

Microsoft CSEO: Ongoing journey to IPv6-only

Veronika McKillop Network Architect Cloud and Connectivity Engineering (CCE)

RIPE 79 Rotterdam, NL October 2019

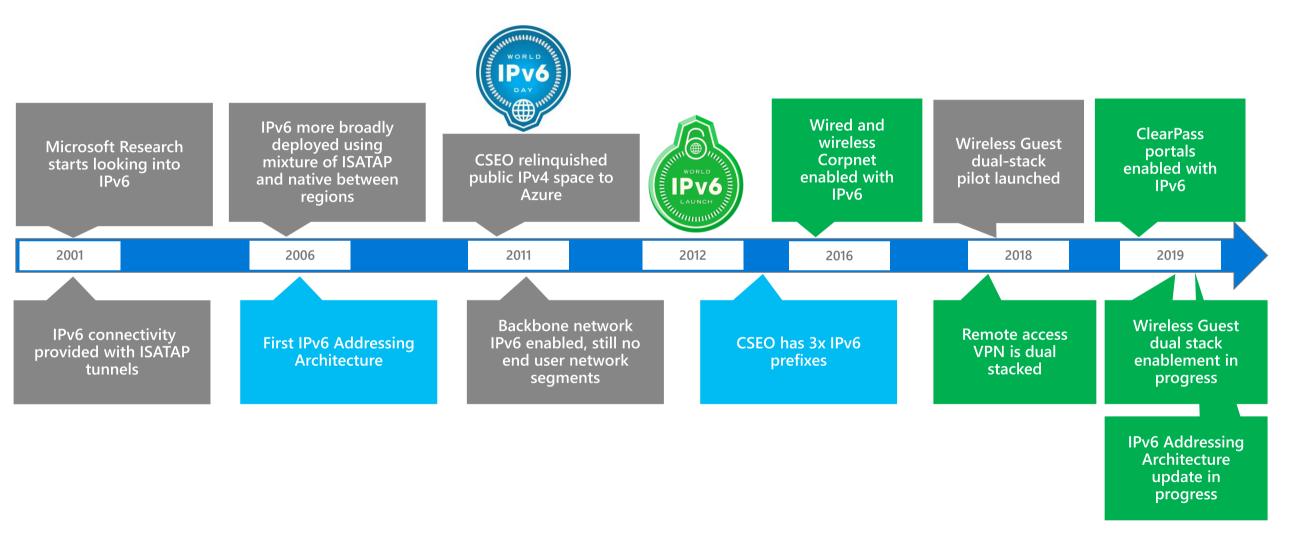


Network Overview

- Four regions with smaller campuses and branch offices
 - Puget Sound (Redmond, WA) the main campus
 - North America, Europe/Middle East/Africa, and Asia Pacific
 - 790+ locations
- On-premise DCs and services in Azure
- Branches WAN connectivity is MPLS, Internet through dedicated Edge locations
- ~ 149K+ employees (~250K end users)
- ~ 2200 LOB applications managed by Microsoft CSEO
- ~ millions of devices use the networks daily
- ~ 80K DNS request/second

NEW: Network Segmentation initiative in progress

Past & Present of Dual-stack in CSEO/Microsoft



Since 2018: the biggest change was the mindset – it's OUR problem to solve.

Dual-stack on Corporate & Guest Networks

- SLAAC + Stateless DHPCv6
- RDNSS is supported in Windows since May 2017 (Creators update)
 - October 2019 Microsoft has an Android-based product (Surface Duo phone)
- Building routers support RDNSS since early 2017 too
- Guest infrastructure requires quite a lot of work

- Internal resources still IPv4-only Azure Express Route dependency -> impact on user IPv6 traffic levels
 - IPv6 must be enabled end to end

Remote Access VPN

- Dual-stacked on the inside
 - Deployed in H1 CY2018, native Windows VPN client and thick client
 - ~250,000 users
- It works on IPv6-only through NAT64 ☺
- VPN is a big consumer of IPv4 address space we want IPv6-only inside the tunnel
- Initial test in autumn 2017 discovered vendor's dependency on IPv4 – fixed in early 2019!
- IPv6-only User Pilot is ready to go
 - NAT64/DNS64 for IPv4-only corporate resources
 - We perform split-tunneling Internet traffic not sent through VPN

Problem with Dual-Stack? It hides IPv6 **

IPv6-only

Microsoft Drivers for IPv6-only

- Industry pressure = Microsoft Product Group requirements
 - June 2015 Apple WWDC announced IPv6-Only
 - >87 apps in Apple App Store



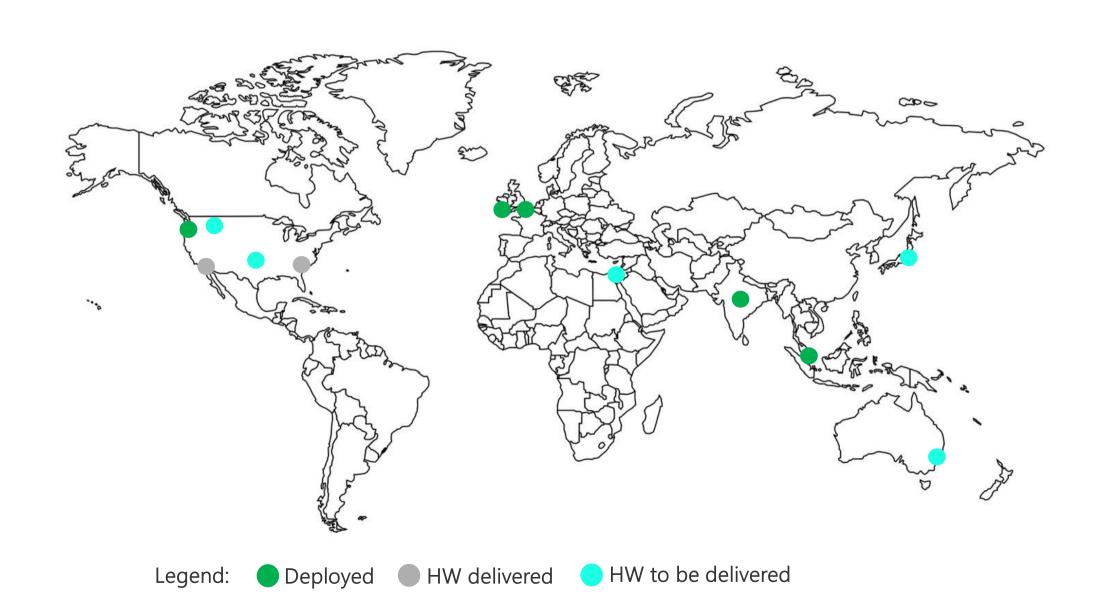
- Azure; Acquisitions (Nokia, LinkedIn, GitHub etc.)
- Outsourcing partners also use the same 10./8 space issues for VPN
- Exhaustion of IPv4 space (RFC1918) is imminent
- Operational complexity of dual stack
 - Sizing of IPv4 subnets questioned in each design review? IPv6 gets "forgotten"? Switched off?!?
- We already feel the business impact of IPv4 depletion







IPv6-only needs NAT64 & DNS64



IPv6-only Development Test Network

- Production IPv6-Only network for Product Groups
 - Since April 2017
- Pure Internet connectivity with NAT64/DNS64
 - Test cases focused on consumers & services living on the Internet and in the Cloud
- Helps to meet the industry and regulatory requirements for Microsoft products
 - Apple AppStore, US Federal Government, State of Washington (USA)
- Testing for Android, iOS, MacOS, Windows
- Deployed in 12 locations (US, Europe, Asia)
 - Product group demand driven

IPv6-only Corporate Network Pilot

- Pilot of IPv6-Only Wireless Corpnet since April 2018
 - Opt-in parallel SSID @ 15 sites in USA, EMEA and APAC
 - "Tidier" device mix on wireless than on wired, better control
- Support for Windows and MacOS devices
- Dependency on NAT64/DNS64 availability in regions
- IPv6 issues with both wireless vendors
 - IPv6 no Internet Connectivity RA flag cleared by Aruba Controllers
 - Cisco WLCs randomly de-authenticating IPv6 clients
 - Stateless DHCPv6 issues on Aruba
- Lesson learned
 - Testing deployment with IPv6-only can clean up your production code

What is your MTTI on IPv6-only?

Network?

Client Stack?

Application?

Who dun it?!?

Good collaboration with OS team!

The usual suspects...

Let's be real... this is an application problem

Identified IPv4 Application Dependencies

- Exposed during IPv6-only Pilot since April 2018
 - Cause applications to fail through NAT64 & DNS64



Connections to IPv4 literals



Hardcoded IPv4 addresses



IPv4-only APIs & Function calls



Backend redirects bypass DNS64

Known Applications within Microsoft

- 190+ Business Critical Productivity Apps and Tools (LOB CSEO)
- 2200+ Supported Apps and Tools (CSEO)
- Approximated 40,000 Unsupported 3rd party Apps and Tools

Identified applications - Fails

• Spotify, Steam, Postman, others??







• UWP Apps (Weather, News, Maps, Duolingo...)



- Challenge as there's no single team that manages UWP, ongoing search
- Payment portals don't always work (redirects)
- Internal applications dependencies on various components that are not IPv6-enabled (yet)
 - Azure Express Route, Azure Front Door, Azure Native Firewall, etc.
 - Sometimes things start to work without us doing anything...

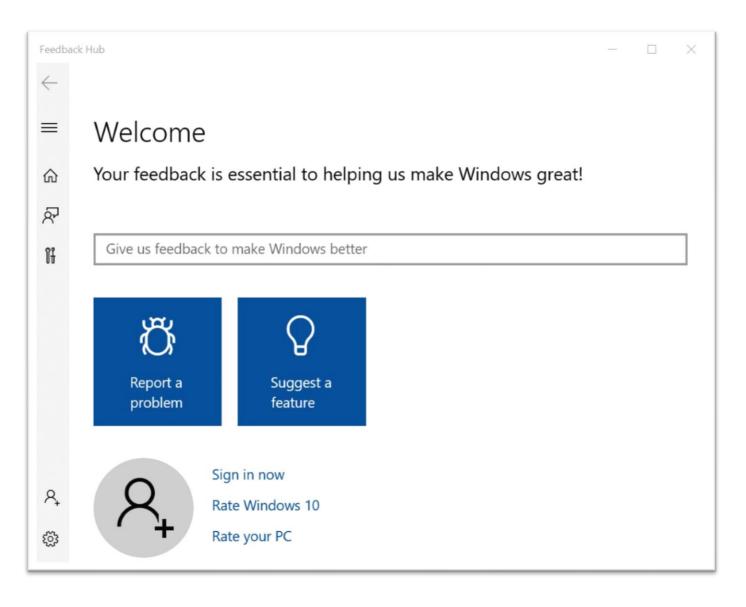
Conclusion

- Microsoft network is big, complex and carries a lot of dependencies
- Everyone needs to be involved
- Some network segments will be dual stack for the foreseeable future

Conclusion

- To see the real effect of IPv6 it MUST be end to end
 - Otherwise you'll see trend inline with Alexa Top 1000
- Dual stack is BUSINESS AS USUAL
 - Don't ask user if they want it, deploy it
- Dual stack hides issues with IPv6 implementation
 - You better verify on IPv6-only

Submit your IPv6 issues with Windows



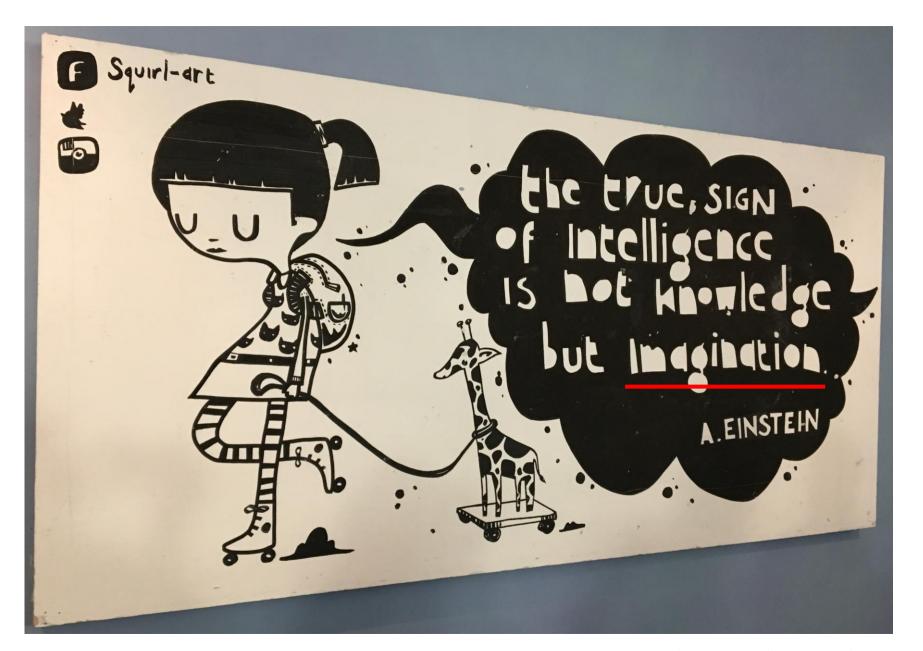


Photo: V. McKillop © Squirl-art



Thank you! IPv6