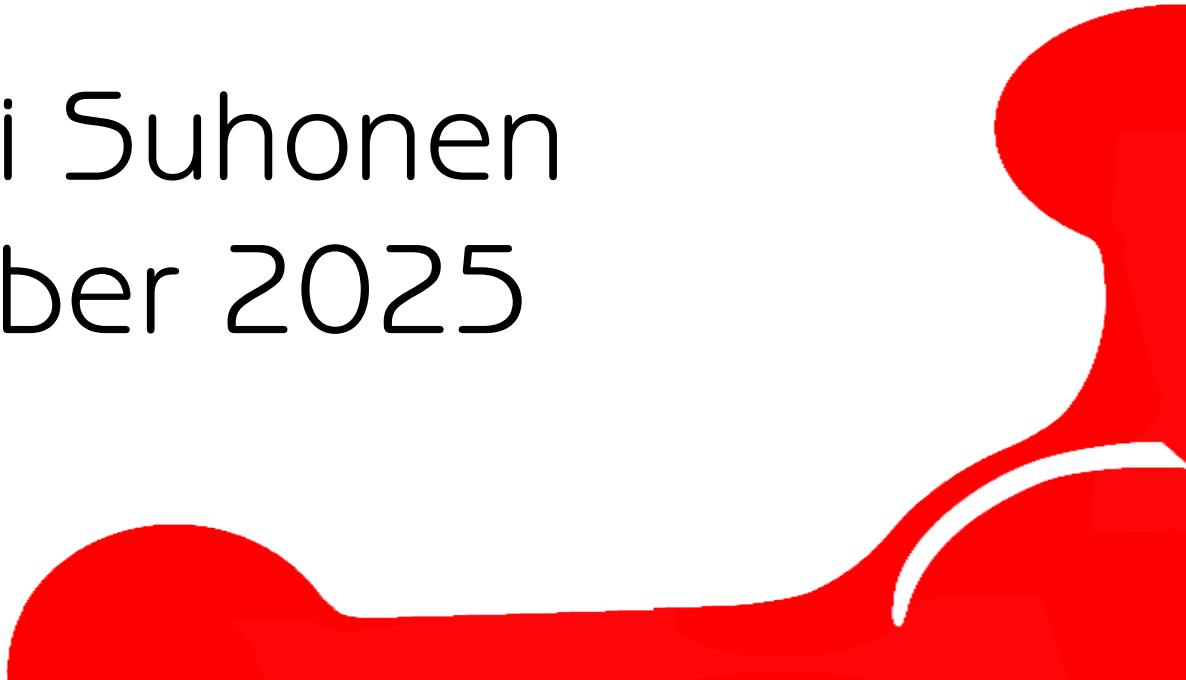


IPv6-only IXPs are Coming?

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A large, abstract red graphic is located in the bottom right corner of the slide. It consists of several rounded, overlapping shapes, resembling a stylized figure or a decorative element. The red is a vibrant, solid color.

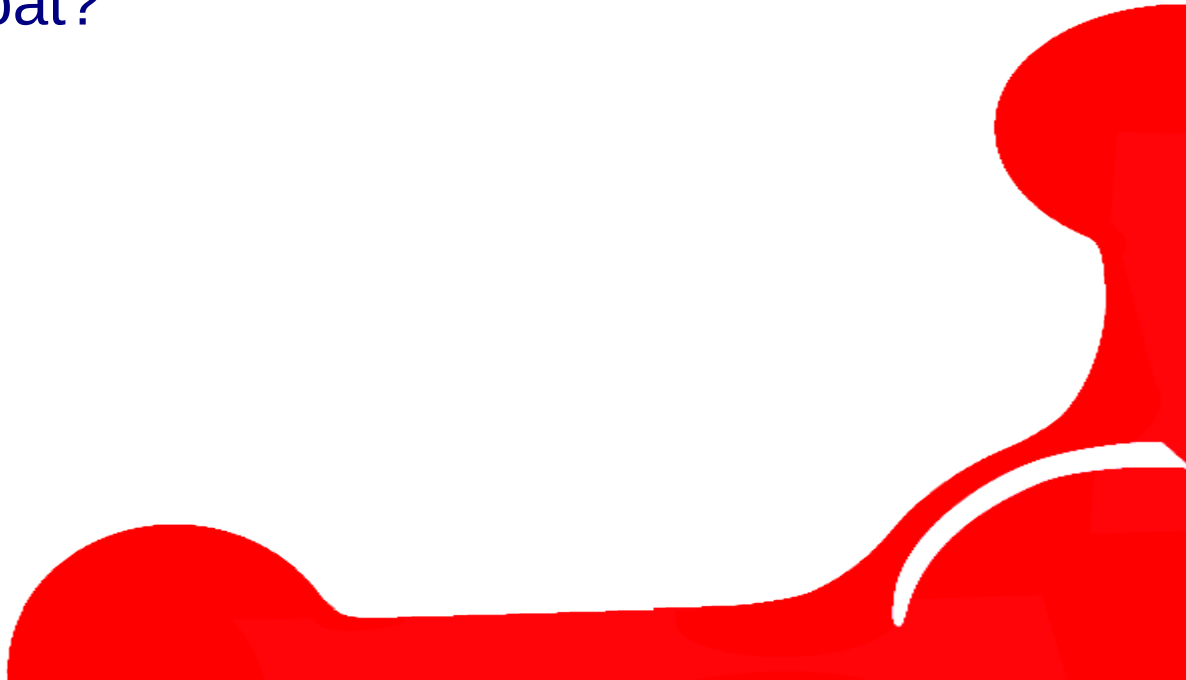
What's This All About?

- Making IPv4 last longer!
- RFC5549/8950 specifies a method for announcing IPv4 routes with IPv6 next-hop addresses using BGP
- Allows operators to save on IPv4 space in link networks
- The saved IPv4 space can go to NAT64 or CGNAT pools
- Routers still need **one** IPv4 address on a loopback interface for ICMP errors (traceroute, PMTUD etc) and various other uses
 - or they might send those messages from 192.0.0.8

RFC5549 In A Nutshell

- The original RFC5549 is from 2009
 - Initial implementations aimed mostly at MPLS VPN AFI/SAFIs
- RFC8950 replaced RFC5549 with a few small updates
- BGP routes for IPv4 nets will point to an IPv6 router address
- ARP replaced by IPv6 Neighbor Discovery (ND)
- IBGP next-hop-self even more important now
 - because some routers in IBGP might not support this spec

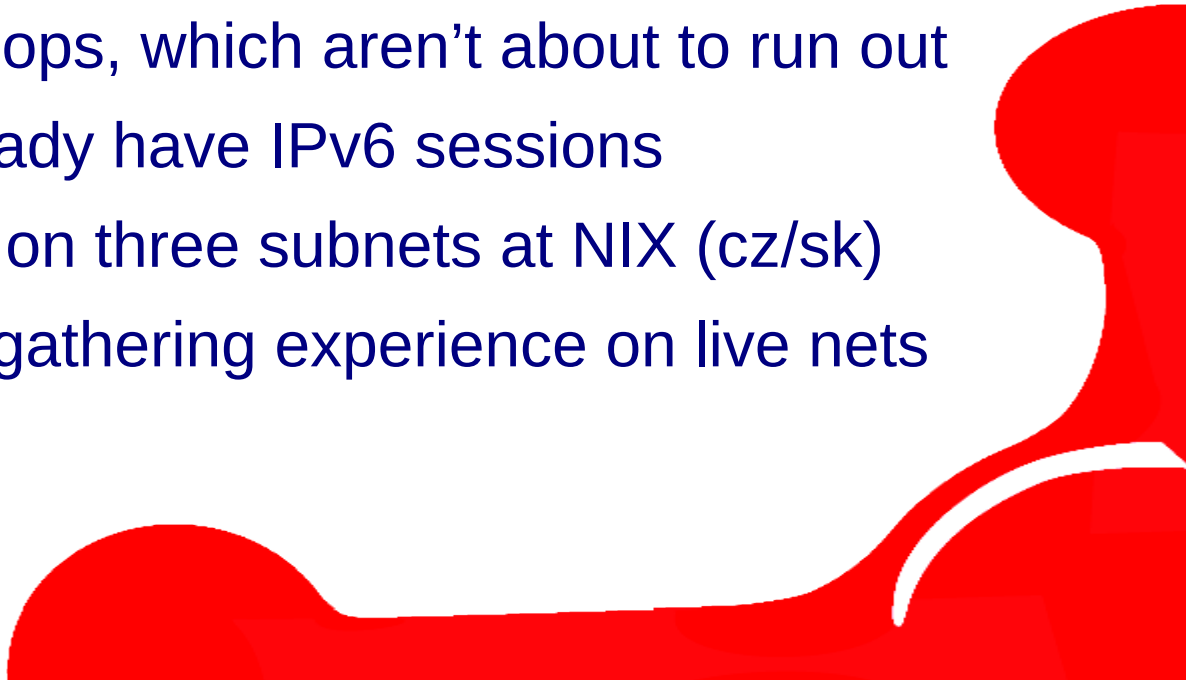
But IXPs? Why?

- Old IXPs already have IPv4 addresses
 - APNIC even has a special address assignment policy for IXPs
 - Why bother rocking the boat?
- 
- A large, abstract red graphic in the bottom right corner of the slide, resembling a stylized shape or a splash of paint.

Renumbering an IXP Is Painful

- France-IX renumbering took almost two years 2019-2021
 - Thanks to Radu-Adrian Feurdean for dates
- AMS-IX last renumbered (/22 -> /21) in 2014
- DE-CIX renumbered once and changed netmask twice
- Many more examples...

Alternative: One Final “Renumbering” Event

- When the peering subnet becomes full, think about whether you really want to go through the pain of renumbering again and again...
 - ... or switch to IPv6 next-hops, which aren't about to run out
 - All members typically already have IPv6 sessions
 - RFC8950 is in production on three subnets at NIX (cz/sk)
 - BCIX and TREX are also gathering experience on live nets
- 
- A large, abstract red shape with a white curved line, resembling a stylized 'P' or a decorative element, is located in the bottom right corner of the slide.

What About New IXPs?

- APNIC's IXP Address Space Assignment policy for IXPs:
 - Initial assignment is now /26
 - Multiple renumbering events needed even before you reach /24
- If we start with an IPv4 subnet, it's difficult to give it up later
- So take a chance to never have to renumber at all?
- We are trying this IPv6-only approach at TREX Turku
 - A new IXP, not a lot of connected members yet...

RFC8950-ixp Working Group

- Euro-IX started a working group to map out the challenges and to work on best practices for adopting RFC8950 at IXPs
 - Chairmen: André Grüneberg (BCIX) and Aleksi Suhonen (TREX)
 - Active members from DE-CIX, LINX, NIX.CZ, nic.cz ...
 - Also members from APIX, LAC-IX ...
- <https://github.com/euro-ix/rfc8950-ixp>
 - Pull requests accepted...
- There's also a mailing list and a mattermost chat channel

RFC8950 Challenges

- The original RFC5549 is from 2009
 - Initial implementations aimed mostly at MPLS VPN AFI/SAFIs
- Interoperability hadn't been tested much before this
- ICMP Unreachables unpredictable on some platforms
- Since we began this work, a lot of platforms have matured
 - We've discovered and reported many bugs
 - Some have been fixed
 - Some new platforms now support RFC8950

Junos Config Example 1/2

```
[edit interfaces irb unit 7]
description EXCHANGE_Turku;
family inet {
    filter {
        input spoof-protect-trex;
    }
}
family inet6 {
    filter {
        input 6spoof-protect-trex;
    }
    address 2001:7f8:1d:7::72f8:1/64;
}
```

- The family inet section has to exist for the router to process IPv4 traffic
- But it doesn't need an address.

Junos Config Example 2/2

```
[edit protocols bgp group peering-rfc8950]
type external;
export [ 6export_peering 4export_peering deny-all ];
import [ 4hygiene 6hygiene deny-tier1s 4import_peering 6import_peering deny-all ];
family inet {
    unicast {
        prefix-limit maximum 9999;
        extended-nexthop;
    }
}
family inet6 {
    unicast {
        prefix-limit maximum 999;
    }
}
```

Junos Show Route Example

```
axu@betty> show route 193.163.5.0 terse
```

```
inet.0: 975756 destinations, 1499988 routes (507404 active, 0 holddown, 728982 hidden)  
+ = Active Route, - = Last Active, * = Both
```

A	V	Destination	P	Prf	Metric 1	Metric 2	Next hop	AS path
*	V	193.163.5.0/24	B	170	300		>2001:7f8:1d:7:0:3:289b:2	207003 I
	V		B	170	300		>2001:7f8:1d:7:0:3:289b:1	207003 I
	V		B	170	100		>195.140.192.47	207003 I
	V		B	170	60	0	>195.140.192.13	6667 207003 I

```
axu@betty>
```

Thank you!

Questions?

