RIPE NCC
RIPE NETWORK COORDINATION CENTRE

IPv4 Exhaustion

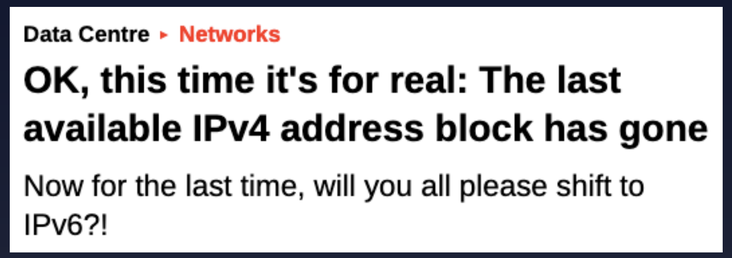
It’s almost here… so what comes next?

Ingrid Wijte | April 2019 | MENOG 19

Sound Familiar? (Headlines from 2012)

IPv4 address pool almost dry

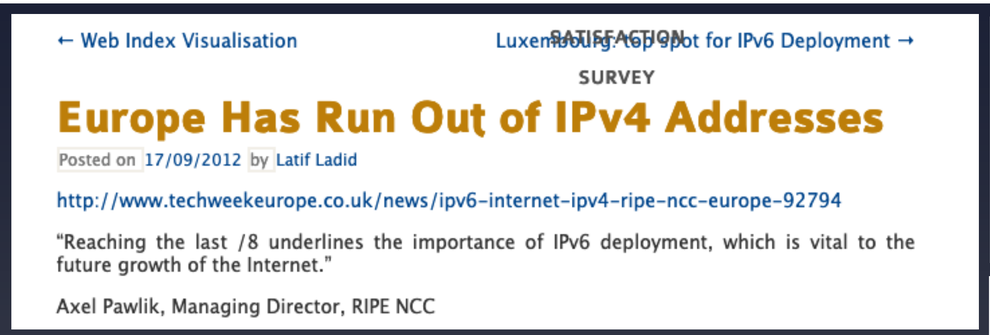
The five Internet Registries now have just 16.8 millions IPv4 addresses left



Data Centre ▸ Networks

OK, this time it's for real: The last available IPv4 address block has gone

Now for the last time, will you all please shift to IPv6?!



← Web Index Visualisation Luxembourg: Top Spot for IPv6 Deployment →

SATISFACTION SURVEY

Europe Has Run Out of IPv4 Addresses

Posted on 17/09/2012 by Latif Ladid

http://www.techweekeurope.co.uk/news/ipv6-internet-ipv4-ripe-ncc-europe-92794

"Reaching the last /8 underlines the importance of IPv6 deployment, which is vital to the future growth of the Internet."

Axel Pawlik, Managing Director, RIPE NCC

Home > WAN > Internet

Europe's supply of IPv4 addresses nearing depletion

RIPE NCC to run out of IPv4 addresses any day, putting pressure on network operators to deploy IPv6

CRUNCH TIME —

Europe officially runs out of IPv4 addresses

RIPE NCC now allocating IPv4 address space from the last /8 netblock

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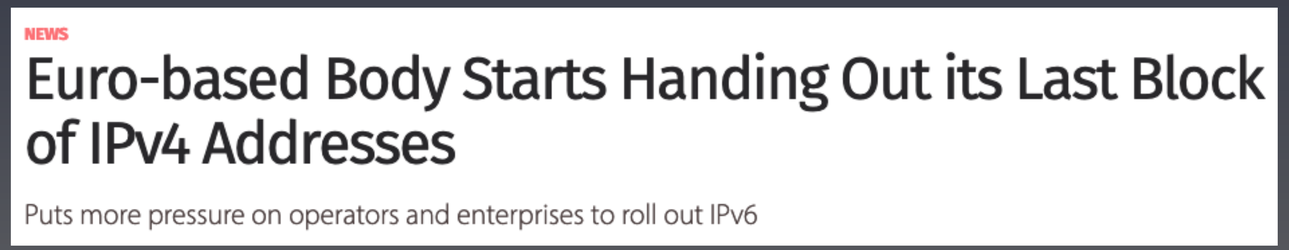
Technology

Europe hits old internet address limits

By Mark Ward
Technology correspondent, BBC News

14 September 2012 Share

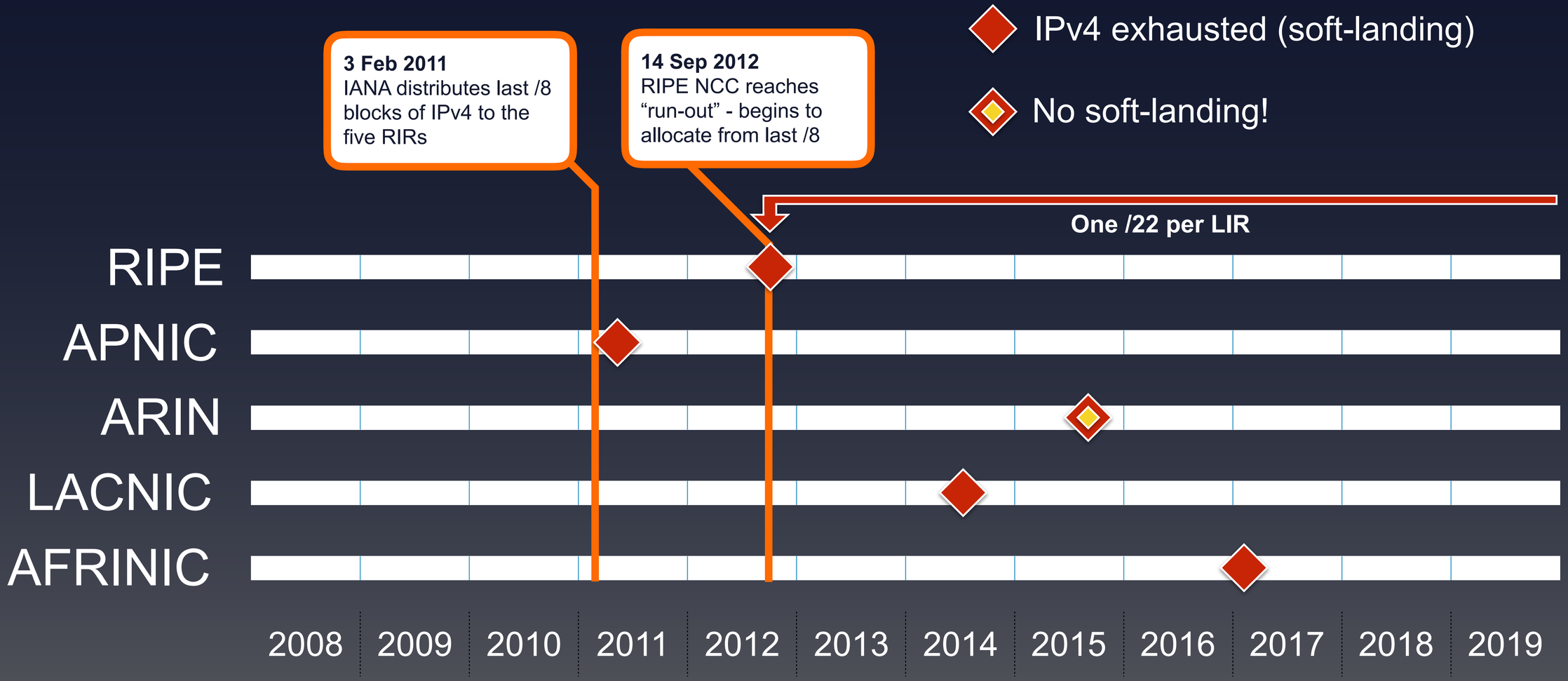


NEWS

Euro-based Body Starts Handing Out its Last Block of IPv4 Addresses

Puts more pressure on operators and enterprises to roll out IPv6

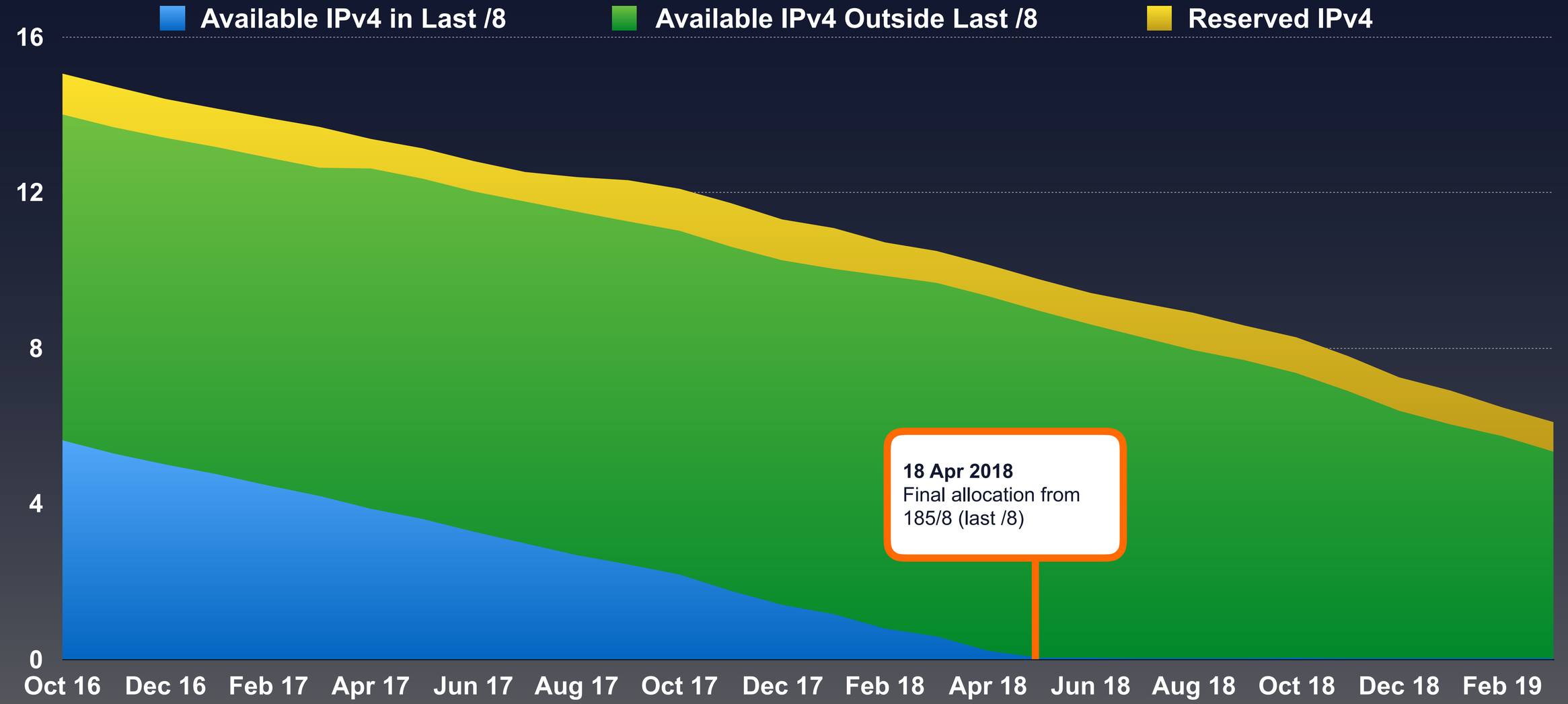
Timeline


IPv4 exhausted (soft-landing)
No soft-landing!
3 Feb 2011
IANA distributes last /8 blocks of IPv4 to the five RIRs
14 Sep 2012
RIPE NCC reaches "run-out" - begins to allocate from last /8
One /22 per LIR
RIPE
APNIC
ARIN
LACNIC
AFRINIC
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

“Exhaustion” “Depletion” “Run-out”

- **In our region this meant “one final /22”**
  - For both new and existing LIR accounts
- **Similar soft landing approaches in AFRINIC, APNIC and LACNIC regions**
- **Only ARIN went for full run-out**
  - …though here you can still get a /24 for IPv6 transitions

RIPE NCC Remaining IPv4 Pool (Millions)



IPv4 Run-out is Almost Here

- **At current rate, run-out expected in February 2020**
  - Exact date will vary according to the rate at which new and existing members request their final /22 allocations
- **This will be the last MENOG meeting before our remaining pool is fully exhausted**

The Period Before

Leading up to exhaustion

Current Allocation Process

- Now that the last /8 is gone, we are allocating contiguous /22s from our pool of returned IPv4 addresses
- When we can no longer allocate contiguous blocks, we will make /22 allocations out of the smallest-routable blocks (/23s and /24s)
- Once we can no longer make a /22 equivalent allocation, we will have reached run-out

Unforeseen Circumstances Pool

- **A /16 has been reserved for unforeseen circumstances**
- **If policy remains as-is, this pool will become available for allocations:**

“A /16 will be held in reserve for some future uses, as yet unforeseen” (…) “In the event that this /16 remains unused at the time the remaining addresses covered by this policy have been distributed, it returns to the pool to be distributed”

- **This will be exchanged with a non-contiguous /16 equivalent of returned space so we can issue contiguous /22s for as long as possible**

Other Considerations

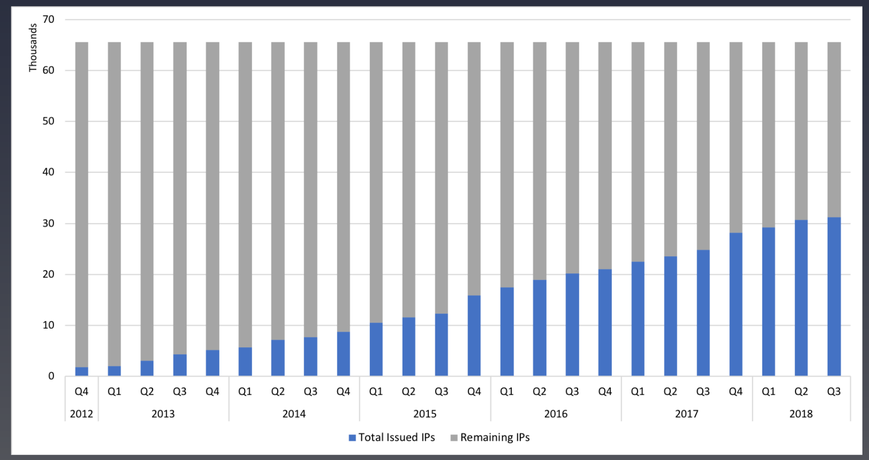
- How can we handle run-out in a way that is fair, transparent and efficient?
- How should we handle the possibility that members might have to spend time on a waiting list or not get any IPv4 at all?
- Complex changes to our internal/external software will need to be made ahead of time
- We need to keep members and other stakeholders informed as we approach run-out

The Final Allocation

…what comes next?

There Will Still be *Some* IPv4 Remaining…

- **A /13 for temporary assignments**
  - Conferences and events, research and experiments, etc.
- **A /16 for Internet Exchange Points (IXPs)**
  - IXPs are an important part the Internet's infrastructure
  - This pool is expected to last four more years
- **Some leftover IPv4 "dust"**
  - Blocks smaller than a /24
  - Mostly from returned PI assignments



…and Addresses Being Returned

- We will continue to receive returned IPv4 addresses after run-out
- Closures for non-payment, bankruptcy/liquidation, or violation of RIPE policies and RIPE NCC procedures
- Recovered Space: 238 /22s over the past three years

Recovered IPv4 Addresses (2016-2018)	
2016	83.712
2017	106.368
2018	53.824

Waiting List

- **Returned addresses shouldn’t remain with us if networks can use them**
- **This position is supported by the IPv4 policy:**

“Any address space that is returned to the RIPE NCC will be covered by the same rules as the address space intended in section 5.1.” [i.e. should be allocated as /22s]

- **As returned addresses won’t meet demand, a waiting list seems like the most logical and fair approach**
  - (Only LIRs that have not already received a final /22 allocation will be eligible)

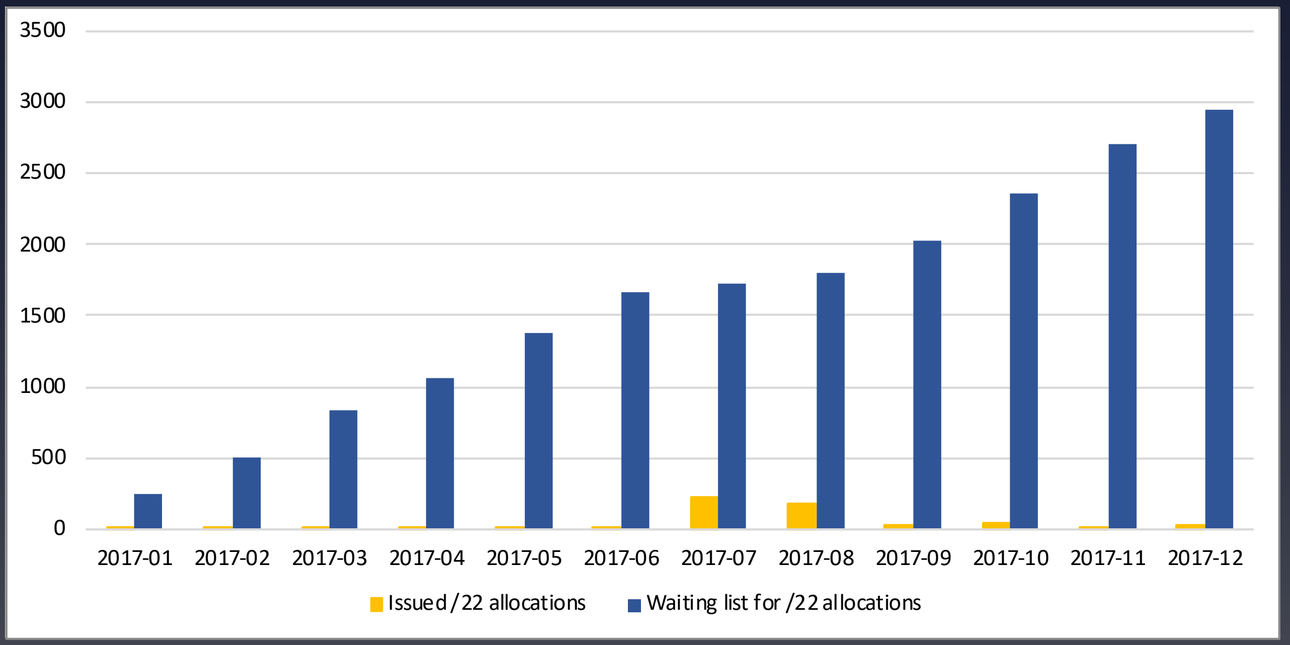
Policy Discussions

Reducing IPv4 Allocations to a /24

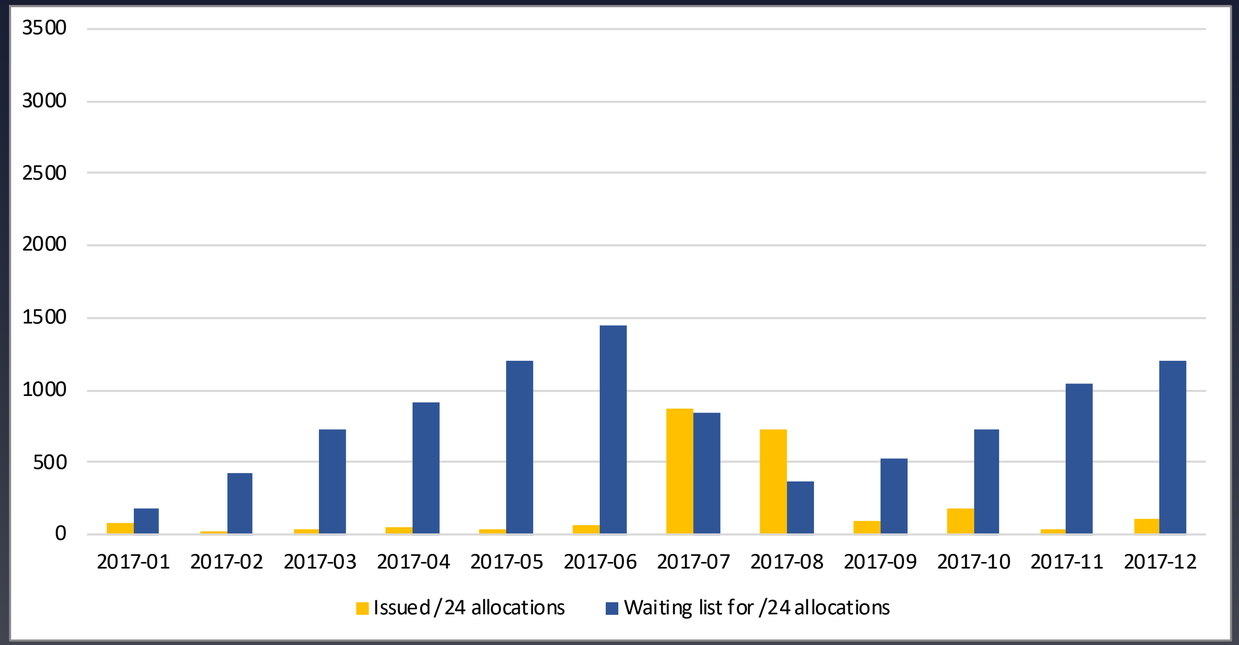
- **Any returned addresses will be given out almost immediately if they are allocated as /22s**
- **/24s might enable a larger number of networks to connect their IPv6 infrastructure**
- **Current discussion in the Address Policy WG - 2019-02 “Reducing IPv4 Allocations to a /24”**
  - Once the RIPE NCC can no longer issue a contiguous /22, the allocation size will be reduced to /24
  - Proposal here: https://www.ripe.net/participate/policies/proposals/2019-02

Waiting list projections /22 vs /24

Model with /22 allocations



Model with /24 allocations



Other Questions from RIPE 77

- **Should more addresses be added to the IXP pool?**
  - Currently set to last four years - perhaps this could be extended
- **Should the community keep the /16 for unforeseen circumstances?**
- **What (if anything) should be done with the IPv4 “dust”?**
- **All of these would require a policy proposal - and there is not much time remaining before run-out**

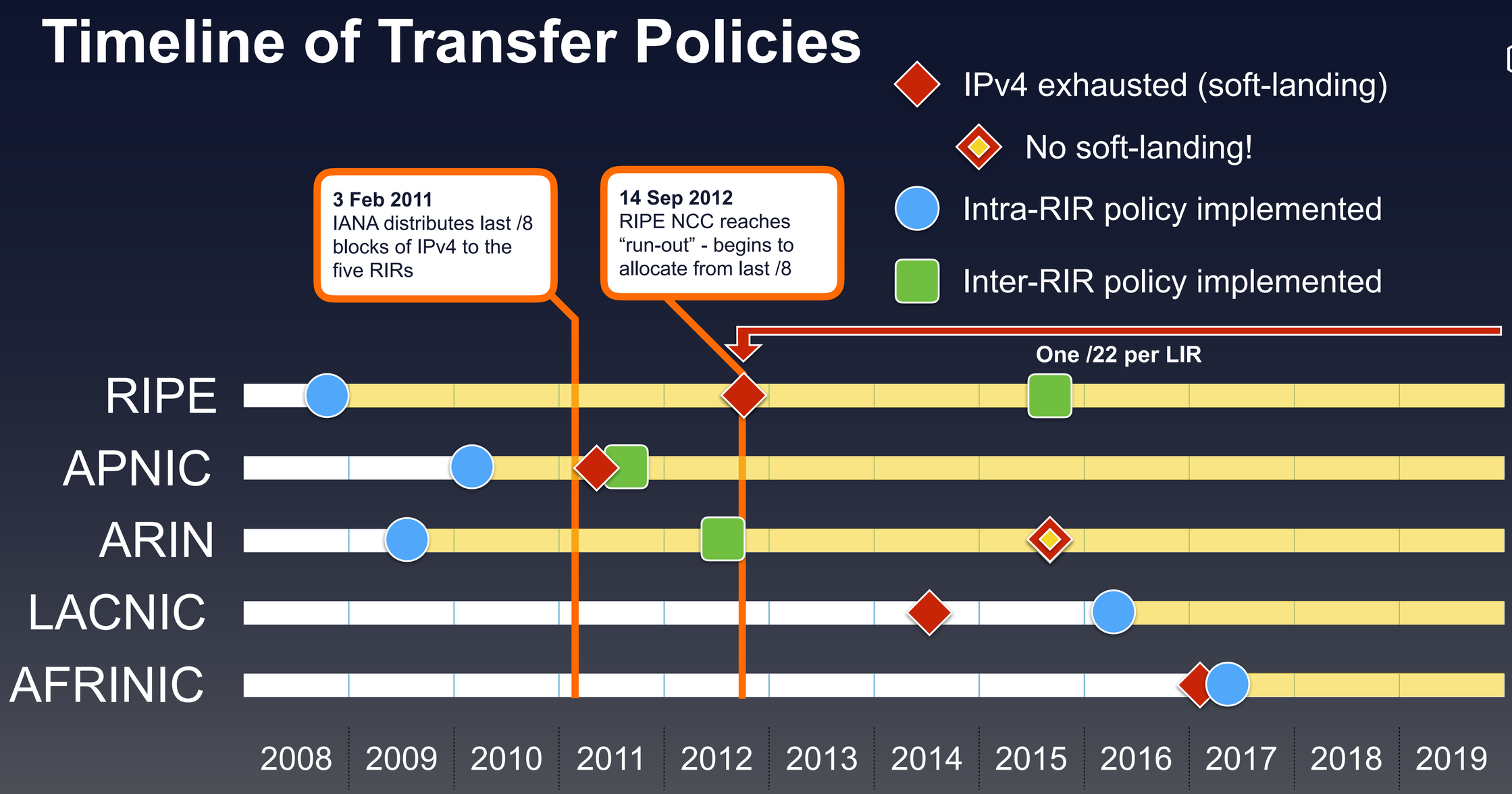
Transfers and Hijacking

Products of IPv4 scarcity

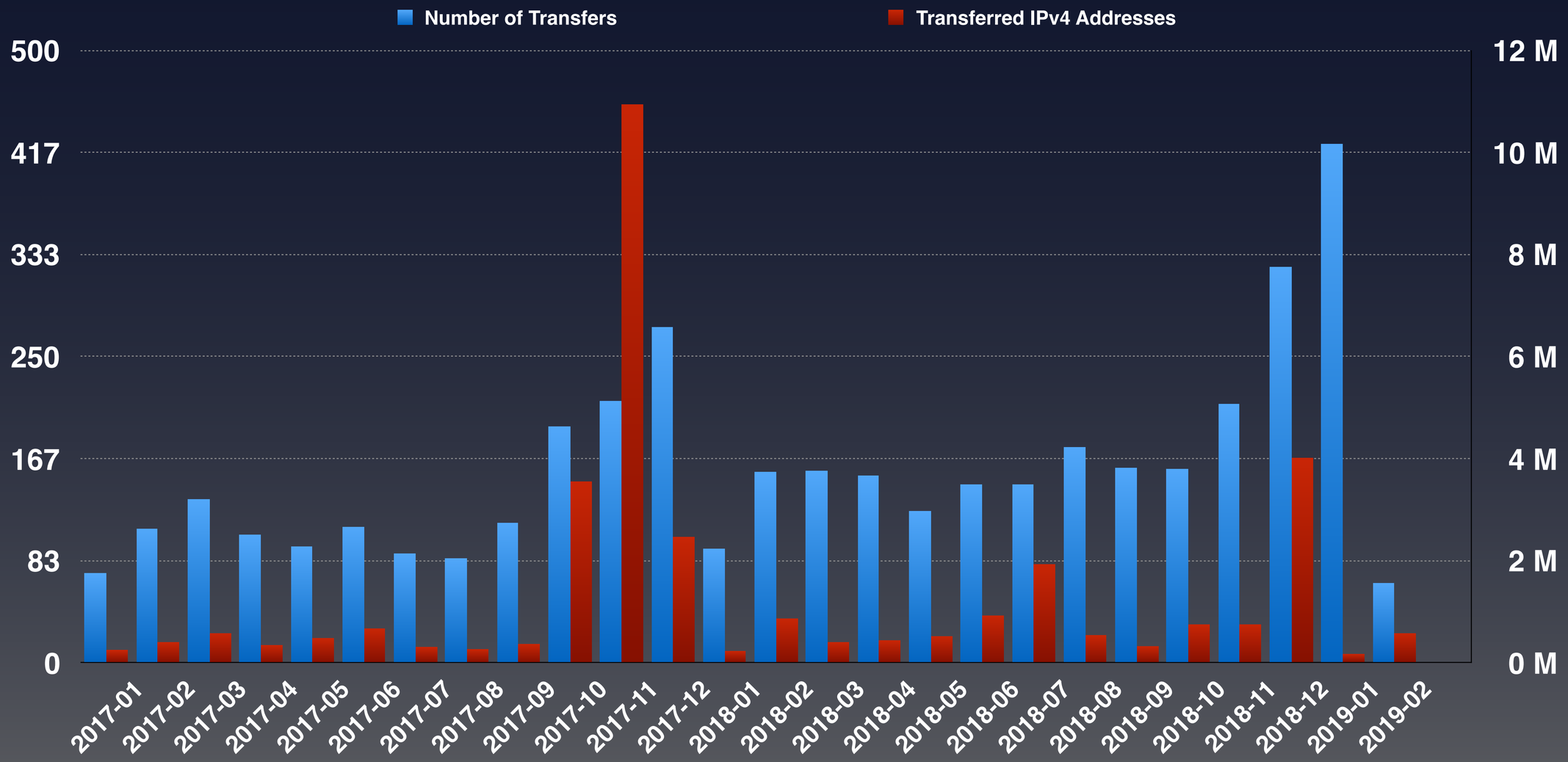
Transfers: RIPE Community Policy Response

- **Trading in IPv4 addresses was seen as inevitable**
- **The priority is an accurate registry**
- **Current policy situation:**
  - LIRs and End Users can transfer IPv4 allocations/assignments
  - Transfers can be within the RIPE NCC service region and to/from other RIR service regions with compatible policies (currently ARIN and APNIC)
  - Resources subject to a 24-month holding period after a transfer (also applies to /22 allocations from the RIPE NCC)

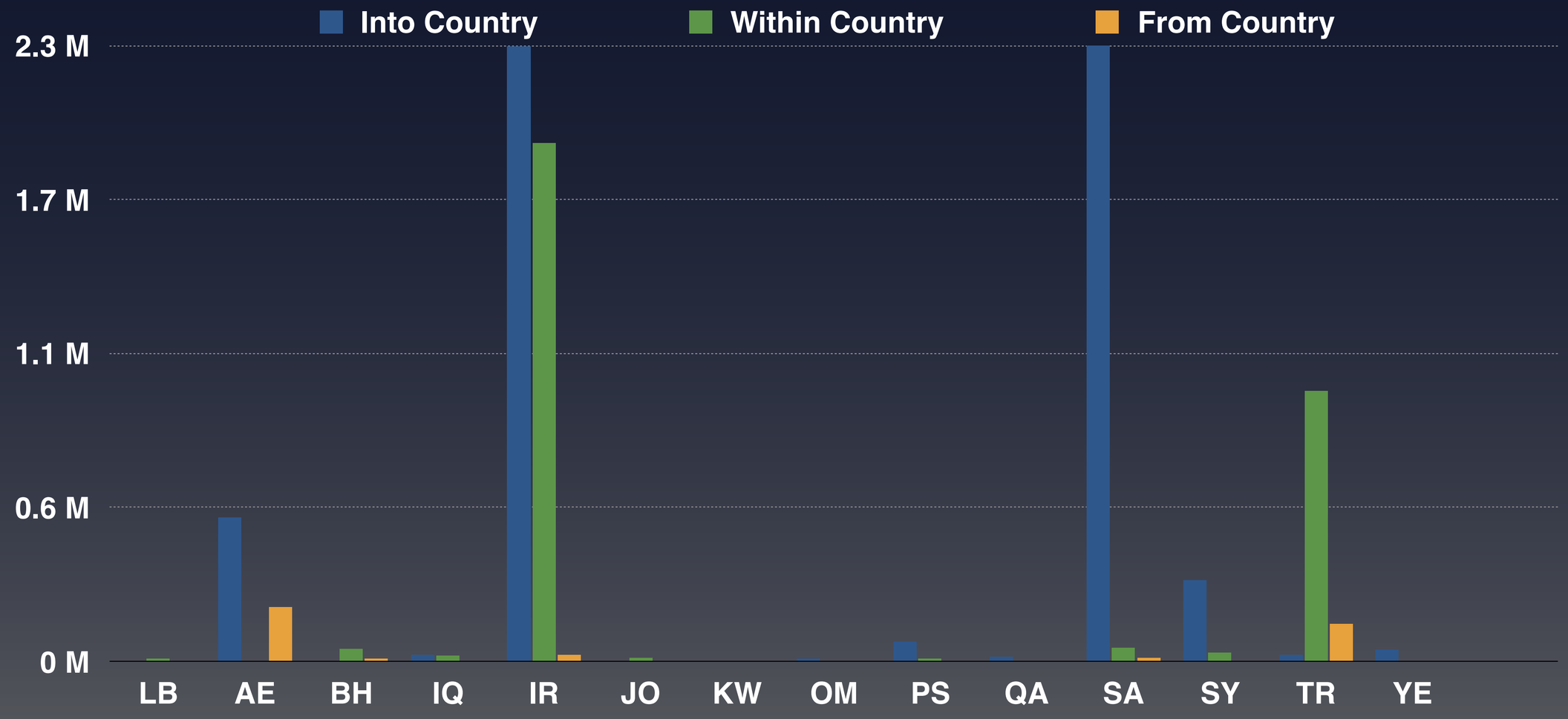
Timeline of Transfer Policies



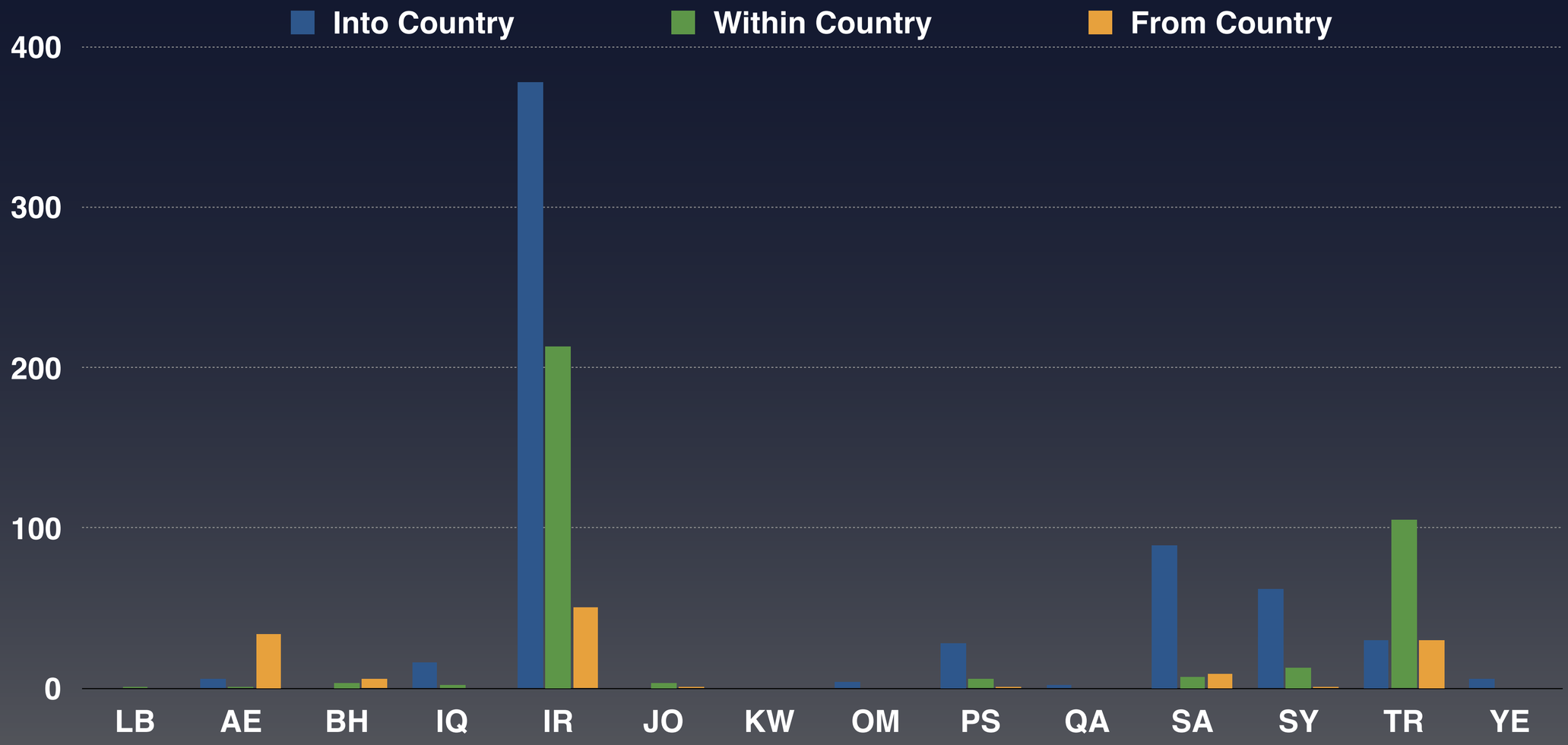
IPv4 Transfers in RIPE NCC Service Region
(2017-2019)



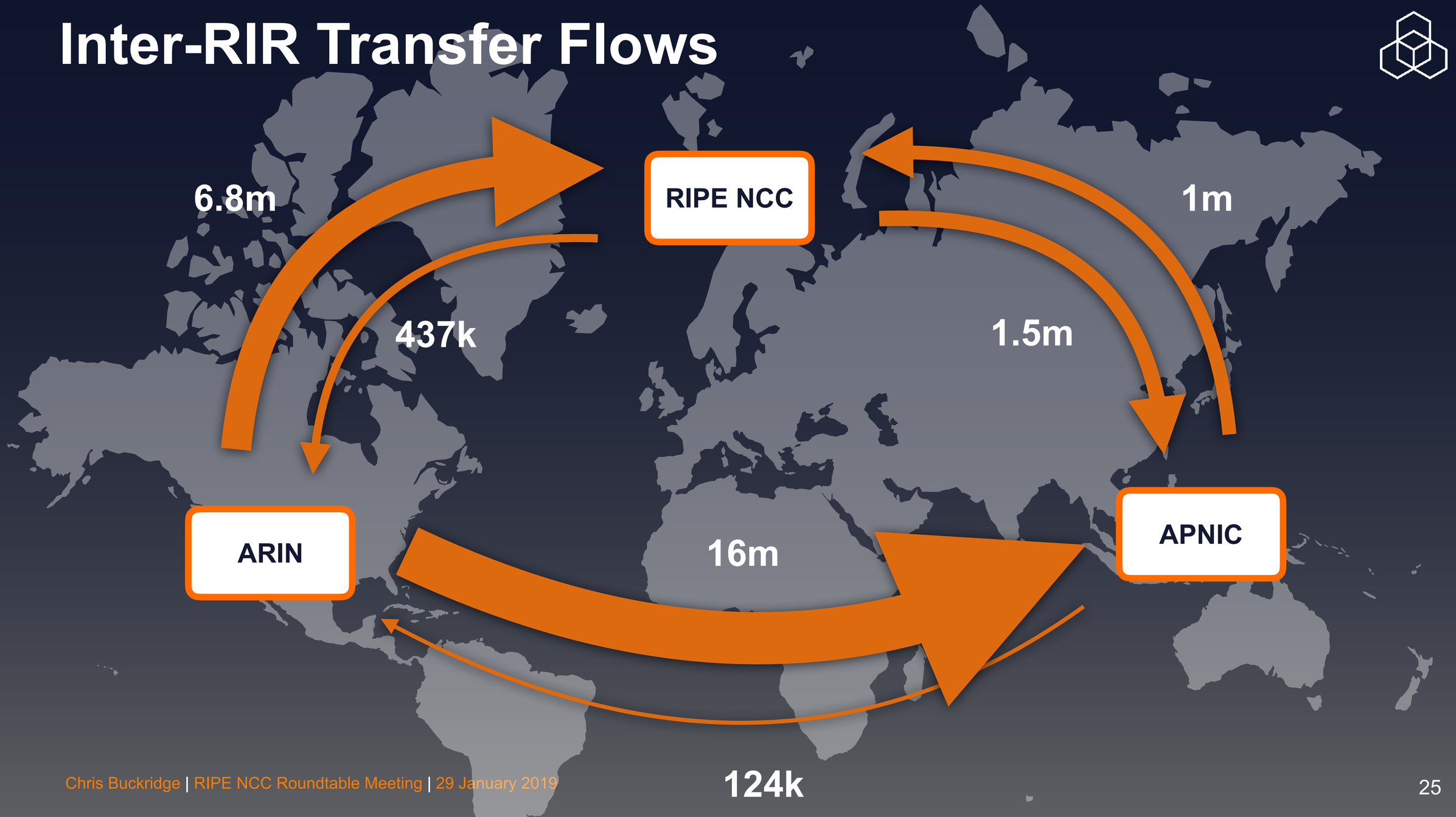
IPv4 Addresses Transferred in MENOG Region
(2017-2019)



Number of IPv4 Transfers in MENOG Region
(2017-2019)



Inter-RIR Transfer Flows



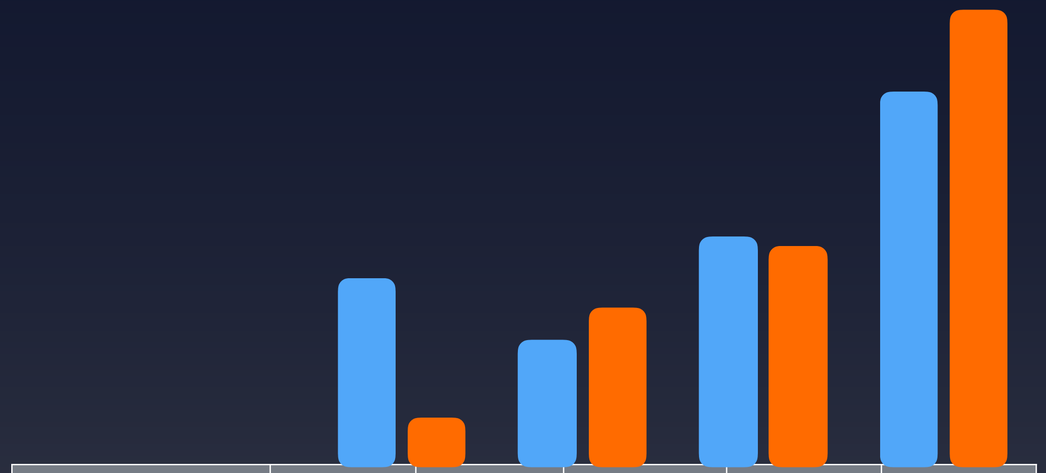
Disputes Over IP Addresses

- **Disputed transfers**
  - Outdated contact information
  - “LIR contact was no longer working at the company”
- **Hijacked, disputed LIR accounts**
  - LIR contacts removing other contacts from the LIR Portal
  - LIR accounts opened on behalf of unaware organisations

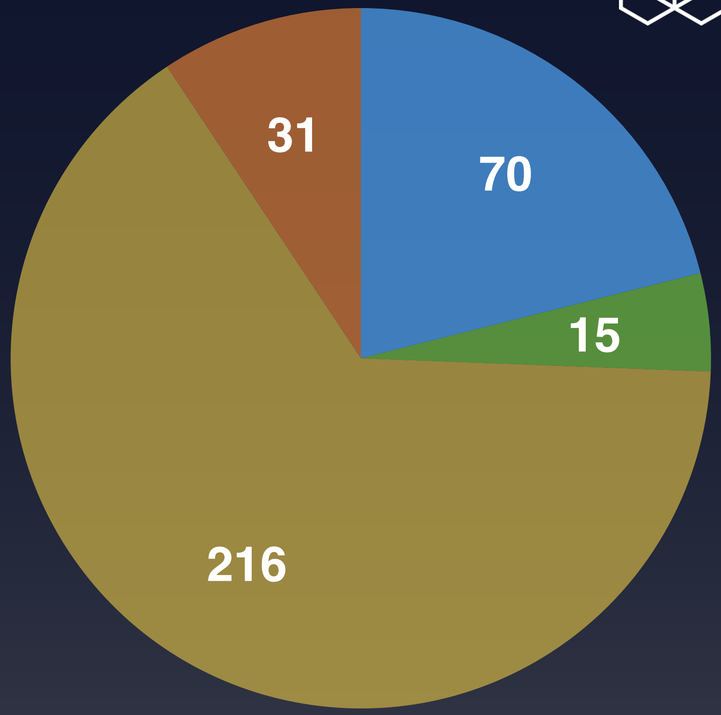
Protecting IP Registrations

- **Criminals use very sophisticated methods to obtain control over (seemingly) unused address blocks**
  - Faking registration and identity papers
  - Faking entire websites and domains
- **Hijackers often target resources with long-standing contact details!**

Actions Taken by the RIPE NCC



Year	2015	2016	2017	2018	2019
Concluded	95	64	116	188	12
New	25	80	111	229	20



- Due-diligence reminder*
- Final warnings**
- LIR closures (SSA termination) (203 in 2018)
- Disputed transfers

* Due diligence reminder for more minor infringements
** Final warnings for major policy and contractual violations

What Does It All Mean?

A New Paradigm for IP Addresses

Available as needed	→	A scarce resource
No inherent monetary value	→	Seen as a commodity to be bought or sold
Hierarchical distribution	→	More complex movement between all parties

What This Means for the Internet Community

- **Extending the lifespan of IPv4 as a technology**
- **Possibly slowing or delaying IPv6 adoption**
- **Possibly adding complexity to the routing table**
  - (Though we haven't seen evidence of this to date)
- **New kinds of actors in the RIPE Policy Development Process, and in the RIPE community generally**
- **Greater attention/involvement from governments and regulators who may view IPv4 as an economic issue**

What This Means for the RIPE NCC

- Transfer market reinforces the importance of the registry
- Impacts the dynamic between the RIPE NCC and our members
- New services and processes required
- Speculators, hoarders and hijackers with greater incentive to abuse the system
- A need to make sure we maintain the right balance between due diligence and not being overly bureaucratic

What Does This Mean for *you?*

- **Make sure your information is correct in the LIR Portal**
  - Especially update your contacts when staff members leave the company
- **More and more cases involving bad actors in transfer deals - know who you are dealing with!**
- **Make sure you fulfil your obligations as a RIPE NCC member (i.e. pay your bills on time, follow policies)**
- **Make sure you're ready for IPv6 - and become an advocate for IPv6 in your region**

Questions

ingrid@ripe.net