# RIPE
Réseaux IP
Européens

# IPV6-MOSTLY EXPERIENCES AT 2 INDUSTRY EVENTS

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Slide content by Joe Clarke, Cisco, Cisco Live & IETF NOC member
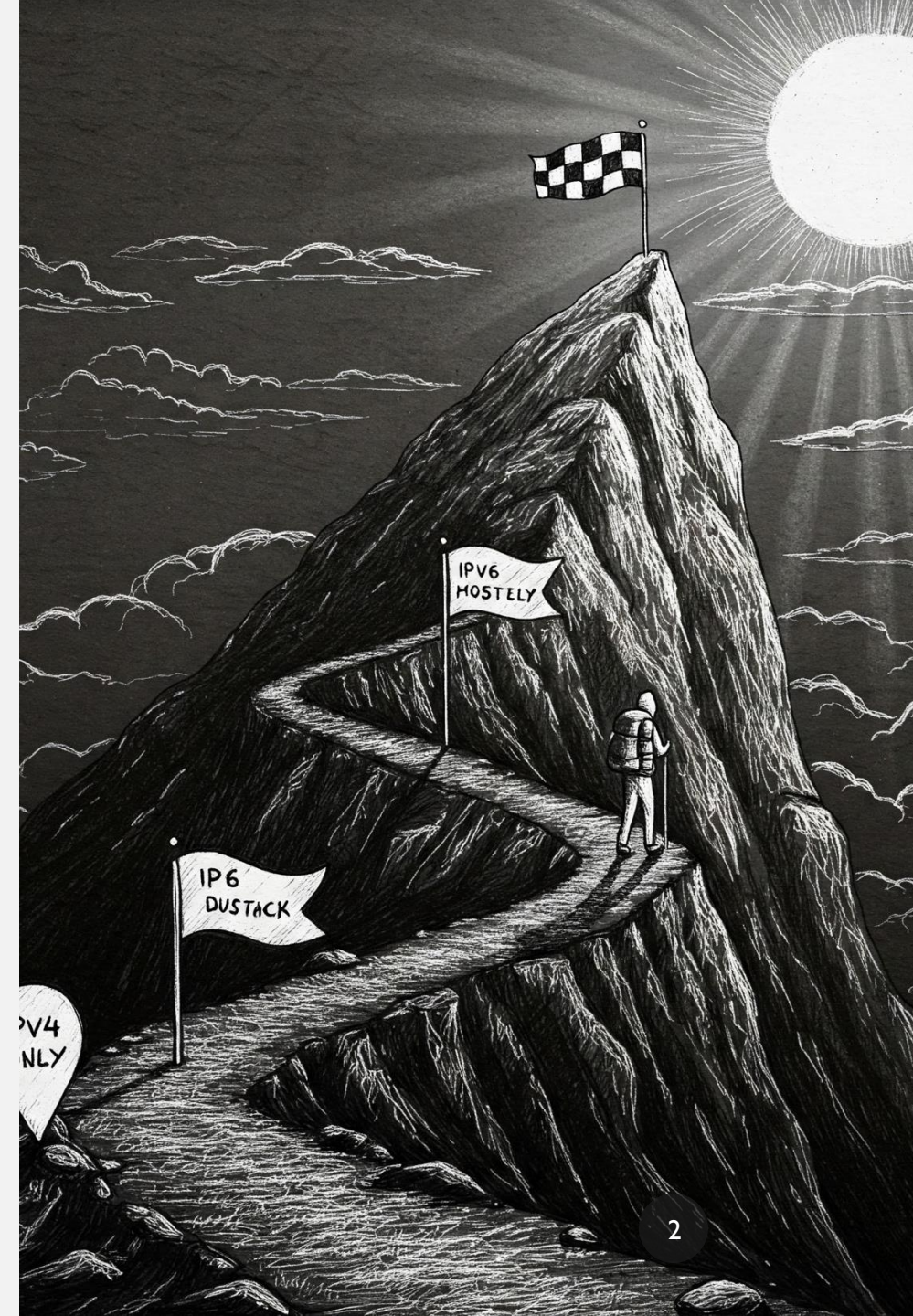
GenAI graphics by Gemini

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# IPV6-MOSTLY ?

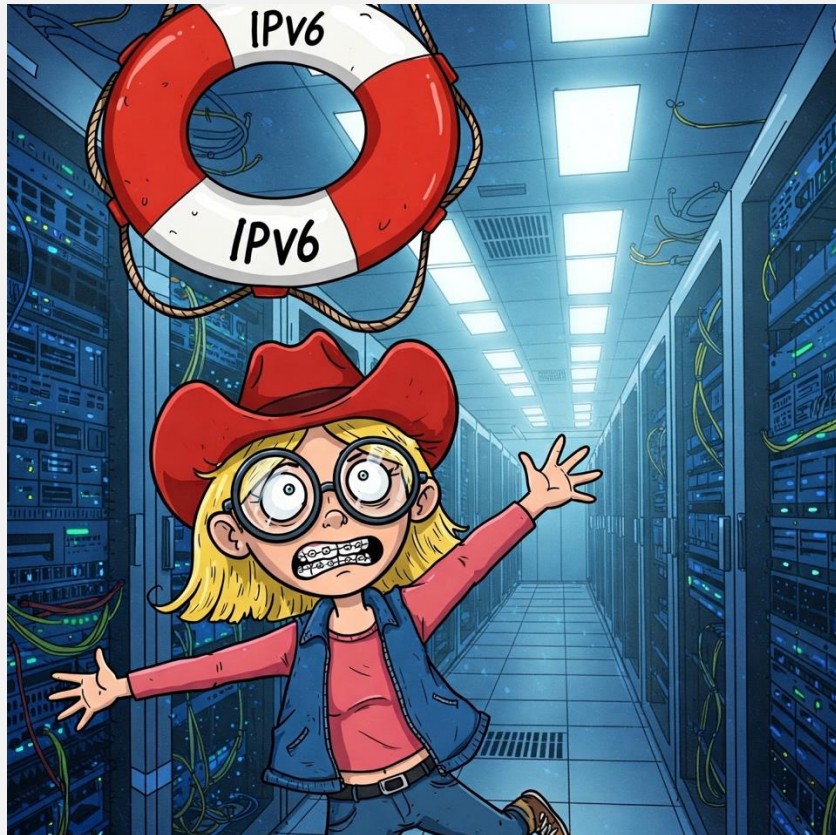In IPv6-Mostly networks, 2 classes of hosts

- 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 1 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"

- https://datatracker.ietf.org/doc/draft-ietf-v6ops-6mops/ 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 https://www.ipv6.org.uk/wp-content/uploads/2024/10/08_IPv6-Mostly_at_Imperial.pdf

# 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)
- <mark>Default SSID was IPv6-mostly</mark>
- <mark>Public IPv6 space, private IPv4</mark>
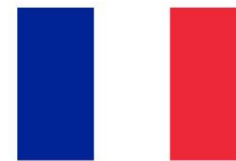
# Wired Core Team



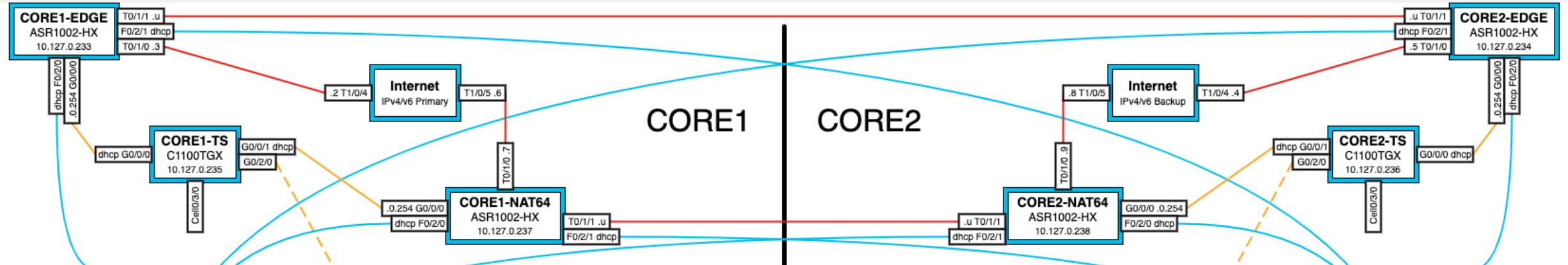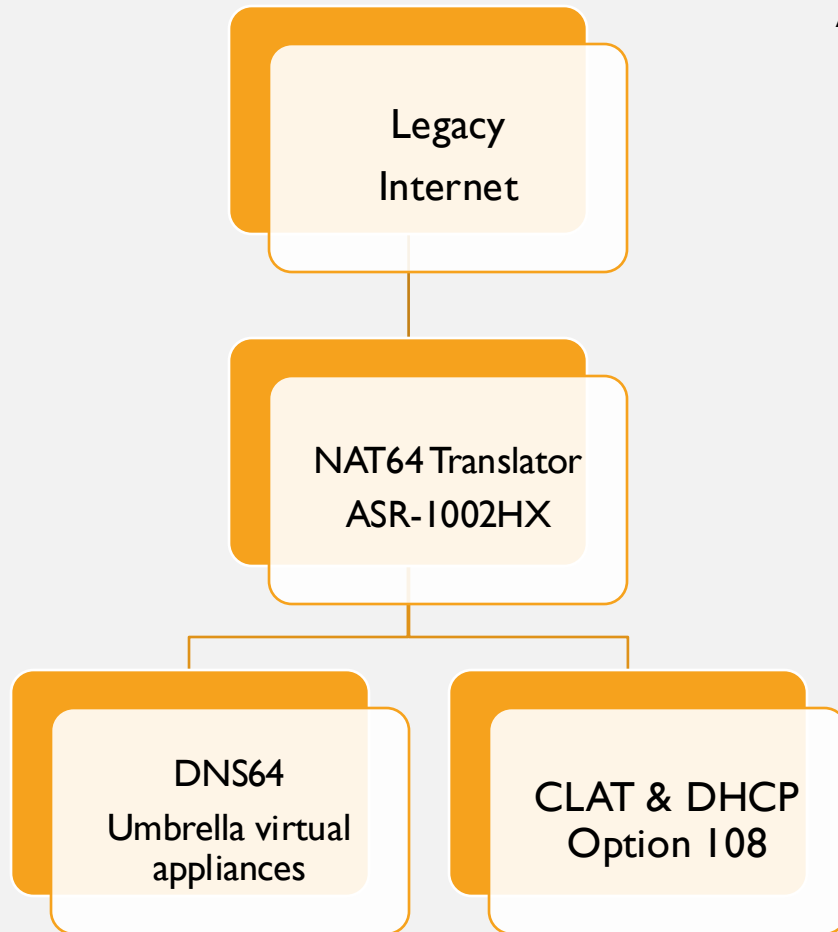| Lionel Hercot | James Botting | Andrew Yourtchenko | Martin Kriska | Ivan Ivanov |

# 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
1x 10Gb/s connectivity to Venue
2x 40Gb/s to core

# NAT64 DESIGN

Legacy
Internet

NAT64 Translator
ASR-1002HX

DNS64
Umbrella virtual
appliances

CLAT & DHCP
Option 108

Aspiring for 100% IPv6 inside the network

IPv4 Traffic
83.97.13.0/24

IPv6 Traffic
64:ff9b::/96

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# 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, Cisco Secure Client split tunnel VPNs didn't like CLAT*

MAIN SSID V6 MOSTLY SUPPORT

Total Internet Volume since Core Power-on

# 90.26 TB

## TOTAL TRAFFIC TO THE INTERNET...

20,000 attendees over five days

# IETF 122

- Bangkok, March 2025

- 764 onsite registered participants

- Typical geek audience

- <mark>Default SSID is dual-stack</mark>

  - *Plan for IETF-123 IPv6-Mostly ;-)*

- <mark>"ietf-ipv6-mostly" widely advertised and used by many</mark>

- <mark>Public IPv4 and IPv6 space</mark>



IETF 122 Bangkok
15-21 March 2025

photo by Brian Campbell

# IPV6-MOSTLY COMPONENTS



NAT64/44 gateway, DHCP relay, & LAN router (i.e., RA source)

SRX4600-AC

DNS64 Server

unbound

Wireless controller

9800 WLC

kea

DHCP Server
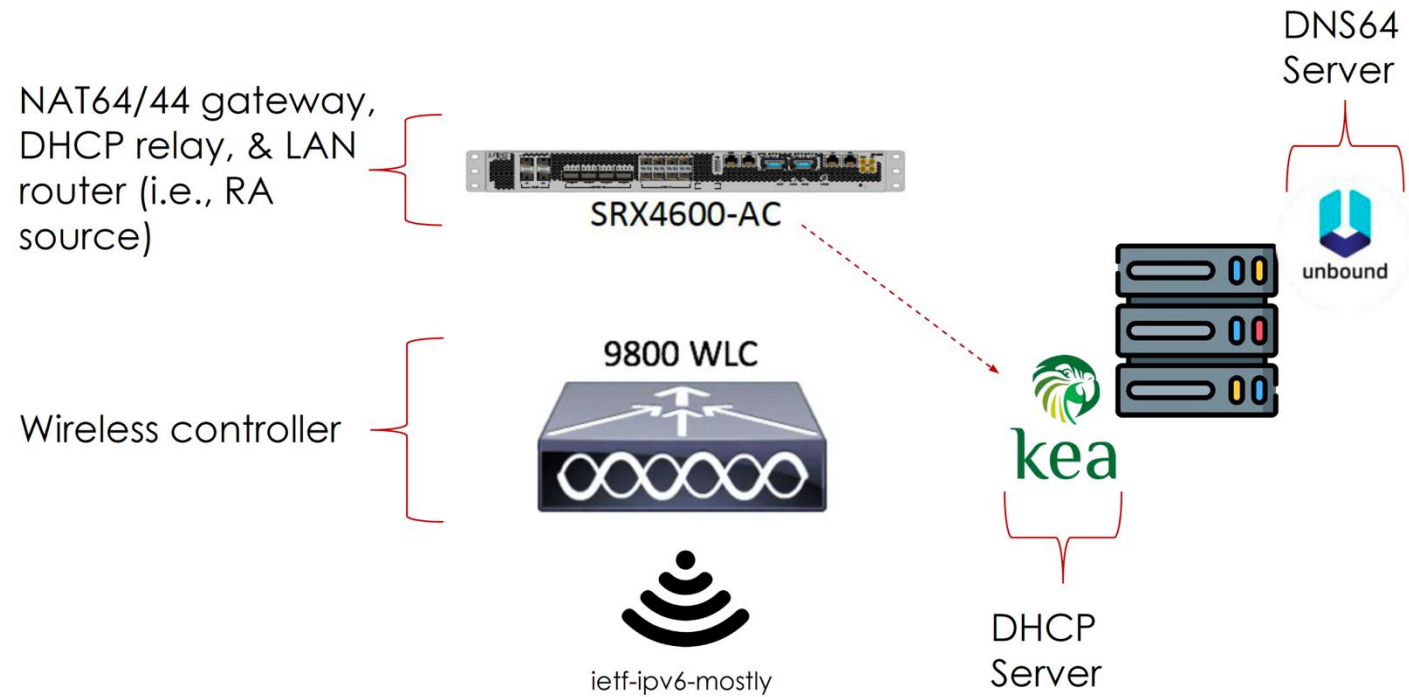
ietf-ipv6-mostly

# 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 😬

```
static {
    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;
                }
            }
        }
    }
}
```

**SRX**

- Without **The Line™**, 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[*]

[*]Config was finalized, but too late. So DNS64 over v6 and DNS over v4

# Overall, People Seem Happy

| Name | Last * ⌄ | Max | Mean |
|------|------|-----|------|
| ▬ SSID: ietf | 274 | 582 | 201 |
| ▬ SSID: ietf-ipv6-mostly | 100 | 138 | 29 |
| ▬ SSID: eduroam | 18 | 52 | 19 |
| ▬ SSID: ietf-legacy122 | 0 | 1 | 0 |

And 371 "unique" clients total

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

# 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 ☺

- *"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