



RIPE NCC

RIPE NETWORK COORDINATION CENTRE

IPv4 Exhaustion

It's almost here... so what comes next?

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 →

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

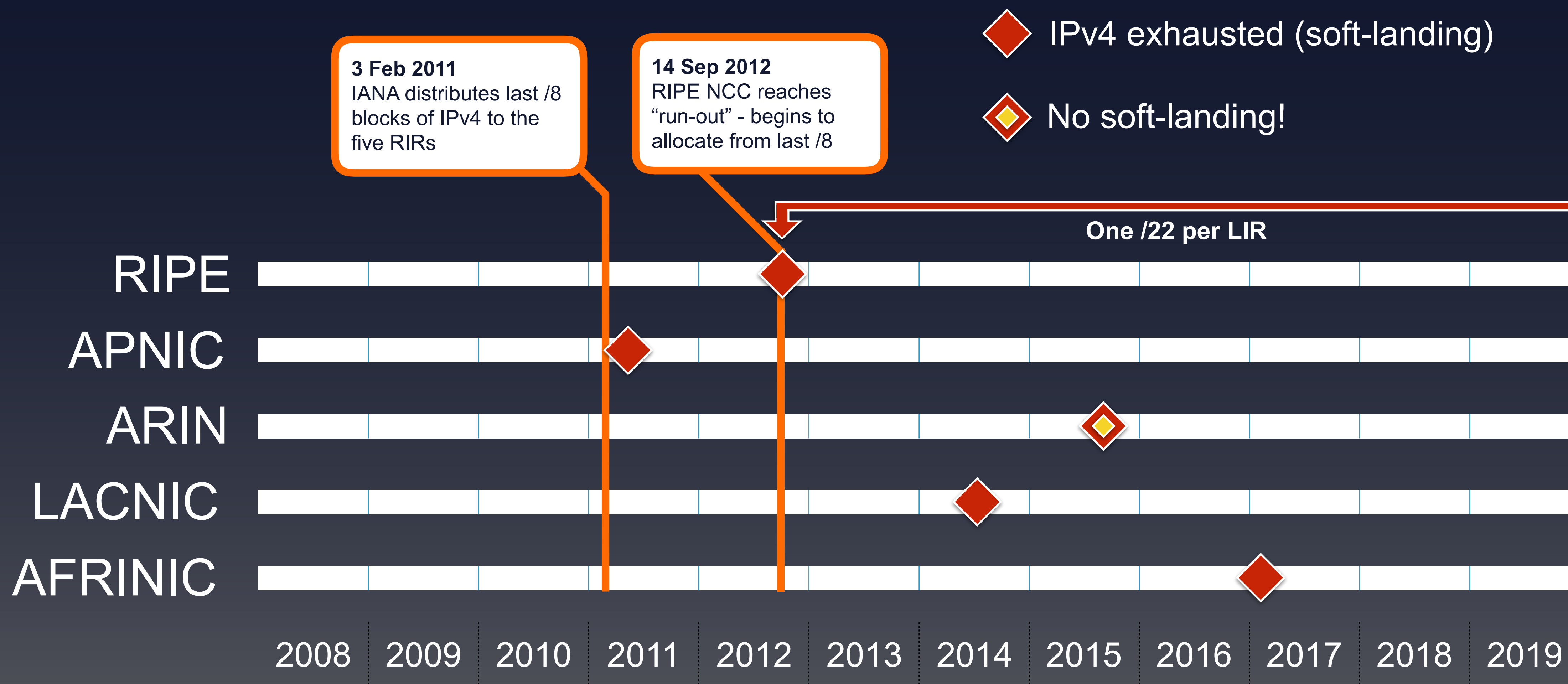
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NEWS

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

Puts more pressure on operators and enterprises to roll out IPv6

Timeline

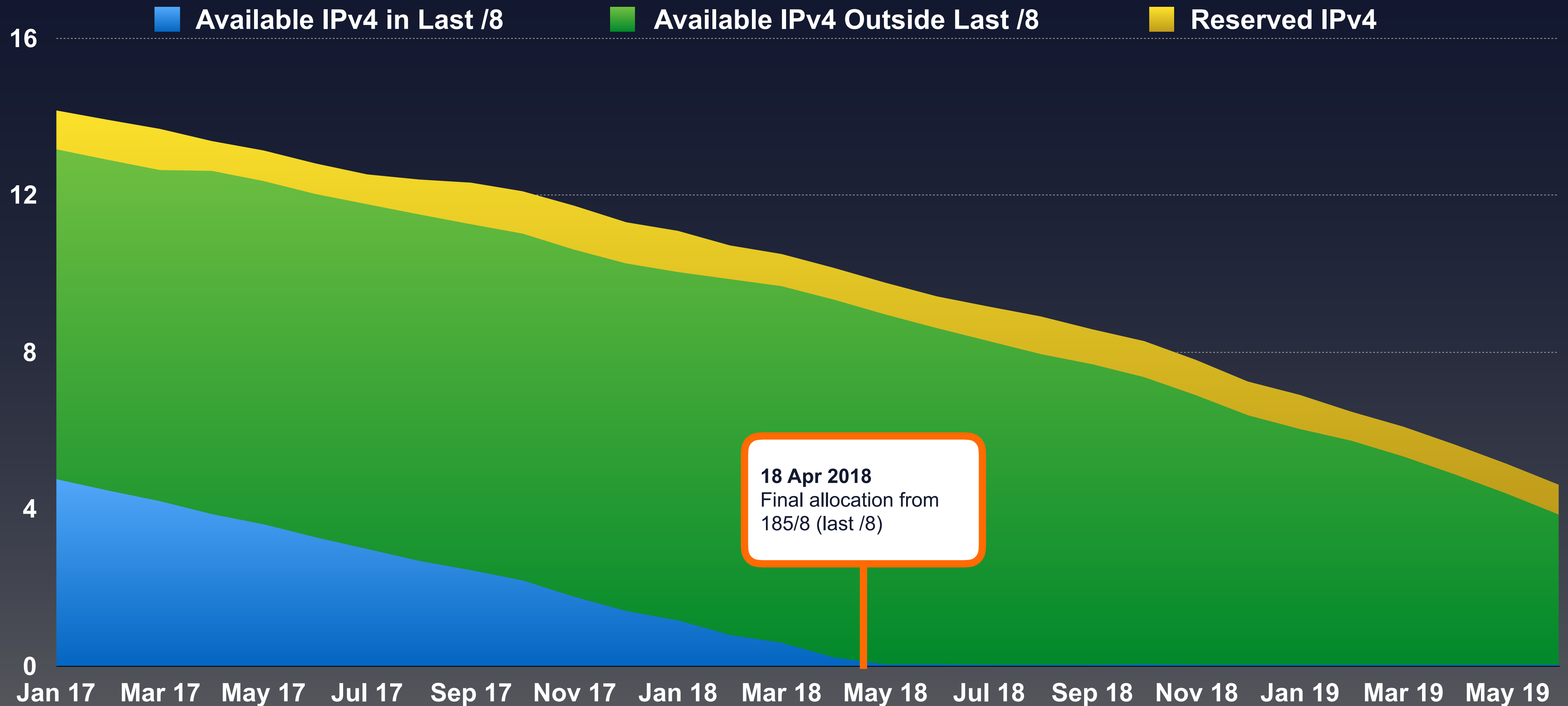


“Exhaustion” - “Depletion” - “Run-out”



- **In our region this meant “one final /22”**
 - For both new and existing members
- **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 January 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 ENOG 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**



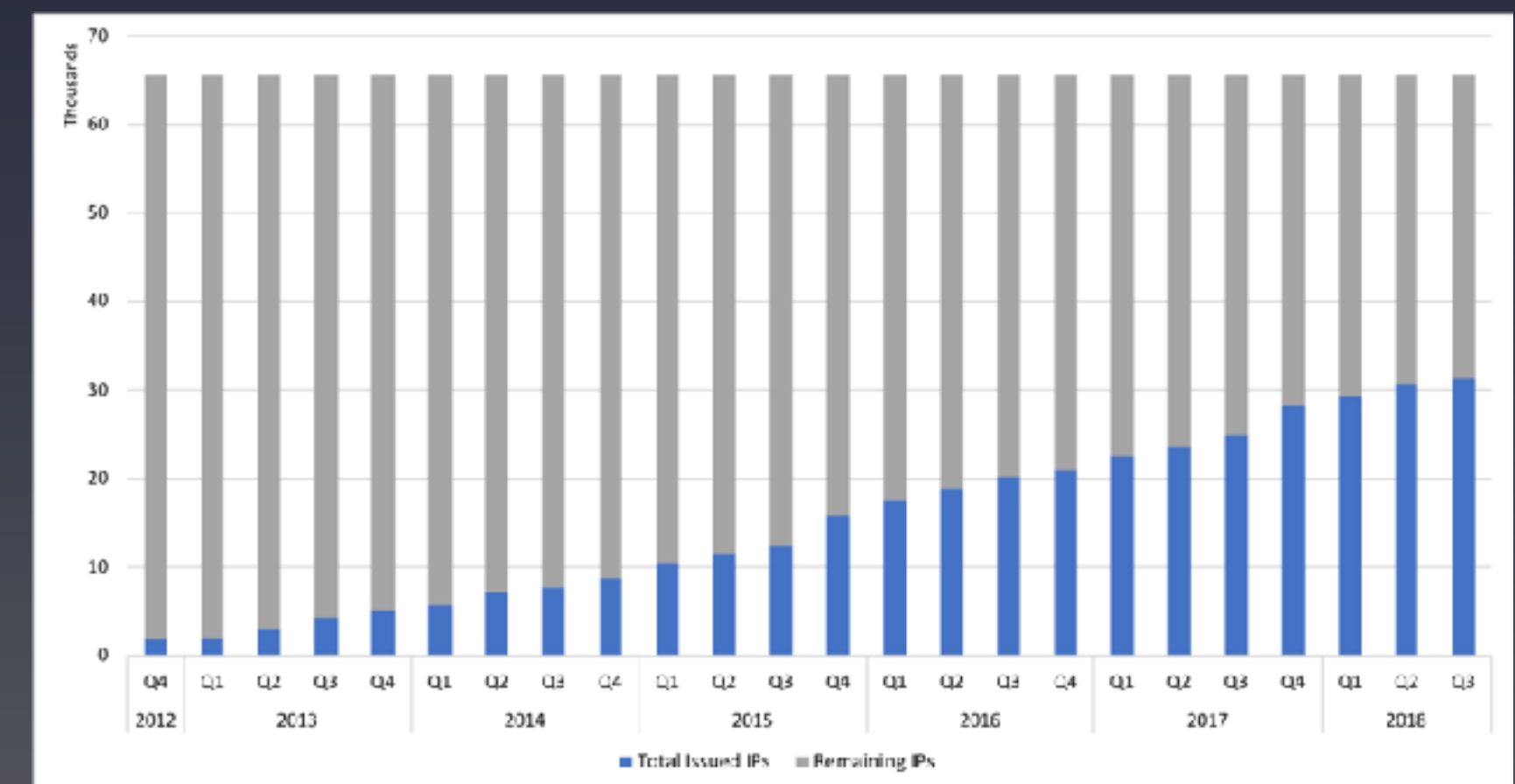
The Final Allocation

...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 members that have not already received a final /22 allocation will be eligible)



Policy Discussions

Reducing IPv4 Allocations to a /24

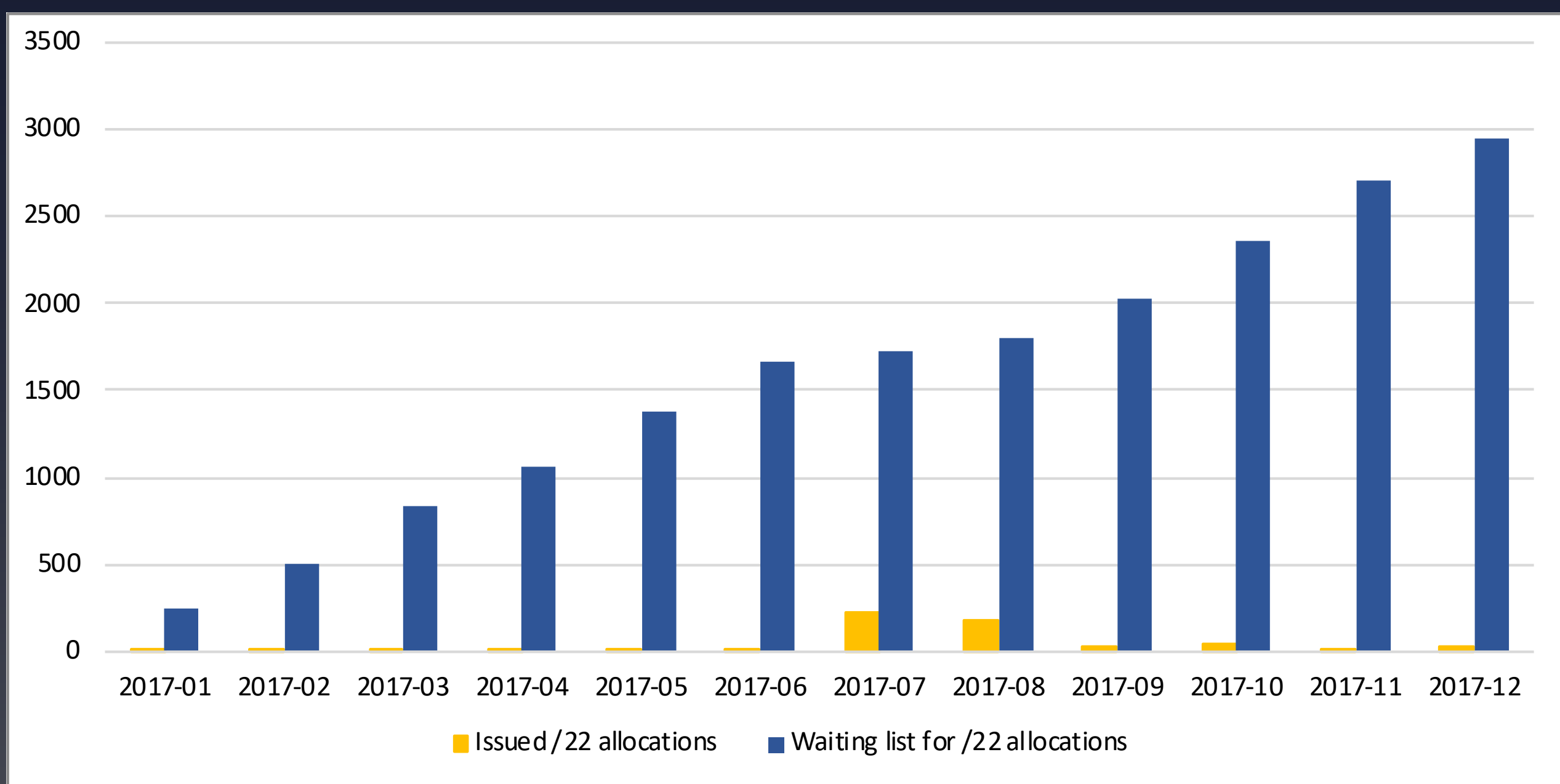


- Any returned addresses will be given out almost immediately if they are allocated as /22s
- /24s might enable a larger number of networks to connect their IPv6 infrastructure
- Current discussion in the Address Policy WG - 2019-02
“IPv4 Waiting List Implementation”
 - Once the RIPE NCC can no longer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

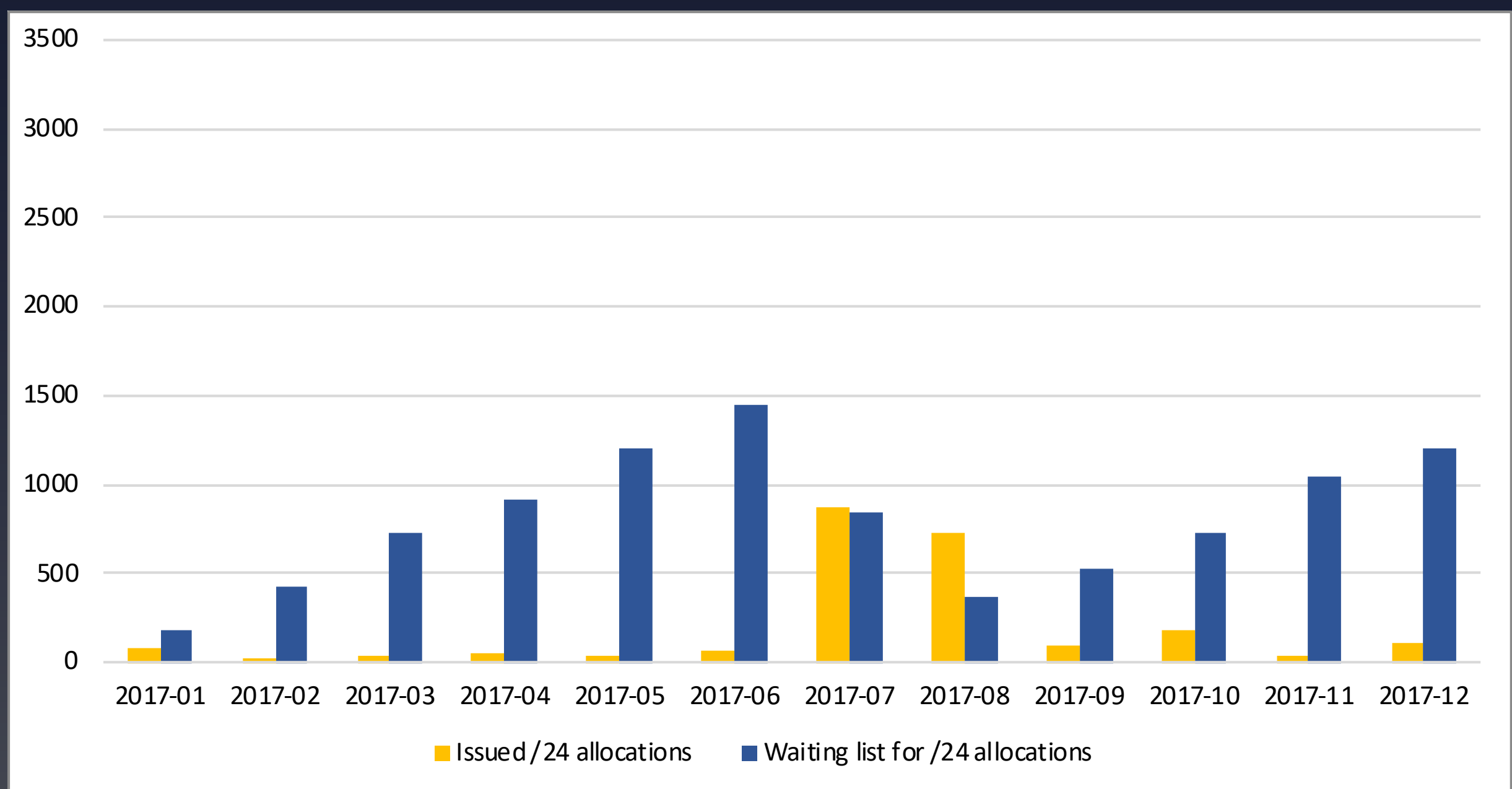
Waiting List Projections /22 vs /24



Model with /22 allocations



Model with /24 allocations



Other Questions from RIPE 77



- **Should more addresses be added to the IXP pool?**
 - Addressed in 2019-05 “Revised IPv4 assignment policy for IXP”: Changing IXP pool size from /16 to /15.
- **Should the community keep the /16 for unforeseen circumstances?**
- **What (if anything) should be done with the IPv4 “dust”?**
 - Addressed in 2019-02: All address blocks smaller than a /24 are declared unallocatable until the missing fragments are recovered by the RIPE NCC
 - Addressed in 2019-05: Upon request, assignments down to a /27 can be made for IXPs



Transfers and Hijacking

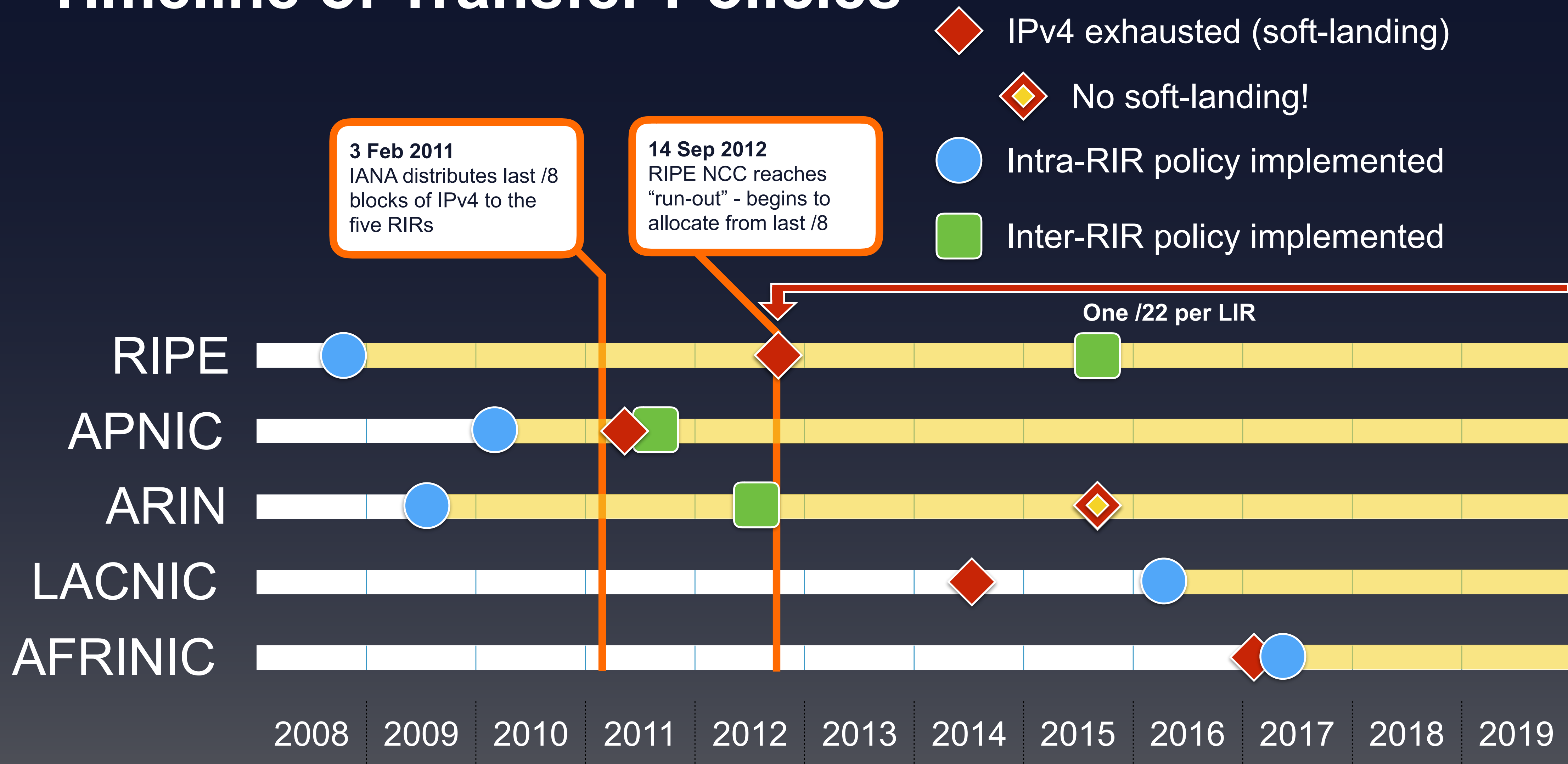
Products of IPv4 scarcity

Transfers: RIPE Community Policy Response

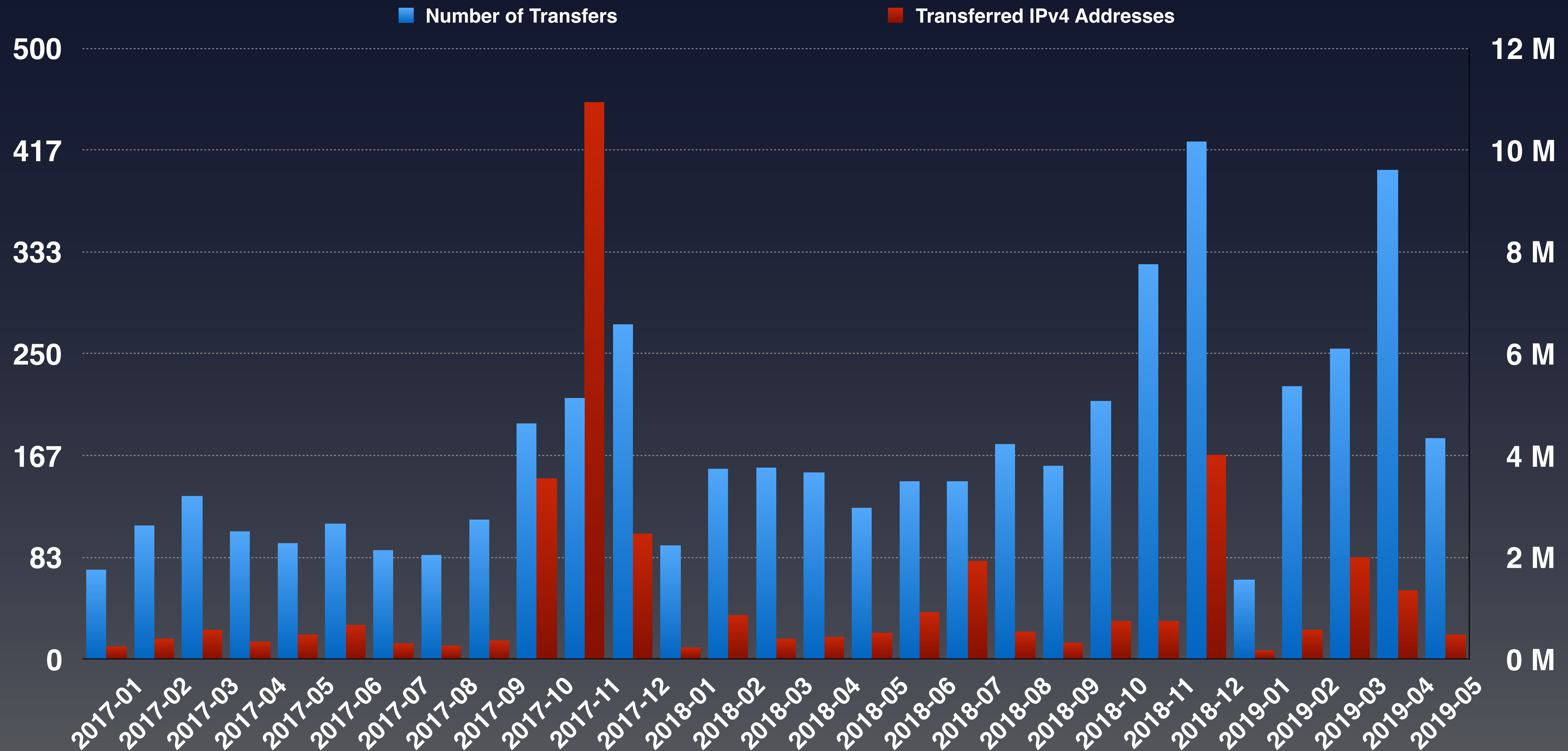


- **Trading in IPv4 addresses was seen as inevitable**
- **The priority is an accurate registry**
- **Current policy situation:**
 - LIRs and End Users can transfer IPv4 allocations/assignments
 - Transfers can be within the RIPE NCC service region and to/from other RIR service regions with compatible 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)

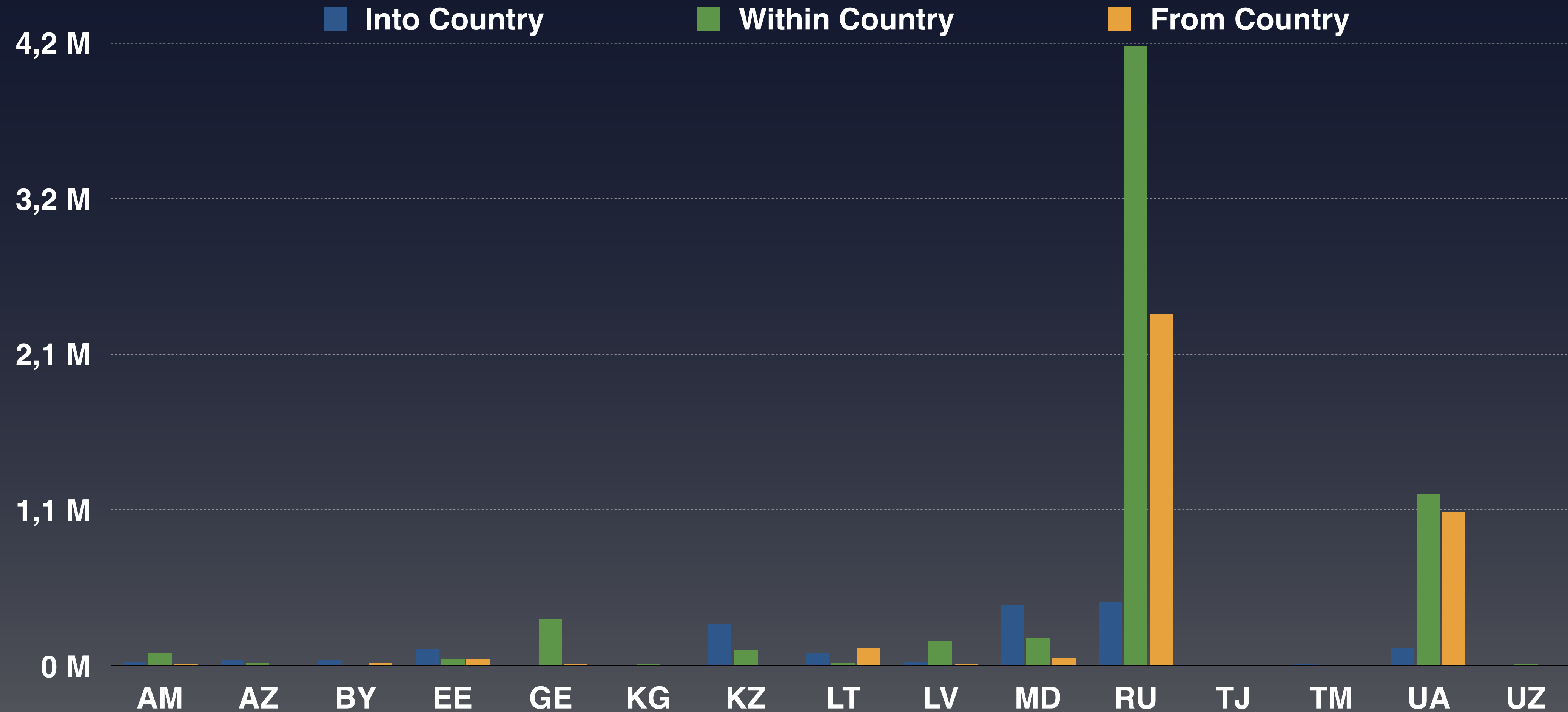
Timeline of Transfer Policies



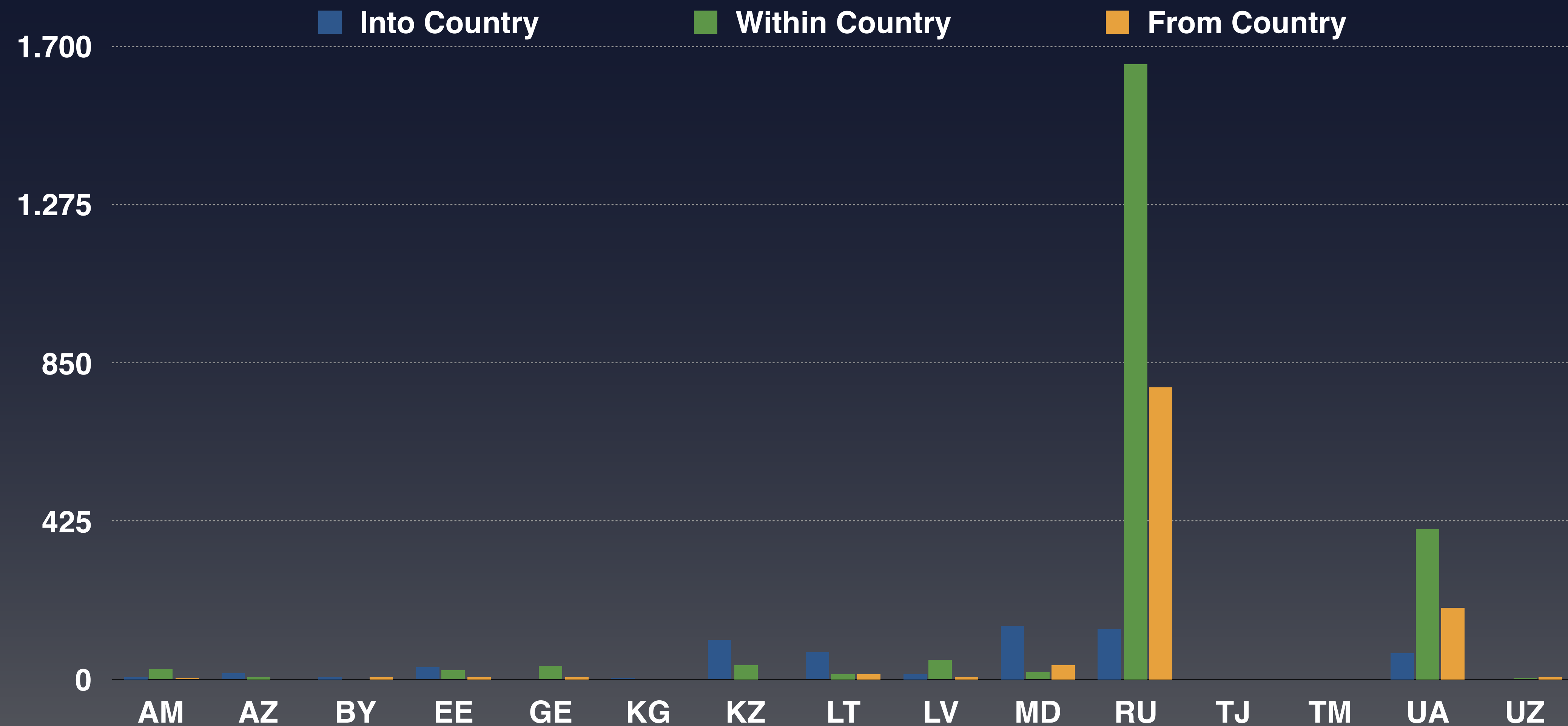
IPv4 Transfers in RIPE NCC Service Region (2017-2019)



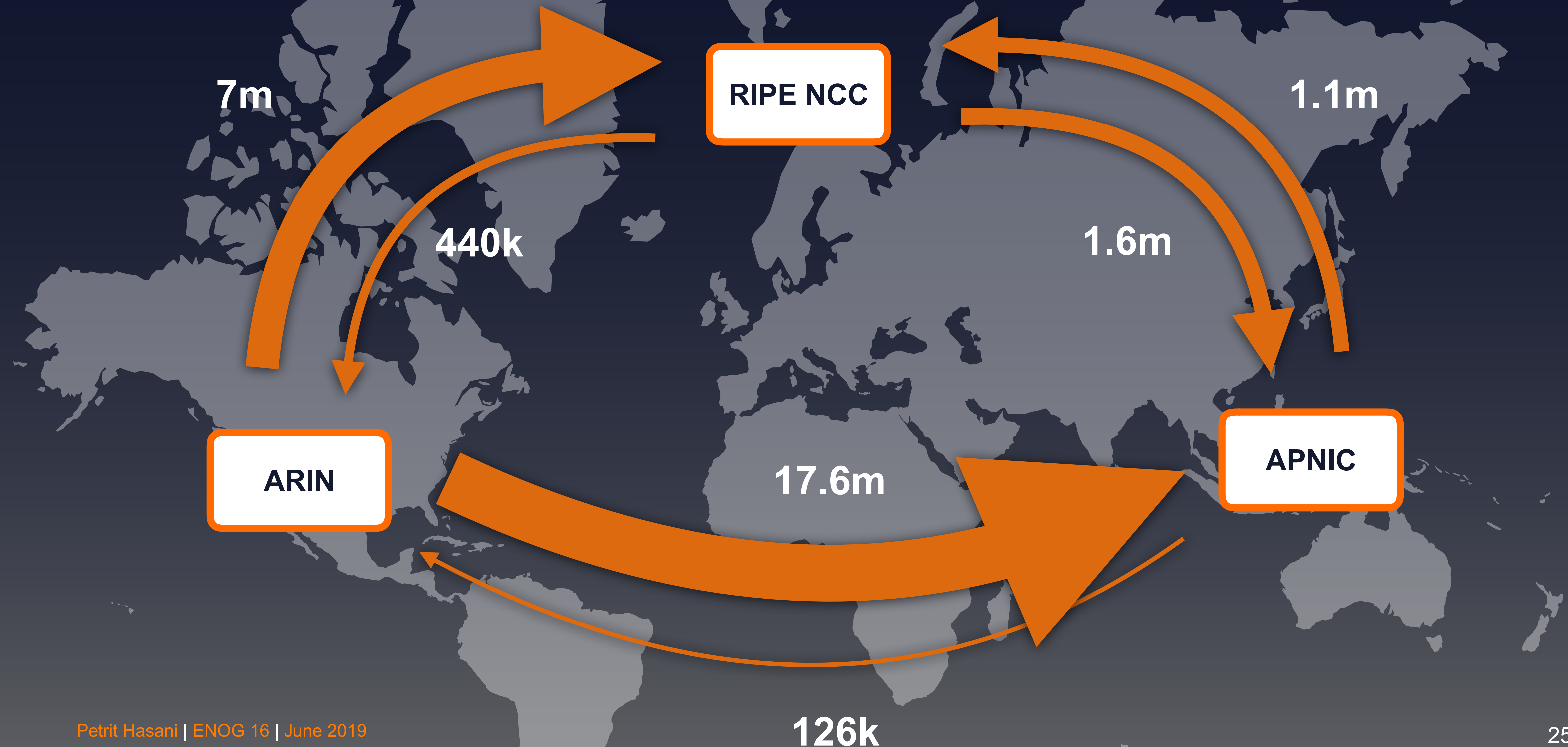
IPv4 Addresses Transferred in the ENOG Region



Number of IPv4 Transfers in the ENOG Region



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**

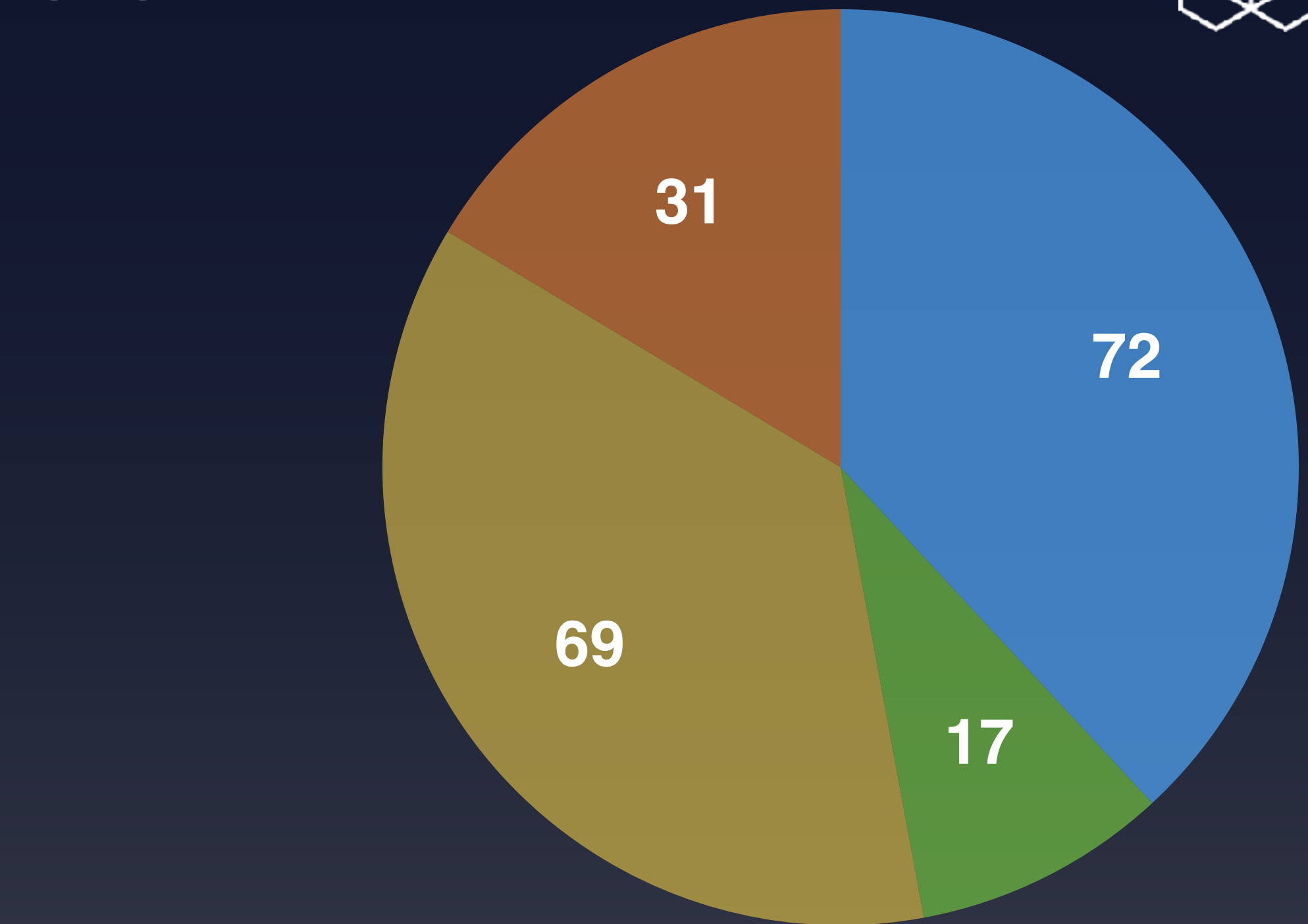
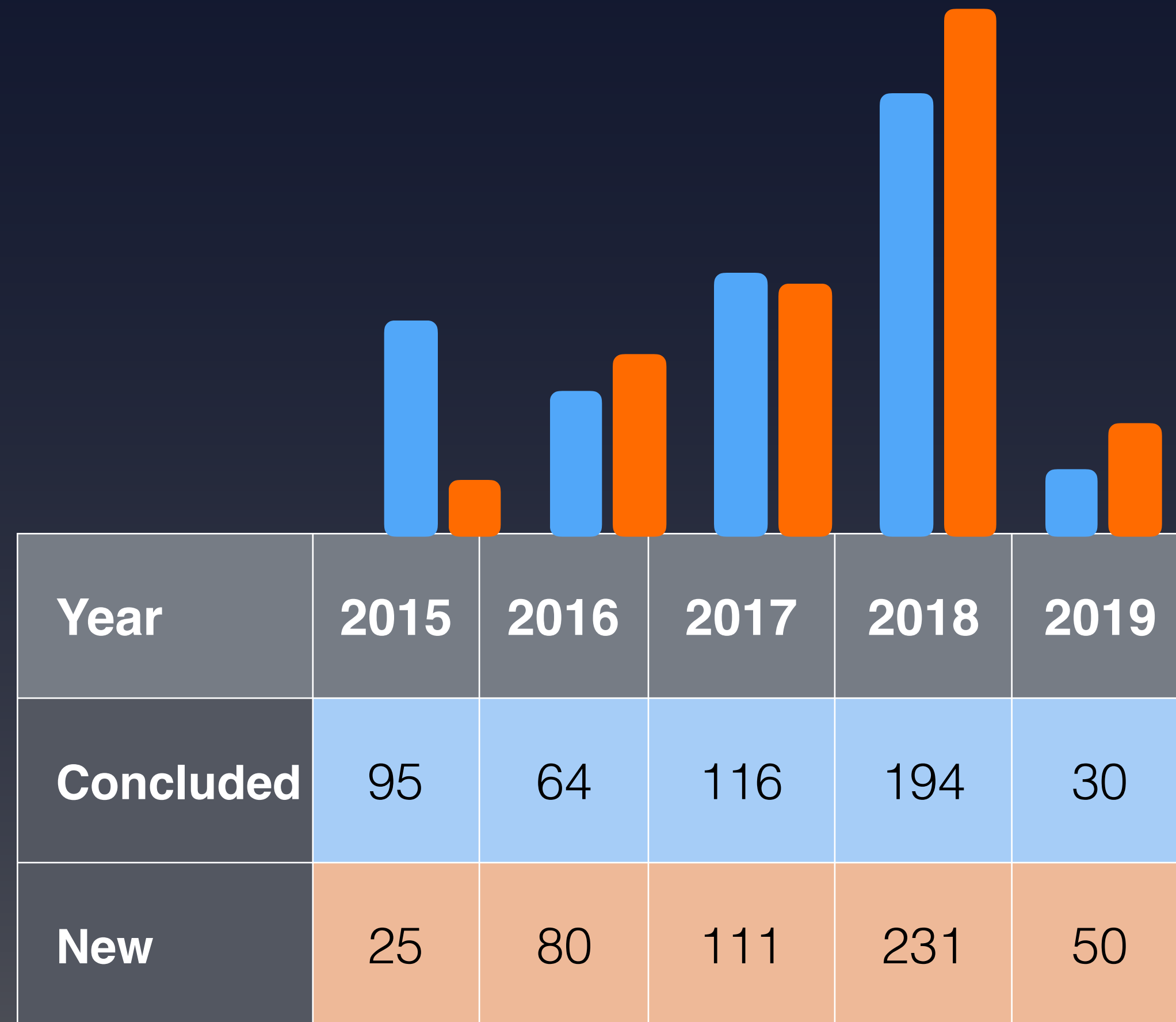
- LIR contacts removing other contacts from the LIR Portal
- LIR accounts opened on behalf of unaware organisations

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



- Due-diligence reminder*
- Final warnings**
- Member closures (SSA termination)
- 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



**Plentiful, 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



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What can we do better for you?

Tell us and you could win an iPad!

www.ripe.net/survey

