some future uses, as yet unforeseen. The Internet is a disruptive technology and we cannot predict what might happen. Therefore it is prudent to keep a /16 in reserve, just in case some future requirement makes a demand of it. In the event that this /16 remains unused at the time the remaining /8 covered by this policy has been distributed, it returns to the pool to be distributed as per clause 1.

Last /8 Policy

When the RIPE NCC reaches the last /8 of its pool, every LIR will only be able to get one /22 on the condition it already has an IPv6 allocation

On top of this, the RIPE NCC keeps one /16 just in case.

Source:
http://ripe.net/ripe/docs/ripe-530

The end of IPv4, rationing (2010-02)

- Very constraining policy for LIRs
  - for many of them, resources are already exhausted
- Small benefit for the community
  - LIRs with little need can still get what they require

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IPv6 non-deployment

- Small benefit for LIRs
  - no direct advantage to deploy IPv6
- Strong constraint for the community
  - If only one LIR doesn't deploy, all will have a problem

The end of IPv4, rationing (2010-02)

- Same policy in Asia-Pacific region
- APNIC reached its last /8
- For many the shortage is already here

The end of IPv4, rationing (2010-02)

- Same policy in Asia-Pacific region
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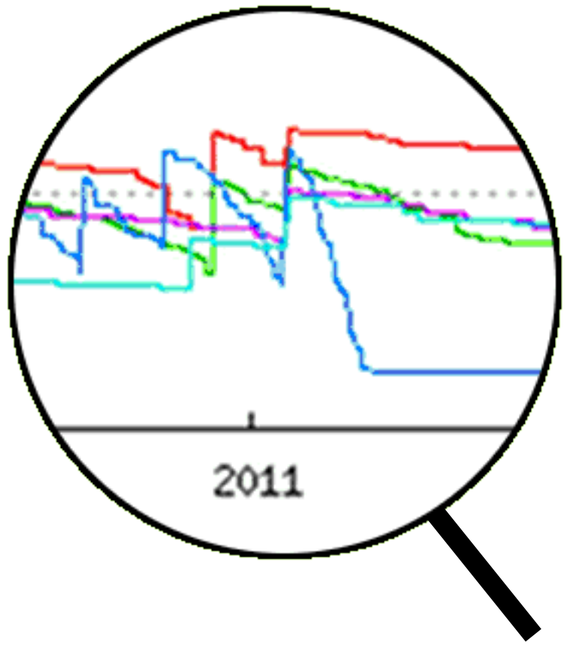


Source:
http://www.potaroo.net/tools/ipv4/

The end of IPv4, rationing (2010-02)

- Alternatives adopted by LIRs in the APNIC region
  - IPv6 ?
  - NAT
  - CGN
  - Transfers

The end of IPv4, rationing (2010-02)

5.5 Transfers of Allocations

Any LIR is allowed to re-allocate complete or partial blocks of IPv4 address space that were previously allocated to them by either the RIPE NCC or the IANA. Such address space must not contain any block that is assigned to an End User.

Address space may only be re-allocated to another LIR that is also a member of the RIPE NCC. The block that is to be re-allocated must not be smaller than the minimum allocation block size at the time of re-allocation. An LIR may only receive a transferred allocation after their need is evaluated and approved by the RIPE NCC, following the policies set for receiving further allocations within RIPE region (see the Section 5.3 Additional Allocations of this document).

Re-allocation must be reflected in the RIPE Database. This re-allocation may be on either a permanent or non-permanent basis.

LIRs that receive a re-allocation from another LIR cannot re-allocate complete or partial blocks of the same address space to another LIR within 24 months of receiving the re-allocation.

The RIPE NCC will record the change of allocation after the transfer. Please note that the LIR always remains responsible for the entire allocation it receives from the RIPE NCC until the transfer of address space to another LIR is completed or the address space is returned. The LIR must ensure that all policies are applied.

Re-allocated blocks will be signed to establish the current allocation owner.

Re-allocated blocks are no different from the allocations made directly by the RIPE NCC and so they must be used by the receiving LIR according to the policies described in this document.

Transfers

Transfers are authorised by RIRs.

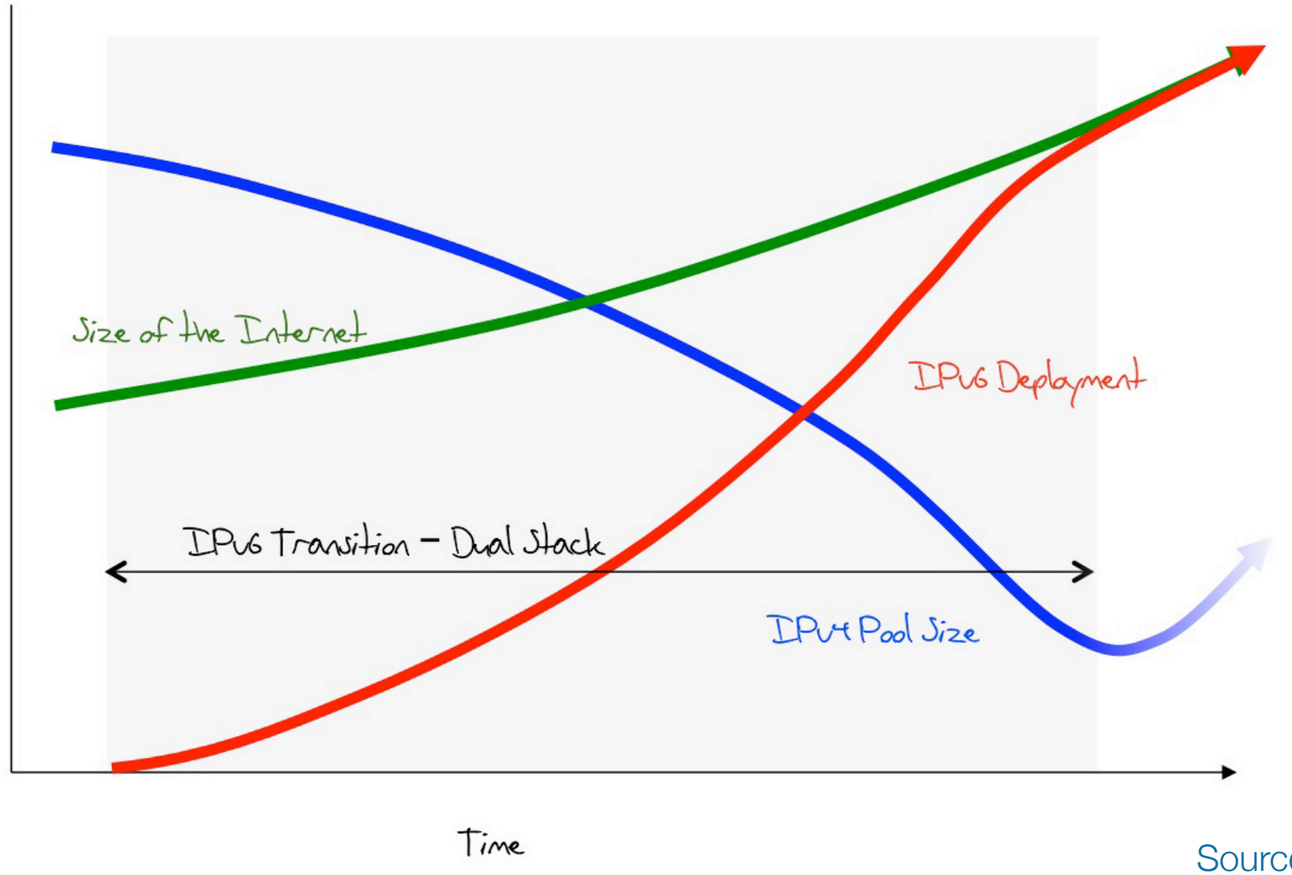
The new recipient must justify his need.

The new recipient must be in the same region.

Source:
http://ripe.net/ripe/docs/ripe-530

IPv6 Uptake

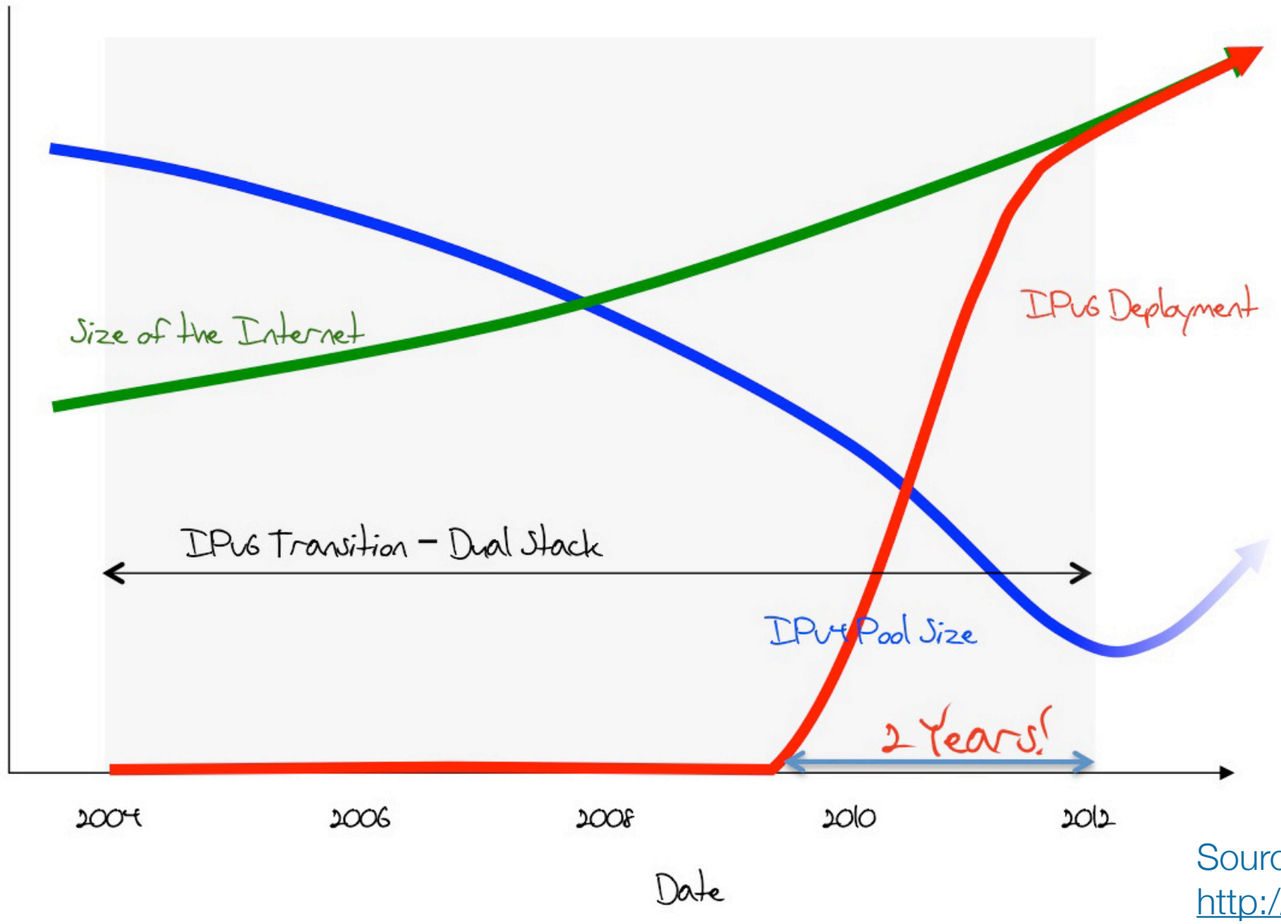
The plan



Source:
http://www.potaroo.net/tools/ipv4/

IPv6 Uptake

The reality (in 2009)



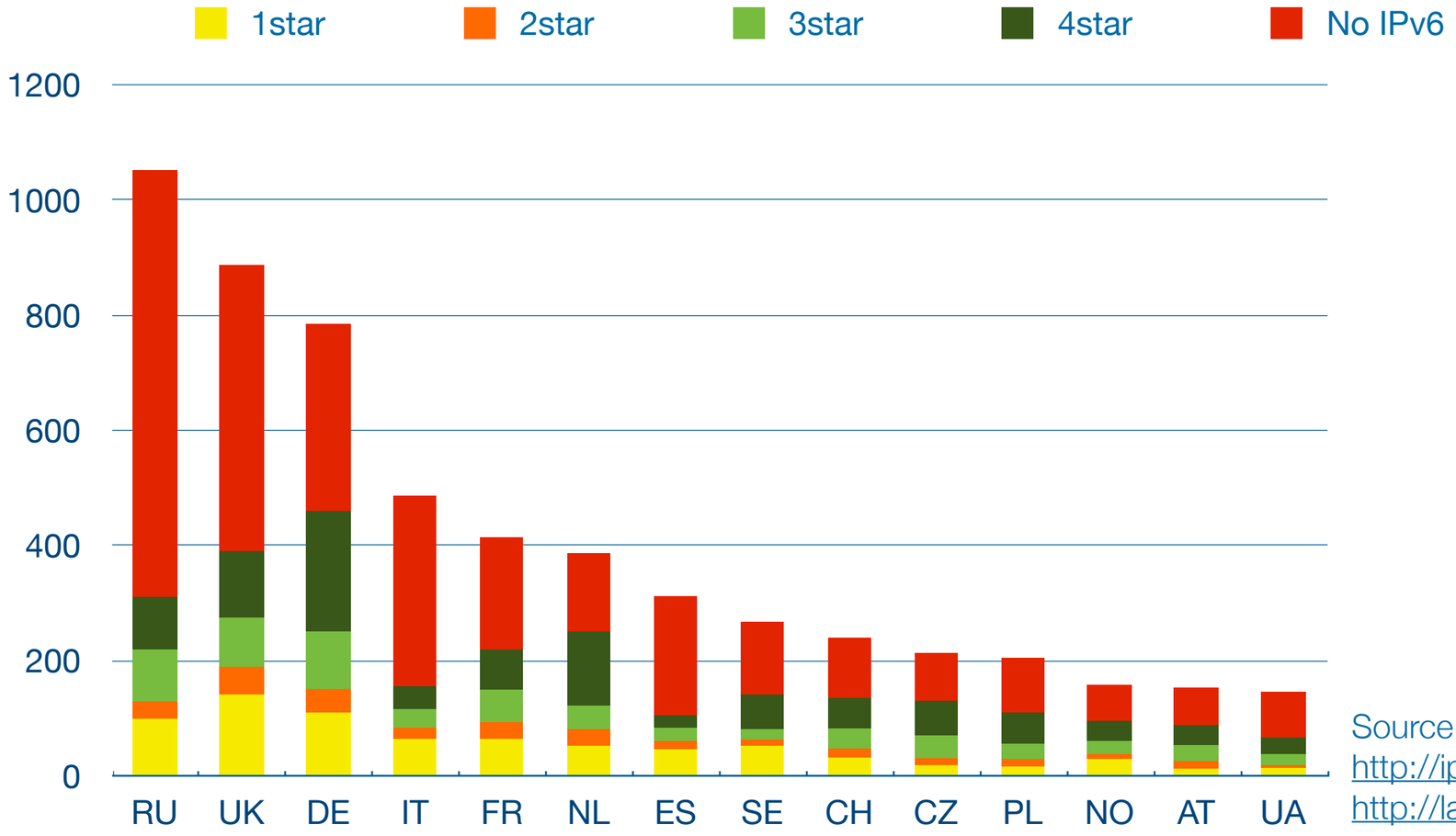
Source:
http://www.potaroo.net/tools/ipv4/

IPv6 Uptake

- The RIPE NCC supports IPv6 uptake
  - Trainings, IPv6ActNow.org, RIPE Labs
- The RIPE NCC measures IPv6 uptake
  - IPv6 RIPEness
  - IPv6 ASN count
  - World IPv6 Day
- Others measure IPv6 uptake
  - Google, Yahoo...
  - Alexa

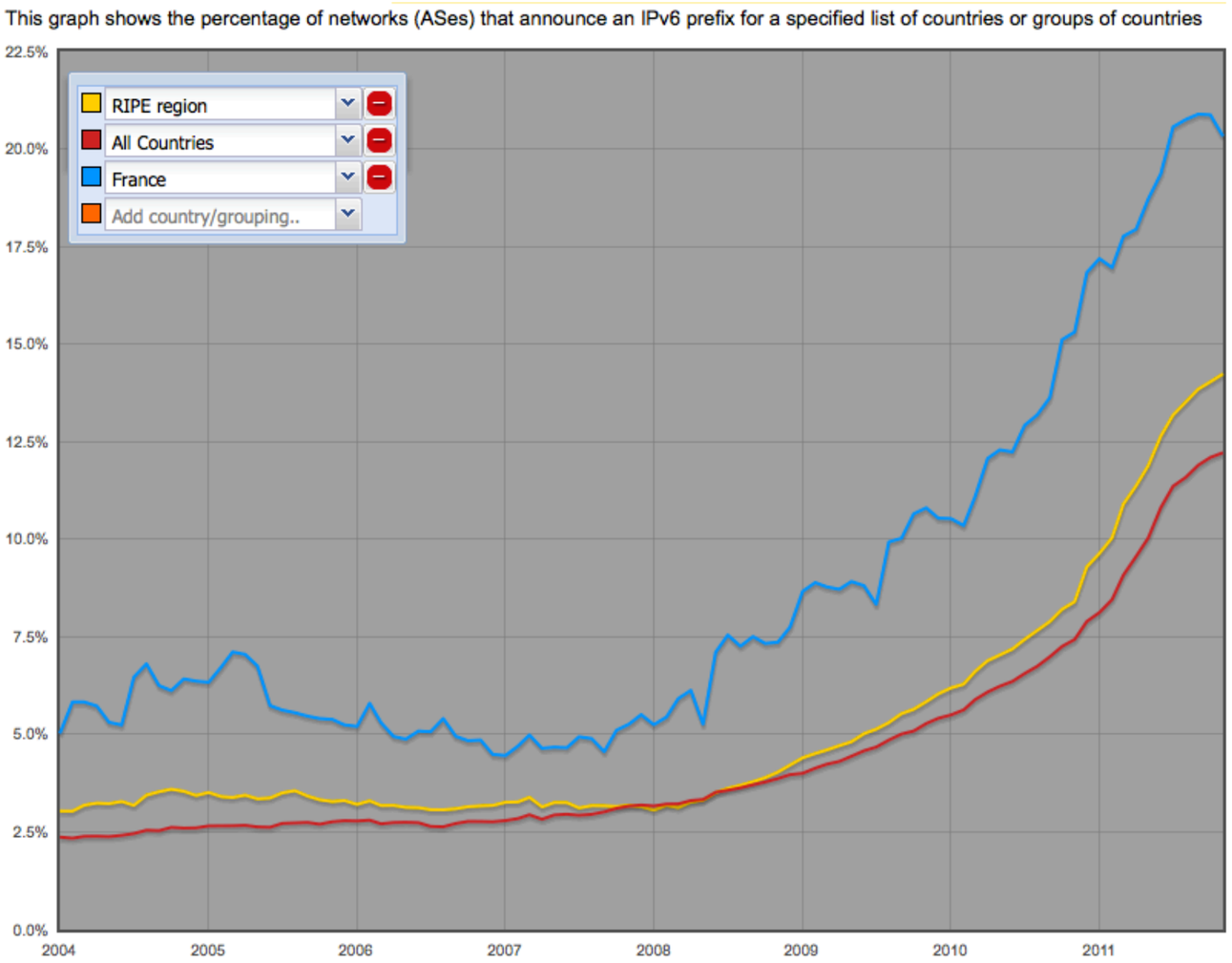
IPv6 RIPEness

TOP 15 countries with most LIRs



Source:
http://ipv6ripeness.ripe.net/
http://labs.ripe.net/Members/mirjam/ipv6-ripeness/

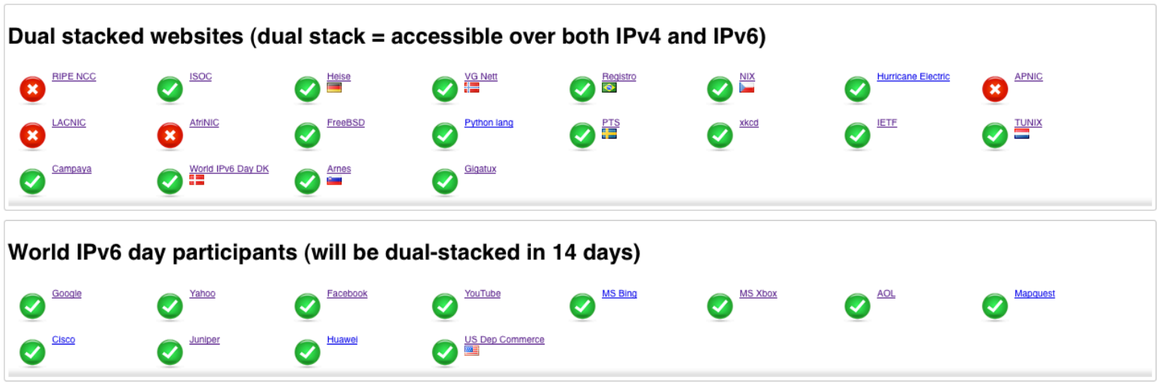
IPv6 ASN Count

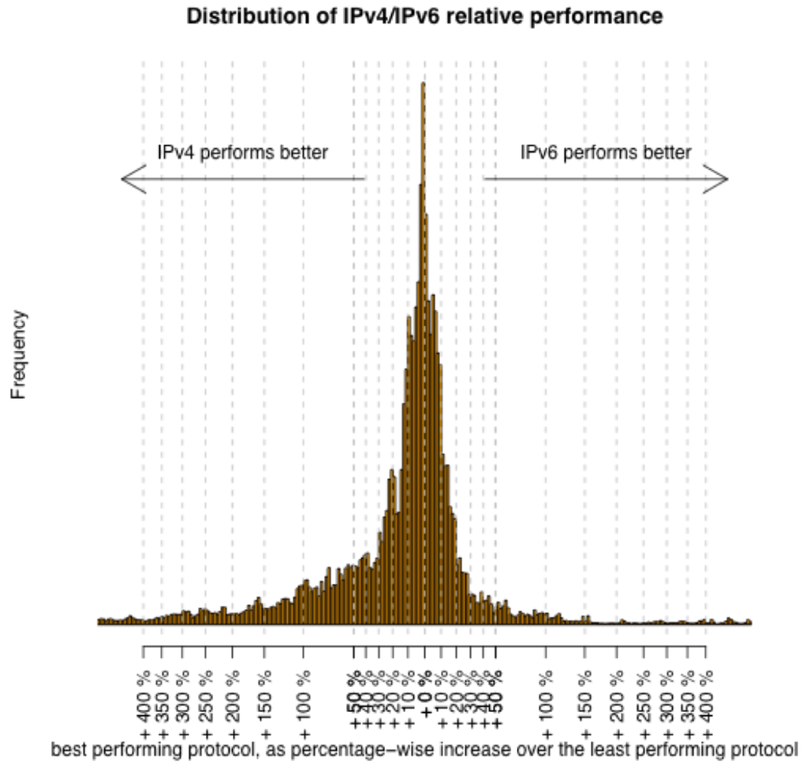


Source:
http://v6asns.ripe.net

World IPv6 Day

- RIPE NCC made tests before, during and after this day





Sources:
http://labs.ripe.net/ipv6day

World IPv6 Day

- Percentage of users
- Google
- Yahoo
- RIPE NCC

World IPv6 Day

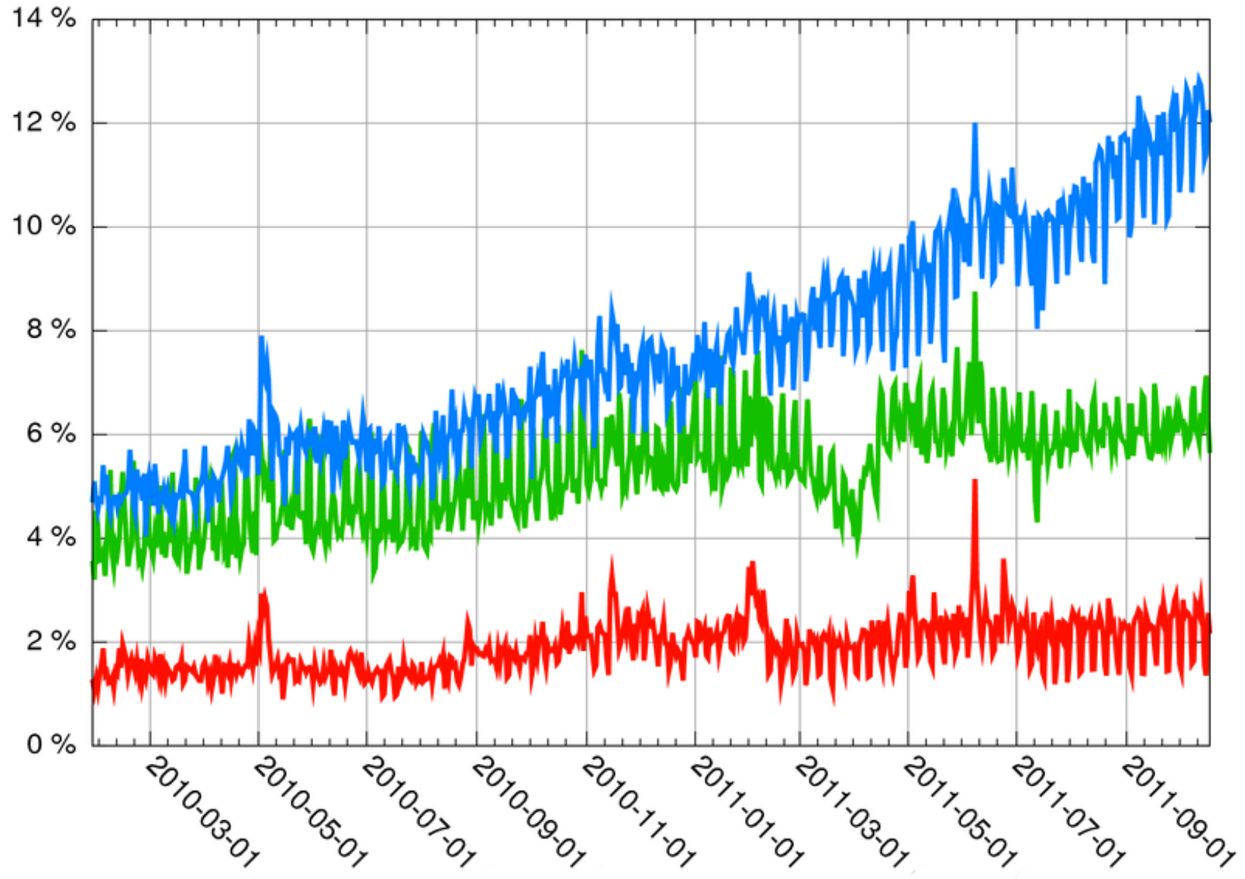
- Percentage of users
- Google : 0,11%
- Yahoo : 0,22%
- RIPE NCC

World IPv6 Day

- Percentage of users
- Google : 0,11%
- Yahoo : 0,22%
- RIPE NCC : 5%

World IPv6 Day

Visitors on ripe.net

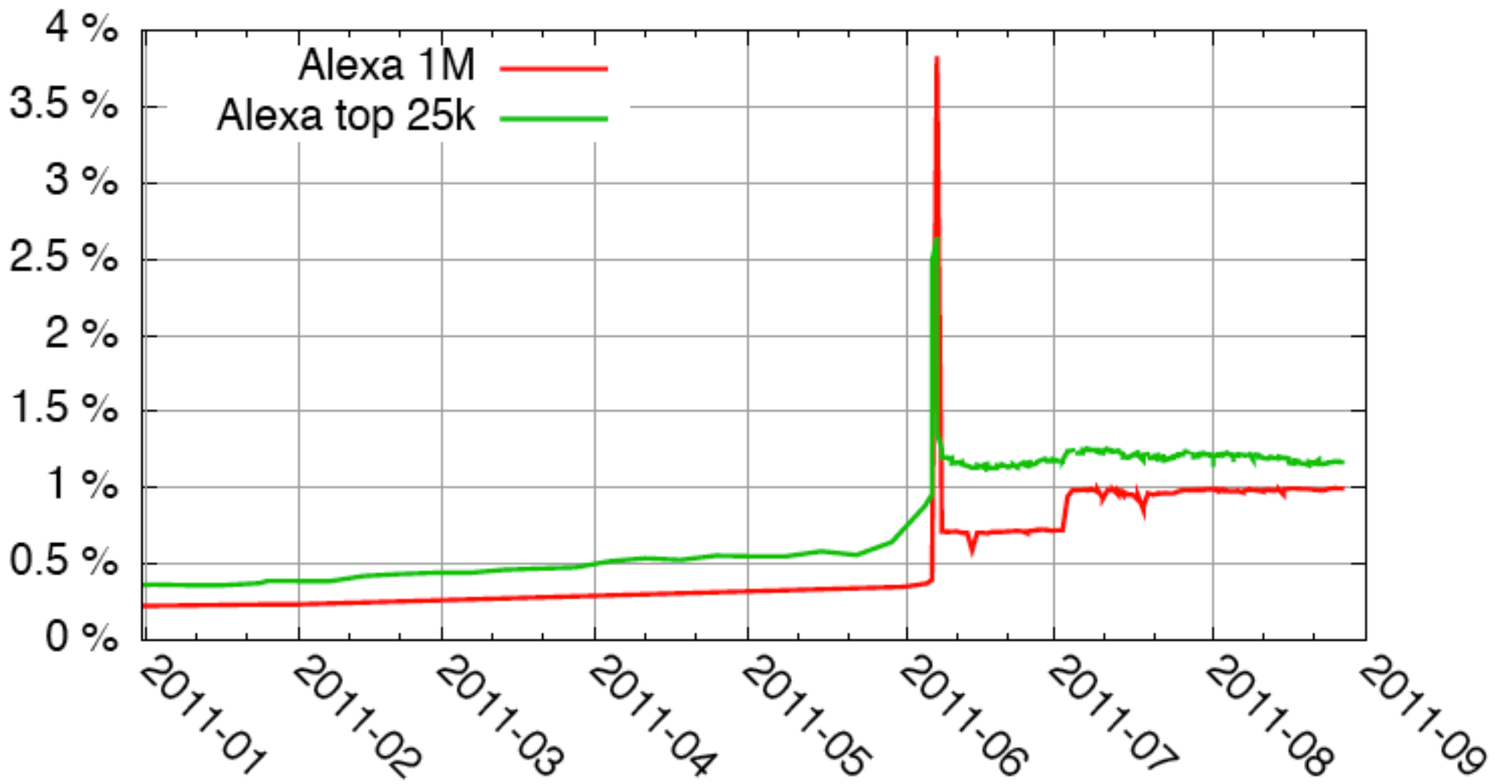


ripe.net only delivers 2% of its users in IPv6 but 6% of them can already use IPv6.

Visitors with IPv6 compatible resolvers reached 12% in October 2011.

World IPv6 Day

Biggest websites



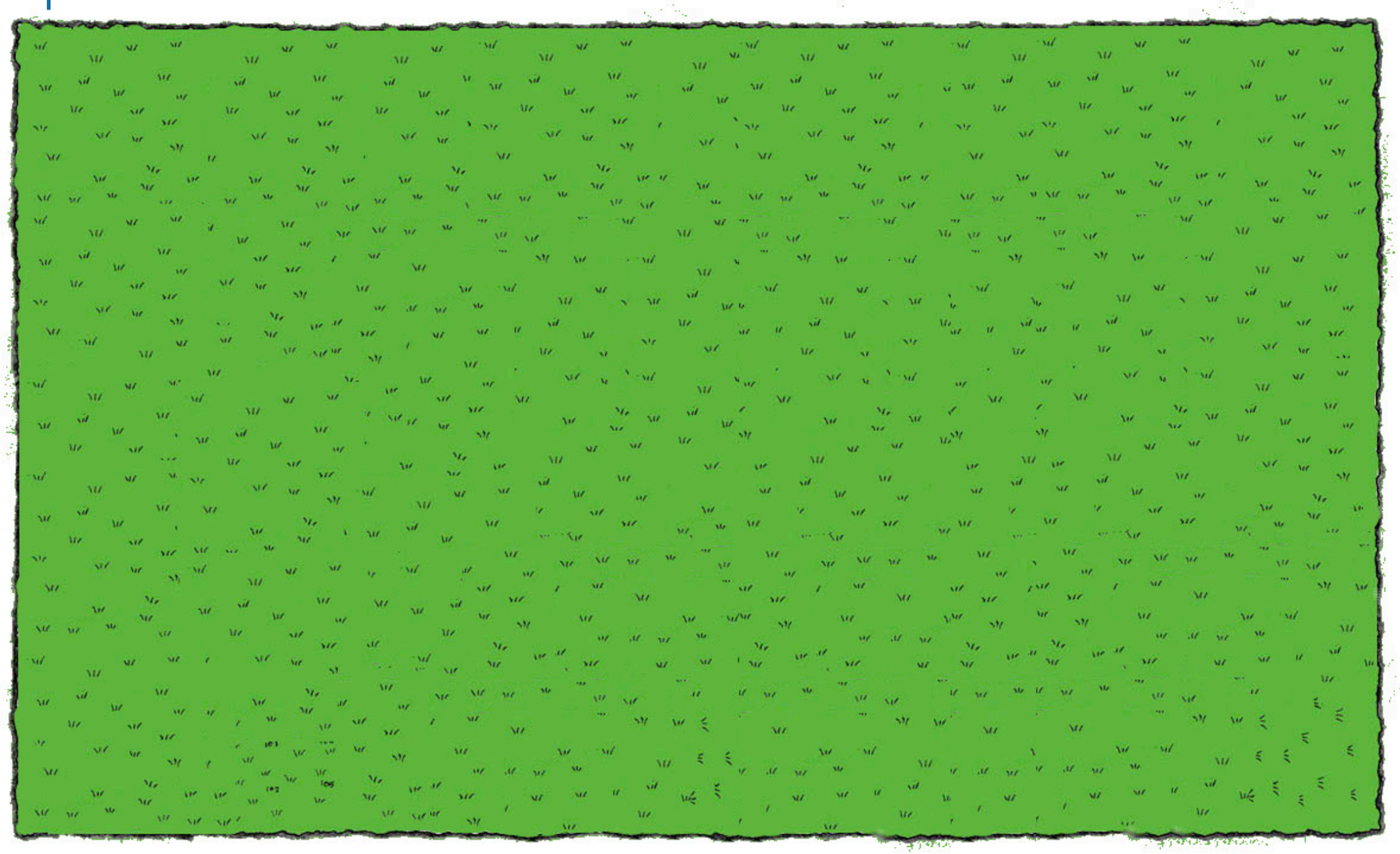
4% of the world biggest websites participated in World IPv6 Day.

Some of them didn't switch off IPv6 after this day.

More infos on : http://labs.ripe.net/

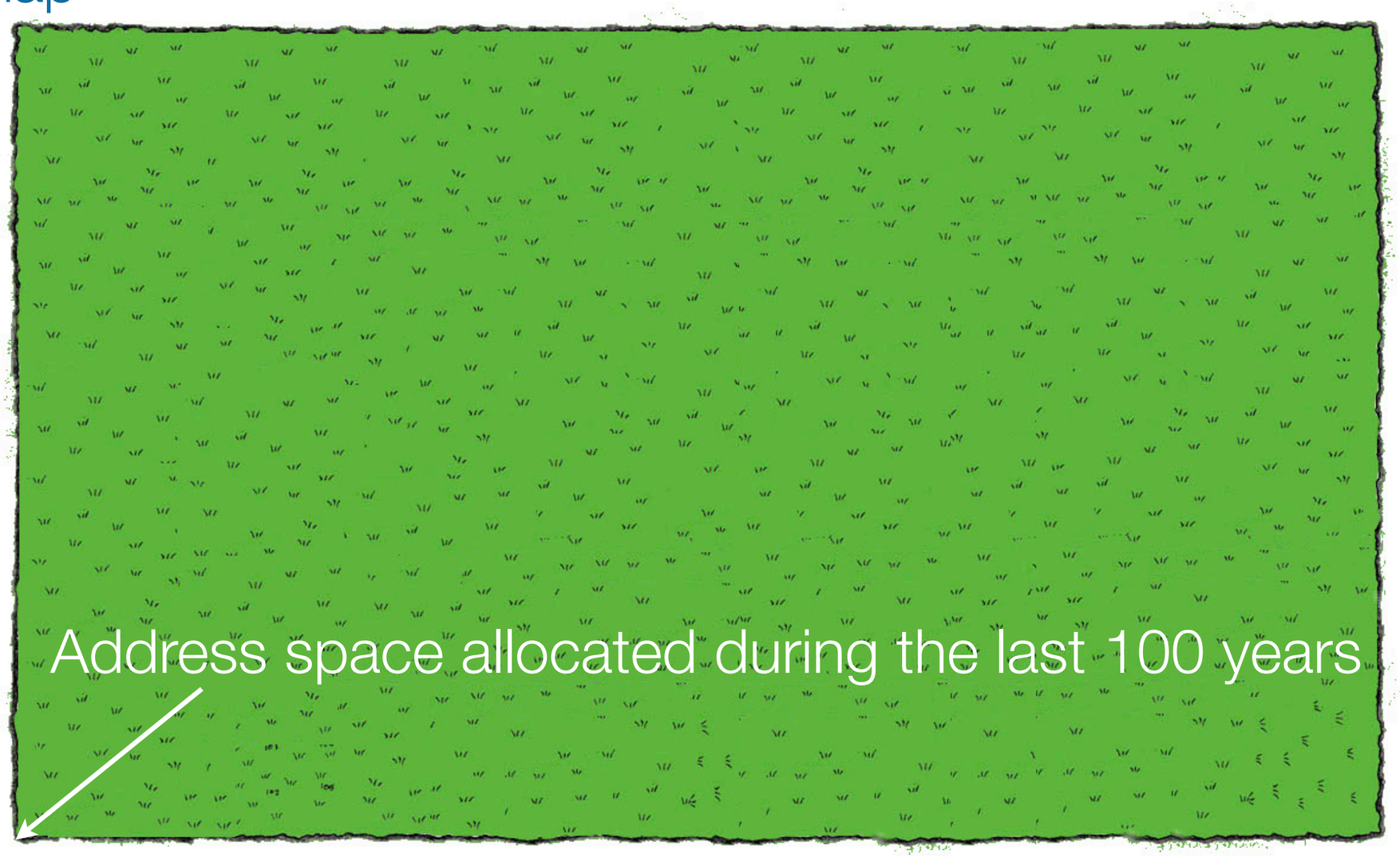
IPv6 Uptake

IPv6 map



IPv6 Uptake

IPv6 map



Questions?

RIPE NCC