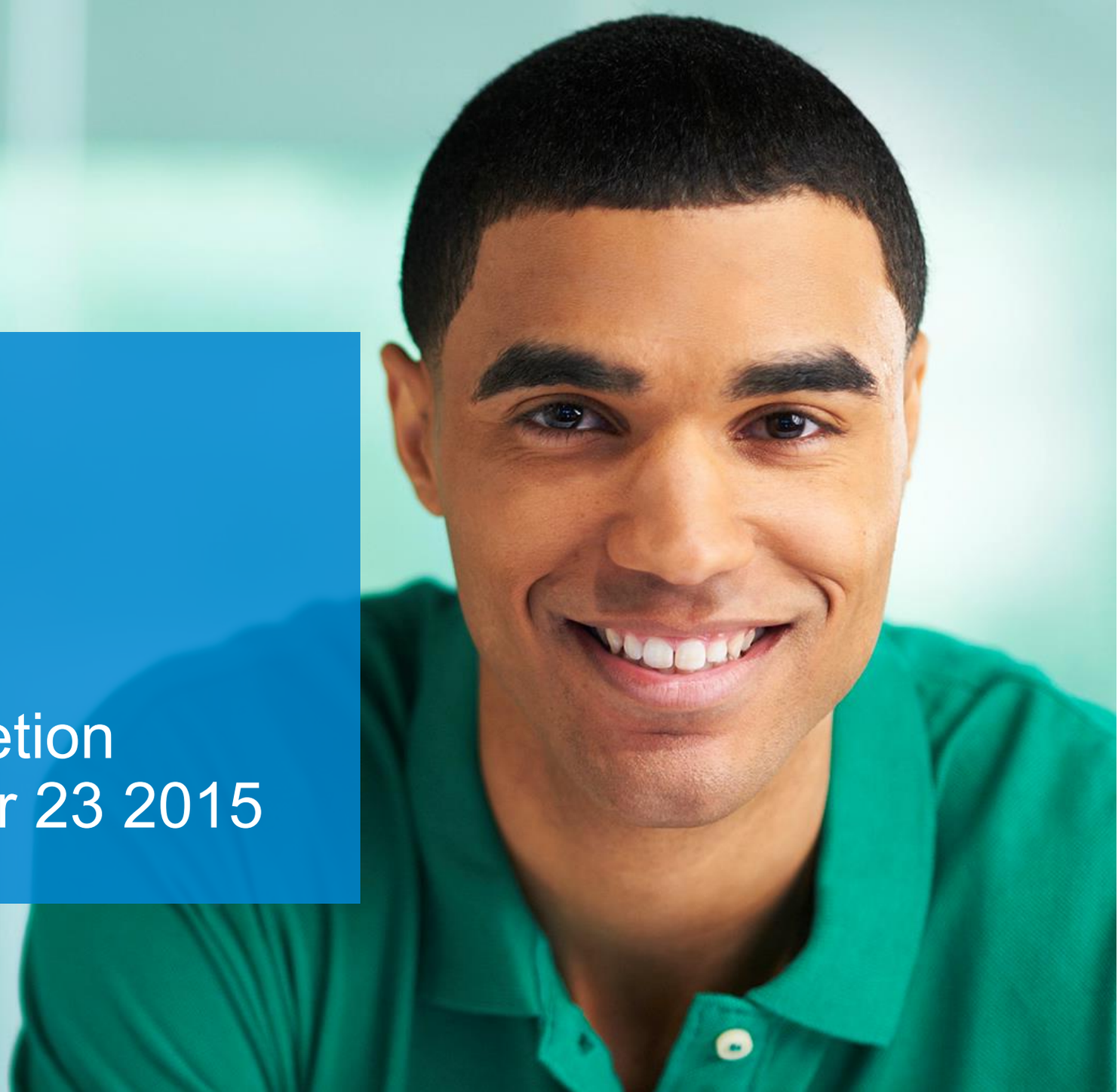
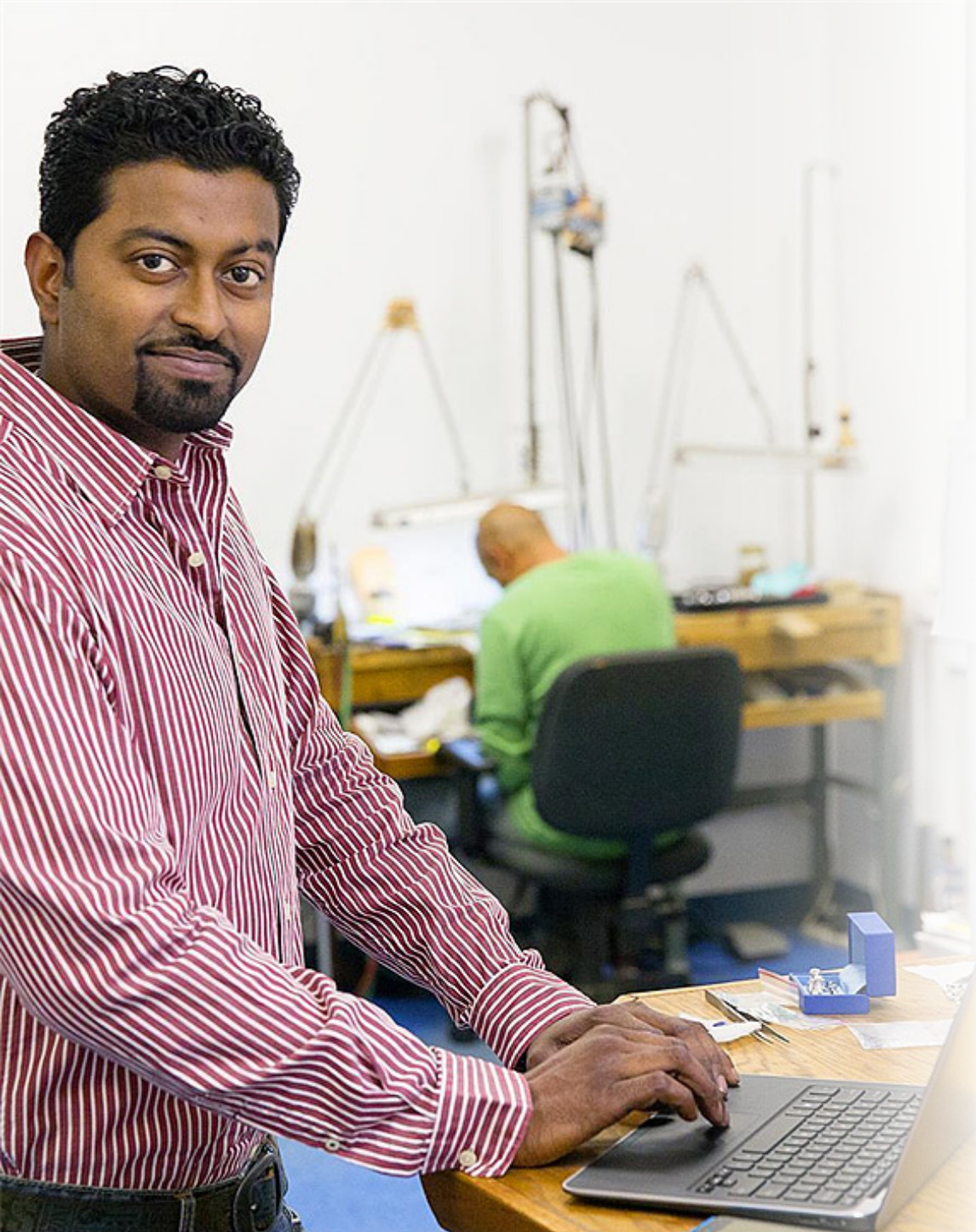
Microsoft

# Microsoft IT's IPv6 Killer App

## IPv4 Private Address Depletion

Marcus Keane - September 23 2015





# Agenda

- Evolution
- Enabling IPv6
- Challenges
- Pilot Solution
- Future work

# IPv6 Evolution

- ISATAP tunneling for IPv6 enablement for development and research started in 2006.
- Operating Systems IPv6 capable
  - Client and Server OS's on the corporate network IPv6 capable and prefer v6 by default
- Transition Technologies
  - ISATAP deployed and then deprecated in favour of dual-stack
  - Initial IPv6 only pilot
- Native deployed in selected locations

# IPv6 Evolution continued…

- World IPv6 Day June 8, 2011
- Corporate wide interest and excitement leading up to World IPv6 launch day!!
- World IPv6 Launch June 6, 2012…..YAY!

# Enabling IPv6

- Routing Protocols
  - IGP
  - VPNv6
- Security infrastructure v6 aware
  - Firewalls v6 enabled
  - Other security components (AMA, APT, DLP, IDS) v6 capable
  - NetFlow v9 deployed
- Corporate on-prem datacenters IPv6 enabled
  - Includes hardware load balancers
- Internet Peering
  - IPv6 internet peering enabled
  - Enabling direct v6 internet into labs on request

# Internet Routing Challenges

- Initial announcement of ARIN /32 from HQ in Seattle
- Lack of certainty about advertising space from one regional RIR in another region
- Questions about geolocation
- Considered PI /48s
- Proceeded to procure one /32 per region
- No IPv6 NAT for first implementation
  - Therefore could only announce in one location in the region
  - E.g. Tokyo in Asia and Dublin in EMEA

# IPv6 Challenges

- Enabling dual-stack at the user edge created some scaling issues
  - ARP and ND timers – much increased traffic
  - Increased control plane traffic – SSDP, LLMNR
- Challenges with introducing IPv6 into MPLS
- Issues with OSPFv2/v3 taking different paths through the network. Mostly solved by IS-IS ☺
- Extension Headers – quickly fixed by vendor
- Quirks introduced by IPv6 – eg DAD on WAN links
- Staff training
  - IPv6 addressing seems to be hard
  - Ensuring consistency between IPv4 and IPv6 during new deployment
  - Operational issues with IPv6

# IPv6 current status

- Current Stats
  - 100% of WAN and Backbone is v6 enabled; IS-IS backbone (OSPFv2/v3 campus)
  - 63% of managed hosts are v6 enabled
  - Dual stack on  20% of corporate access network
  - 6,400 internal v6 routes, 20,000 internal v4 routes
  - DNS AAAA to A record comparison
  - Expect to have complete network dual stack by end of year

**Europe**
A – 34,545
AAAA – 31,946

**Redmond**
A – 410,679
AAAA - 321,113

**FarEast**
A – 67,115
AAAA- 32,039

**Development**
A –  147,633
AAAA – 131,402

# IPv6 Killer App…

- I know you have more v4 addresses…

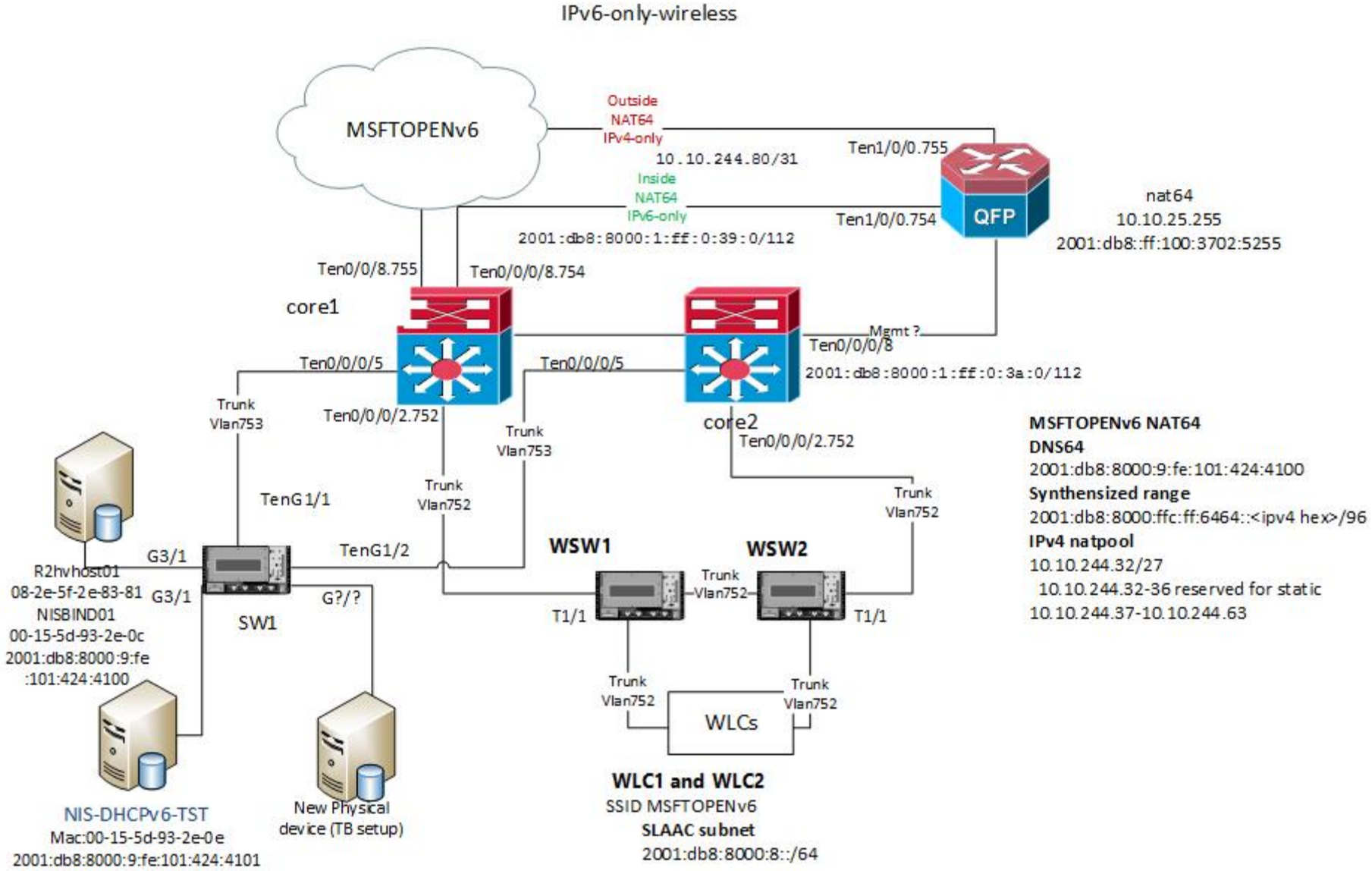
# Vanishing RFC1918 space – Options

- **Start looking at internal NAT44 OR NAT64**

- **We are piloting v6-only using NAT64 (with DNS64).**
  - For wired we are using DNS64 via Direct Access* deployment
  - DHCPv6 stateful on existing DHCP server
  - Cisco ASR1K for NAT64
- Wireless Guest Network
  - BIND9 on Windows Server 2012
  - DHCPv6 stateless on Windows Server 2016
  - Cisco ASR1K for NAT64

*Microsoft VPN solution

# V6-Only Pilot Deployment



# IPv6-only Pilot Results – what works

- Native IPv6
  - Office 365
  - Xbox.com
  - Microsoft.com
  - Windows update (test)
  - Skype for Business
- Applications via NAT64; no noticeable performance degradation
  - SharePoint
  - Yammer
  - Bing search
  - Windows RPC/SMB
  - Windows RDP
  - Xbox VOD, video playback

# IPv6-only Pilot Results– what doesn’t work

- Applications
  - Skype
  - Other applications with IPv4 embedded addresses
  - X-Windows applications
  - Microsoft homegrown applications
- Non-client devices
  - IP phones
  - Conference room schedule monitor
  - Security cameras

# IPv6 w/NAT64 Pilot Results

- Switching between v6-only wired and dual-stack wireless
  - Had to disable Ethernet when switch to dual-stack wireless (Ethernet preferred over Wi-Fi)
  - Without Stateful DHCPv6, no “release6, renew6” had to issue PowerShell “restart-netadapter”
- Still have to figure out IPv4 embedded
  - 464xlat for mobile, what about wired
- Operations and Troubleshooting
  - Issues when one troubleshooting step is to turn off IPv6

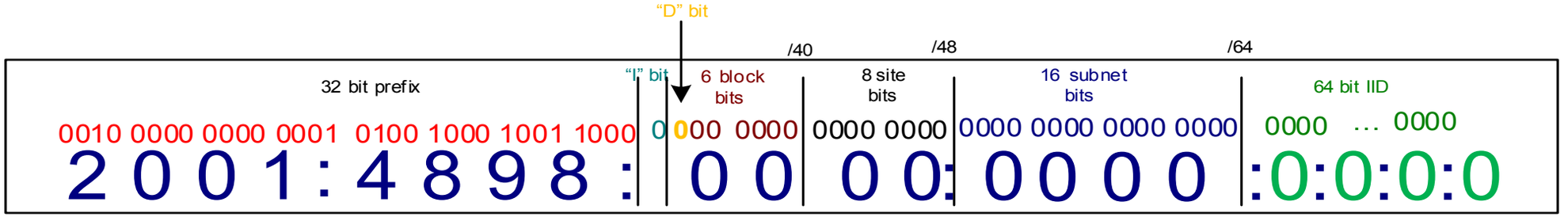
Generally things just worked

# Future Thoughts

- DHCPv6 or SLAAC or both?
- DNS64 deployed globally
- IPv6 Multicast
- NAT64 redundancy testing
- TE - Segment Routing?
- Management

# Q&A

# Appendix: IPv6 address structure




1) Bit 33 0=Corpnet
   1=Internet
2) Bit 34 0=Corpnet
   1=Delegations
3) Bits 35-40 Regional Blocks
   Puget Sound, Canada, Americas
   EMEA
   APJ
4) Bits 41-48 Site Bits
   Site = Hub location ROW
   PS core aggregation pair
   First /48 reserved for infastructure
5) Bits 49-64 User Subnets
6) Bits 65-128 Host identifiers

# Appendix: Acronyms

AMA - Advanced Malware Analysis

DLP - Data Loss Prevention

IDS - Intrusion Detection System

APT - Advanced Persistent Threats

# Disclaimer

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