



Microsoft IT: Journey to IPv6

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Agenda

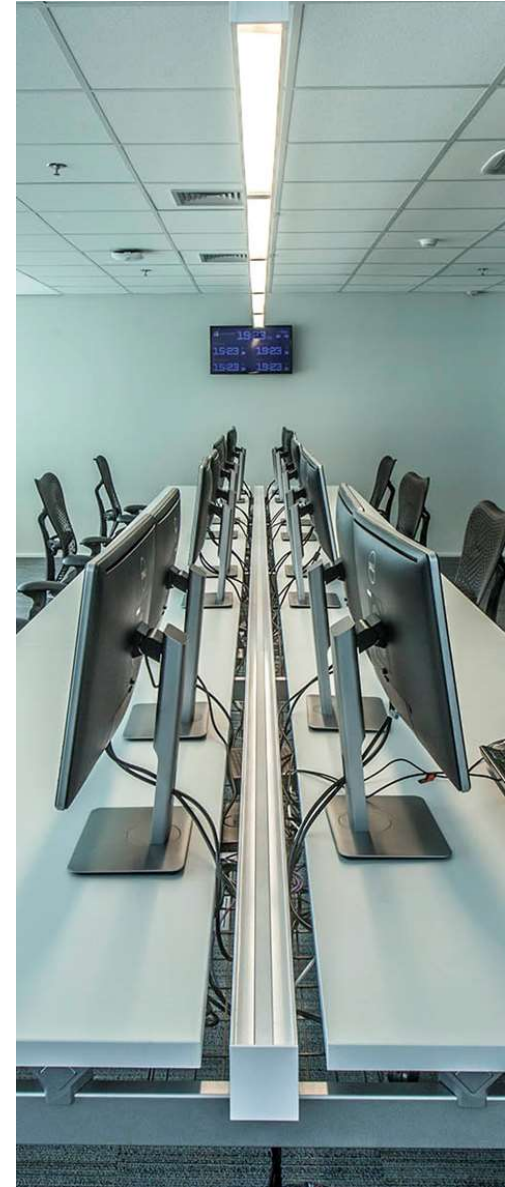
- Network Overview
- IPv6 Dual-Stack Status
- Moving to IPv6-Only
- Current Status
- Future Directions
- UK IPv6 Council Observations:
Service Provider, Enterprise
and IPv6



Network Overview

Network Overview

- Four regions with smaller campuses and tail sites
 - Puget Sound (Redmond, WA) – the main campus
 - North America, Europe/Middle East/Africa, and Asia Pacific, as one BGP AS
 - 790+ locations in total
- On-premise DCs have their own BGP AS
- Tail sites WAN connectivity has cMPLS
- Internet peering enabled in US and regions
 - Mostly with AS8075
 - AS that supports online services in Microsoft (Azure, Microsoft.com, Bing, Office 365, etc.)
- ~ 113K+ employees (~220K end users)
- ~ 1900 LOB applications managed by Microsoft IT
- ~ 1.2M devices hitting the network



IPv6 Dual Stack Story

IPv6 Dual Stack Story

- IPv6 since 2001, Microsoft Research investigating and deploying it
- ISATAP – first on Windows servers, then on a HW platform
- IPv6 more broadly deployed in 2006 using mixture of ISATAP and native
 - In large development centres (India, China, Redmond, WA, etc.)
- 2011 – IPv6 became a strategic goal
 - Remember the Nortel IPv4 address space acquisition?
- Backbone network
 - Dual Stack rolled out
 - Converted to Single Topology IS-IS
- Priorities shifted

IPv6 Dual Stack Story

- Since 2011, all public IPv4 space has moved to Azure
- During 2016 retrofit IPv6 native pushed to all corporate networks
 - All new networks deployed with IPv6 (mandatory)
- All managed labs dual stacked since 2011
 - Unmanaged labs and some other environments are a bit harder
- There are still networks which are IPv4-Only... ☹



The biggest challenge for Dual Stack

People

- Acceptance and prioritization
- Agreement across various teams that touch the network
- Ongoing training needed

Vendor feature support

Moving to IPv6-Only

Motives

Why is Microsoft IT moving to IPv6-Only?

Countless items consume our IP addressing space

IoT is not just a buzz word

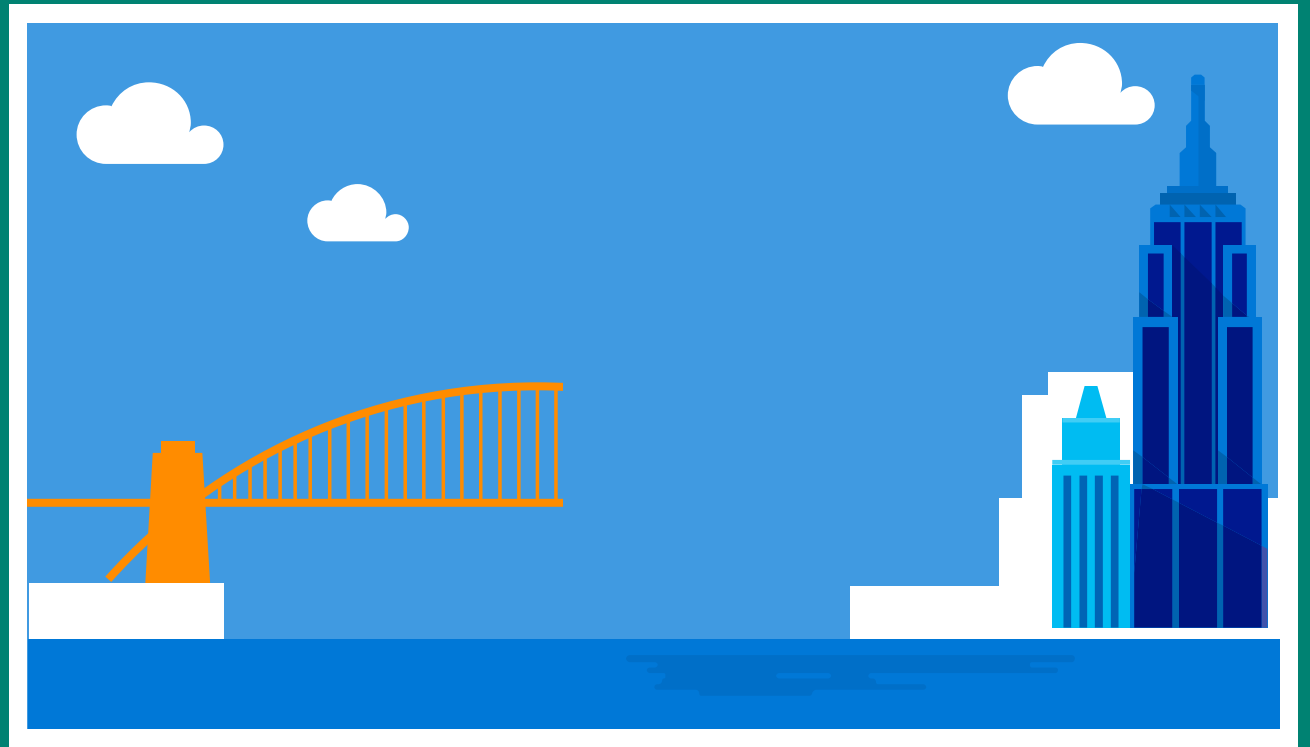
- Smart parking signs
- Micro-herb greenhouses
- Security cameras
- Door access systems



Why is Microsoft IT moving to IPv6-Only?

- Industry pressure = Microsoft Product Group requirements
 - [June 2015 Apple WWDC](#) announced IPv6-Only
 - MS Apps in App Store?
 - >87 apps in Apple App Store
- Exhaustion of IPv4 space – including RFC1918 space
- Overlapping RFC1918 space
 - Azure
 - Acquisitions
- Operational complexity of dual stack
- Strategic goal
 - Management is supportive

Dual stack is
IPv6 is only
half done...



Moving to IPv6-Only

Current Status



Current status

- Two test IPv6-Only networks in Redmond, WA
 - Wireless Guest network
 - Wired and wireless network on the corporate network
 - Deployed local NAT64/DNS64
- Tested different address acquisition schemes
 - SLAAC on wireless guest
 - DHCPv6 stateful and SLAAC for the corporate network
- For Guest network - DHCPv6 stateless + RDNSS
- Issues with vendor support (and our own issues)
<https://blog.apnic.net/2017/01/19/ipv6-only-at-microsoft/>
- Rolling out production networks for Product Groups
 - Security exception
 - Not scalable for future

Why Wireless Guest first?

- We need to test what IPv6-Only looks like
What is going to break?
- Application profile is much simpler
Web, email, etc.
- Can be used by internal development
- Fewer Service Level Agreement issues expected
versus the corporate network
- We want to get the exposure, move faster





Problems – DNS resolver

- DNS name resolution
 - Windows only supports DHCPv6
 - Android only supports RDNSS
- Need to support both
- Parallel DHCPv6 infrastructure
- Not all routers support RDNSS
 - Platform support coming
- Solution – centralised default gateway
 - L2VPN (EVPN) overlay
 - Run RDNSS and DHCPv6 relay on central router pair

Some issues remain...

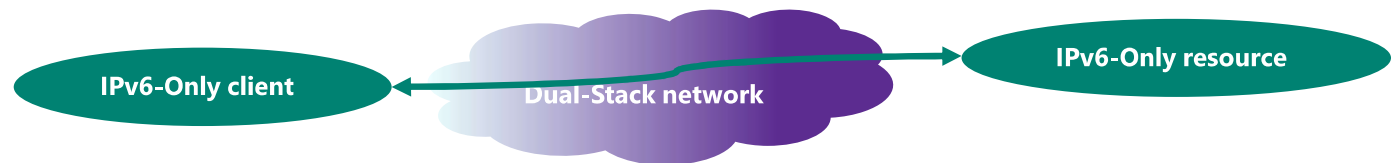
- Most WAN connectivity is carrier L3VPN
 - MPLS EVPN not possible
 - VXLAN a possibility in sites with supporting hardware
- Some LAN routers will never support RDNSS
 - We can use centralised DG model, but...
 - these devices don't support EVPN either
 - A solution with pseudowires is a possibility
 - Redundancy is tricky
 - These will have to be replaced during platform refresh



Will (y)our application work with IPv6?

Environment	Windows 10	iOS	MacOS	Android
Dual Stack	Yes If there are issues with IPv6, falls back on DHCPv4	Yes	Yes	Yes
NAT64 (client side is IPv6-Only, resource is on IPv4)	Yes	Yes	Yes	Yes If you have a DGW that issues RDNSS
IPv6-Only (end-to-end)*	Yes Hint: Switch off IPv4 in TCP/IP Properties	Yes Can you switch off IPv4 (Zeroconf)?	Yes You can switch IPv4 off	Yes If you have a DGW that issues RDNSS Can you switch off IPv4?

*This often means:



Wins and challenges for IPv6-Only

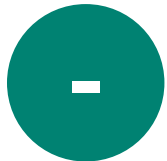


- Thanks to the industry, the demand is bigger than the supply and IPv6-Only makes business sense

Lack of **it is business impacting**

- The biggest support is our management and engineers

Mindshare is already won



- People – prioritization and alignment with other teams

Strong customer demand will always help – Product Group requesting IPv6-Only for certification purposes

- Lack of vendor feature support
- Our own bugs and non-existent features
- The fact that outside Microsoft IT, I still have to explain what IPv6 is... Yes, in 2017!

CK3

Slide 19

CK3

Spelled out acronym for PG as Product Group

Corinne Kuchling, 4/13/2017

Future directions

aka "*The Future is Forever*" (ISOC)

Future directions

- Deploy redundant NAT64/DNS64 to other regions
- Move Wireless Guest from pilot to production
- Start piloting IPv6-Only on the corporate network
Redmond campus and Europe probably first targets
- Incorporate IPv6-Only in our Internet First strategy
This will require reconsideration of NAT64/DNS64 locations
- IPv6-Only management of the network devices, etc.
- Work with our customers on their IPv6-Only strategy

Windows

Windows Server
2016

XBOX ONE



The “Microsoft effect”

- At least 85% of global laptop/desktop market is Microsoft Windows-based
- 100s millions of devices (i.e. servers, Xbox, tablets, HoloLens)
- How long will it make sense to support IPv4 and IPv6 in Windows?
- How would YOU support your customers' transition to IPv6-Only?

Service Provider, Enterprise and IPv6

aka Observations from the UK IPv6 Council

Service Providers & IPv6 – 1.

- Business case can evolve in an unexpected way
 - Built on avoiding cost and operational burden of CGN/NAT444
 - IPv6 has to make sense to business, not all benefits are immediate
 - Timing* and CxO backing are crucial
- IPv6 (as the companion of IPv4) tested and also eventually deployed
- IPv6 readiness means HW, SW, ACLs, management
- The volume and variety of CPEs impacts the speed of deployment
 - A new CPE type restarts the whole cycle but it gets easier

* RIPE, IANA, ARIN etc. story

Service Providers & IPv6 – 2.

- For IPv6 to be successful it has to be “business as usual”
 - Use a well-known CPE to develop your own model of what a dual stack CPE should look like
 - OSS/BSS, Parental control, Filtering, DDoS and other services
- Operations has to be well familiar
 - Training, training, training ... part of any new hire training?
- Make sure your subscribers are happy
 - Communicate, communicate, communicate
- Advantage of latecomers
 - Not everyone is under the same pressure as the largest ISPs
- Enterprise side of ISPs is often left as IPv4-Only

Enterprise & IPv6 – Why not?

- Why is the enterprise IPv6 adoption so slow?
 - They are not technology-driven companies
 - Technology = cost
 - Hard to tie revenue protection to IPv6 rollout
- Small and medium businesses don't suffer with the "RFC1918 effect"
 - Proxied to the Internet, why should they change?
- B2B doesn't leverage the Internet
 - "Private Internets" that drive large deployments of NAT
 - e.g. Airlines, automotive, financial industries
 - Two different DMZs – one connected to the Internet, one to the private network

Enterprise & IPv6 – Why yes?

- Security drivers
 - End-user devices run IPv6 and it can't be switched off
 - Best way to secure is to deploy IPv6
- Support consumers coming over IPv6
 - SLB64 to enable consumer services
 - Your hosting provider turns on IPv6 by default
- Mergers / acquisitions / divestments
- Innovation is happening for IPv6 first
- Virtualised/containerized datacenters are not IPv4-friendly
 - Dual stack doesn't help with address space limitations
 - Going straight to IPv6-Only is more real than 5 years ago

