

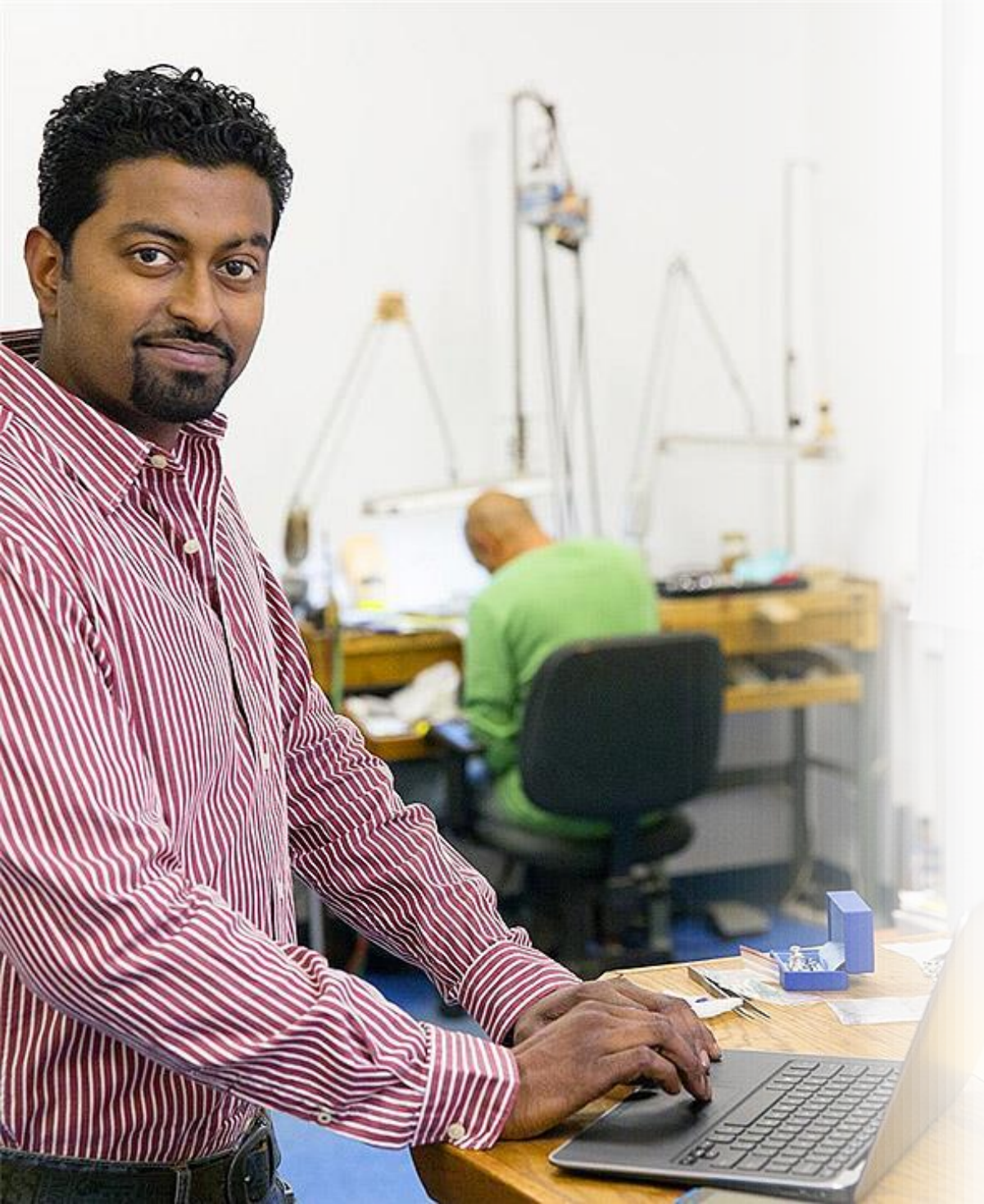


# Microsoft IT's IPv6 Killer App

IPv4 Private Address Depletion



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# Agenda

Evolution

Current State

Solution

Pilot Results

Ongoing work

# IPv6 Evolution

ISATAP tunneling for IPv6 enablement for development and research started in 2006.

**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!





# IPv6 Evolution

- **Operating Systems IPv6 capable**

- Client and Server OS's on the corporate network IPv6 capable and prefer v6 by default

- **Transition Technologies**

- ISATAP deprecated in favour of dual-stack
- Initial IPv6 only pilot

- **Current Stats**

- 100% of WAN and Backbone is v6 enabled; IS-IS backbone (OSPFv2/v3 campus)
- 63% of managed hosts are v6 enabled
- Less than 20% of corporate access network is native enabled
- 6,400 internal v6 routes, 20,000 internal v4 routes
- DNS AAAA to A record comparison

**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 Evolution continued..

- 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
    - Advertising /48's out of three regional /32's (in addition to the /32's)
  - Enabling direct v6 internet into labs on request
- Operational issues with v6 continue to be a challenge for ops teams
  - Requires continual training

# IPv6 Evolution challenges

- ISATAP solved some problems. Created others:
  - Problems with traffic following topology
  - Collapsing hierarchy created internet geo-location problems
  - Issues with MPLS and ISATAP(recirculation)
- Enabling dual-stack at the user edge created some scaling issues
  - ARP and ND timers – much increased traffic
  - Increased control traffic – SSDP, LLMNR
- Challenges with introducing IPv6 into MPLS
- Issues with OSPFv2/v3 taking different paths through the network. Mostly solved by IS-IS 😊
- Quirks introduced by IPv6 – eg DAD on WAN links

# IPv6 Evolution challenges..

- Staff training
  - IPv6 addressing seems to be hard
  - Ensuring consistency between IPv4 and IPv6 during new deployment
- Internet – what do we announce? Where? /32s and /48s?



# IPv6 Killer App...

- I know you have more v4 addresses...

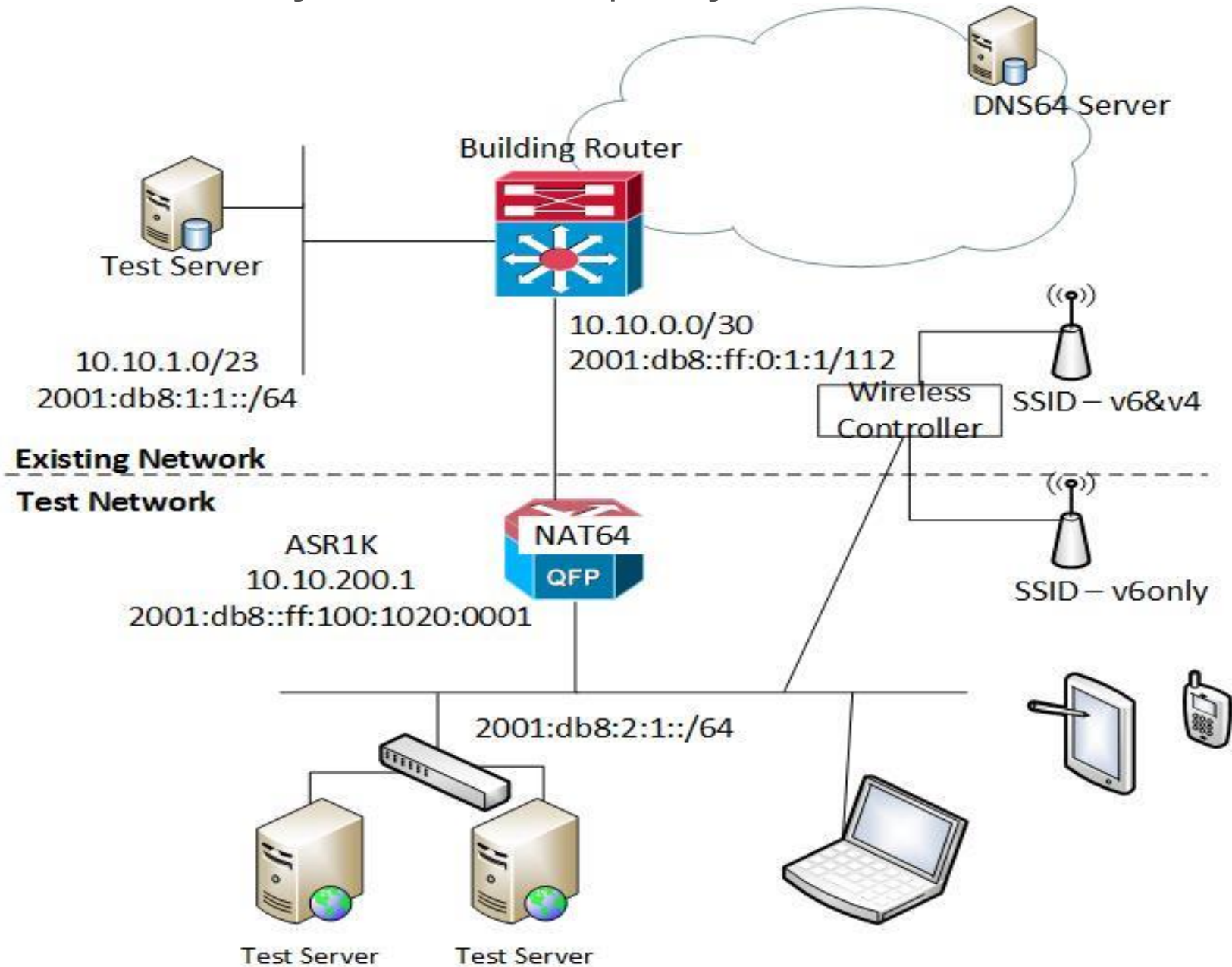


# Vanishing RFC1918 space – Options

- **Start looking at internal NAT44 OR NAT64**
- **Decided to pilot v6-only using NAT64 (with DNS64). Why?**
  - We already have DNS64 via Direct Access\* deployment
  - DHCPv6 already on corporate network in test for Stateful DHCPv6
  - Cisco ASR1K was available

\*Microsoft VPN solution

# V6-Only Pilot Deployment



## DNS64 server

$2001:db8:64:6064:fe::1$

## IPv4 embedded address range

$2001:db8:64:6464::/96$

## IPv4 natpool range

$10.10.10.0 - 10.10.10.250$

# 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”
- Direct Access security exclusion
- Still have to figure out IPv4 embedded
  - 464xlat for mobile, what about wired
- Relying on NAT and all that goes with that
- Operations and Troubleshooting
  - Issues when one troubleshooting step is to turn off IPv6

Generally things just worked



# Ongoing work

- DHCPv6 or SLAAC or both
- DNS64 deployed globally
- IPv6 Multicast
- NAT64 redundancy testing
- Explore other translation options – MAP?

IPv6 is not a transient technology!

# Q&A



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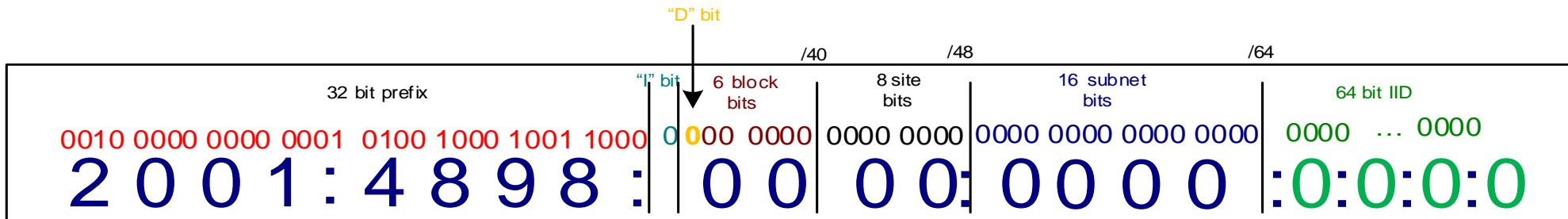
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# Appendix: IPv6 address structure



- 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 infrastructure
- 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

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