

# IPV6-MOSTLY EXPERIENCES AT 2 INDUSTRY EVENTS

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RIPE-90 IPv6 WG - IPv6-mostly at industry events

### IPV6-MOSTLY ?

#### In IPv6-Mostly networks, 2 classes of hosts

- IPv6-Only capable: do not use IPV4 at all
- Not capable: use dual-stack or IPv4-only

### Goal:

- Foster IPv6 adoption
- Lower IPv4 address consumption
- Until 100% are IPv6-only capable



## IPV6-MOSTLY IN I SLIDE



- IPv6-only capable hosts
  - Rely on client-level address translation (CLAT), IPv6 prefix from the PREF64 RA to do translation of IPv4 addresses to v6
  - Decline to request IPv4 address if DHCPv4 server replies to DHCPv4 option 108 RFC 8925 "IPv6-Only Preferred Option for DHCPv4"
- <u>https://datatracker.ietf.org/doc/draft-ietf-v6ops-6mops/</u> by Nick Buraglio , Ondřej Caletka , Jen Linkova



### THE EXPLORERS

- Several other explorers of this route
  - Jen Linkova @ Google
  - Ondřej Caletka for RIPE network since RIPE-85 October 2022 !
  - David Stockdale, Imperial College London with 20.000 students, see <u>https://www.ipv6.org.uk/wp-</u> <u>content/uploads/2024/10/08\_IPv6-</u> <u>Mostly\_at\_Imperial.pdf</u>

## CISCO LIVE

- Amsterdam, February 2025
- 20.000 attendees
- Technical sessions and exhibition by Cisco for its customers
- Cisco NOC has months to prepare and do very careful planning (including contingency plans)
- Default SSID was IPv6-mostly
- Public IPv6 space, private IPv4



### Wired Core Team











Lionel <u>Hercot</u>

James Botting

Andrew Yourtchenko Martin <u>Kriska</u>

Ivan Ivanov



# EDGE DESIGN



2x ASR 1002-HX for NAT44 and Native IPv6 2x ASR 1002-HX for NAT64 only /26 of V4 public per NAT pool Each unit BGP peered to Venue Ix 10Gb/s connectivity to Venue 2x 40Gb/s to core

## NAT64 DESIGN



Aspiring for 100% IPv6 inside the network

8

IPv4 Traffic 83.97.13.0/24

### NAT64 MORE POPULAR THAN EXPECTED SEGMENTING YOUR IPV4 SPACE BETWEEN NAT44 AND NAT64 IS TRICKY

- Didn't really know how popular NAT64 would be over NAT44 edge.
- Ultimately, not enough addresses in NAT64 pool and too many in NAT44
- Changed translation expiry timers to resolve, added more IP's out of hours.
- Additionally, some split tunnel VPNs policies didn't like CLAT

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	Time	Event
	2/11/25 2:23:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.1 Thread:013 TS:00001045967706653903 host = corel-nat64 source = sc4s sourcetype = ciscorios</pre>
	2/11/25 2:22:23.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.0 Thread:041 TS:00001045907705145316 host = corel-nat64 source = sc4s sourcetype = cisco:ios</pre>
	2/11/25 2:20:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.1 Thread:062 TS:00001045787702266807 host = corel-nat64 source = sc4s ; sourcetype = cisco:ios</pre>
	2/11/25 2:19:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.0 Thread:247 TS:00001045727701264995 host = core1-nat64</pre>
	2/11/25 2:18:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.0 Thread:030 TS:00001045667699795864 host = corel-nat64 source = sc4s ; sourcetype = cisco:ios</pre>
	2/11/25 2:17:21.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.1 Thread:073 TS:00001045607699166472 host = core1-nat64 source = sc4s   sourcetype = cisco:ios</pre>
	2/11/25 2:16:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.1 Thread:175 TS:00001045547695930319 host = corel-nat64 source = sc4s ; sourcetype = cisco:ios</pre>
	2/11/25 2:15:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.1 Thread:217 TS:00001045487695689167 host = core1-mat64</pre>
	2/11/25 2:14:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.0 Thread:220 TS:00001045427695452648 host = corel-nat64 source = sc4s sourcetype = cisco:ios</pre>
	2/11/25 2:13:22.000 PM	<pre>%NAT64-6-ADDR_ALLOC_FAILURE: Address allocation failed; pool 1 may be exhaustedQFP:0.0 Thread:167 TS:00001045367693901283 host = core1-nat64 source = sc4s sourcetype = cisco:ics</pre>



## MAIN SSID V6 MOSTLY SUPPORT





Total IPv4 Volume 42.64 тв Total IPv6 Volume 45.18 тв

Percent of Total Internet Traffic That Is IPv6

51.5%

Total Internet Volume since Core Power-on



# TOTAL TRAFFIC TO THE INTERNET...

20,000 attendees over five days

### IETF 122

- Bangkok, March 2025
- 764 onsite registered participants
- Typical geek audience
- Default SSID is dual-stack
  - Plan for IETF-123 IPv6-Mostly ;-)
- "ietf-ipv6-mostly" widely advertised and used by many
- Public IPv4 and IPv6 space



## **IPV6-MOSTLY COMPONENTS**



# ALL WAS GOOD FOR MACOS AND PHONES, BUT...

## Sunday Evening...

Bill mentions, I can't join ietf-ipv6-mostly...

# ietf-ipv6-mostly

### In the process of debugging, we discovered IPv6 Mostly was IPv6 [NAT64] Only

- DHCP discovers weren't being relayed to Kea
- Kea wasn't configured for Option 108 😬

# After Much Troubleshooting



```
static {
                                                   SRX
  rule-set NAT64 {
    from zone [ junos-host nat64 ];
    rule NAT64 {
      match {
       source-address 2001:67c:370:1998::/64; <====== "the line"
        destination-address 64:ff9b::/96;
      then {
        static-nat {
          inet;
```

- Without The Line<sup>™</sup>, DHCP replies were being eaten by the SRX
- No one knows why this line is needed as it's not documented in examples for NAT64
- In addition, Kea needed option 108 (set to 900), and Unbound needed to hand out DNS64<sup>\*</sup>

 $^{\ast}$  Config was finalized, but too late. So DNS64 over v6 and DNS over v4

# Overall, People Seem Happy





### REAL LIFE EXPERIMENT WITH ENGINEERS

- Discovery: MacOS SSH forced to an IPv4 host address. This didn't work. But Tommy Pauly @ Apple was told and hacked up a fix while at the meeting <sup>©</sup>
- "Great environment to deploy such features because when things go wrong, the right people are in the room to fix the problems !" (Quote: Joe Clarke, IETF NOC)

### IPV6-MOSTLY SUMMARY

- If you pay attention, it is not hard at all
- Network operations and debugging are different => ! Learning curve
- Issues & limitations:
  - Split-tunnel VPN (esp. MacOS)
  - Slack weirdness
  - Some corporate MDM (for DNS64)
  - Microsoft Windows current lack of support for CLAT & RFC 8925 are still dual-stack hosts

