



Microsoft Corporate Network: Journey to IPv6

March 2019



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
- Combination of on-premise DCs and services in Azure
- Branch offices WAN connectivity is MPLS
- 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 (~230K end users)
- ~ 1900 LOB applications managed by Microsoft IT
- ~ 1.2M devices hitting the network

History of Dual Stack

2001

Microsoft Research investigating and deploying IPv6
ISATAP – first on Windows servers, then on a HW platform

First IPv6 Addressing Architecture

2006

IPv6 more broadly deployed using mixture of ISATAP and native (India, China, Redmond/WA)

Still many IPv4-only networks...

2016

IPv6 pushed to wireless & wired Corpnet
Including on-prem datacenter networks
We have 3x IPv6 Prefixes

2011 – IPv6 became strategic

Public space moved to Azure
Backbone network – Dual Stack rolled out, Single Topology IS-IS
Managed labs dual stacked
Though **no end user network** segments enabled with IPv6

World IPv6 Day

Resulting IPv6 vs IPv4 Traffic

- 34% of Corpnet traffic is IPv6
 - 66% on IPv4-Only
 - Based on Windows 10 Telemetry
- 22% of Internet traffic is IPv6
 - Inline with the [Alexa Top 1000 websites](#)

Microsoft Drivers for IPv6-Only

- Industry pressure = Microsoft Product Group requirements
 - [June 2015 Apple WWDC](#) announced IPv6-Only
 - >87 apps in Apple App Store
- Exhaustion of IPv4 space (RFC1918)
 - Current estimation suggests **in 2 – 3 years**
- Overlapping RFC1918 space
 - Azure; Acquisitions (Nokia, LinkedIn, GitHub etc.)
 - Outsourcing partners also use the same 10./8 space – issues for VPN
- Operational complexity of dual stack
 - Sizing of IPv4 subnets constantly questioned? IPv6 gets “forgotten” in deployments?
- We already feel the business impact of IPv4 depletion



Why IPv6-Only? Because IPv4 is \$\$\$

ipv4marketgroup.com/ipv4-pricing-in-a-post-arin-runout-world/

IPv4 MARKET GROUP
Setting the Standard for IPv4 Transfers

Broker Services Transfer Processes About IPv4

Block Size	2011	2012	2013	2014	2015 YTD
/16	10.0	10.58	\$9.42	\$7.28	\$6.99
/17			\$10.17	\$8.89	\$7.98
/18		9.95	\$9.90	\$9.09	\$8.79
/19			\$11.00	\$10.58	\$9.03
/20		15.00	\$15.30	\$13.63	\$12.18

Figure 1. Prices Observed by IPv4 Market Group

Pre-ARIN exhaustion



Price in 2019 for 1x /16 = \$ 1,245,184

Block Size*	/24	/23	/22	/21	/20	/19	/18	/17	/16
Price/IP (USD)	26.00	23.00	20.00	20.00	19.50	19.50	19.00	19.50	19.00+ depending on quality

Source: IPv4 Market Group

Status of IPv6/IPv6-only (1)

- NAT64/DNS64 is essential
- IPv6-only SSID for Product Groups
- VPN is dual stacked
 - IPv6-only testing in progress
- IPv6-only corporate network in pilot
 - 12 locations in US and EMEA
- IPv6-only wireless infrastructure management PoC
- Goal: IPv6 enabled everywhere, IPv6-only everywhere we can

Status of IPv6/IPv6-only (2)

- VPN does not work through NAT64 (re [RFC 7269](#))
- In dual stack, IPv4 can hide IPv6 bugs
- Android requires RDNSS (!)
- IPv6 claims on paper \neq IPv6 reality ☹️
- Engage with vendors
- Applications are the big unknown
- IPv6 gets all the blame 😊

Resources

- APNIC Blog Microsoft IT IPv6 posts
 - [January 2017](#)
 - [September 2018](#)
- PacketPushers.net [IPv6 Buzz Podcast \(008\)](#)
– August 30, 2018



Thank you!