



Microsoft IT: Journey to IPv6

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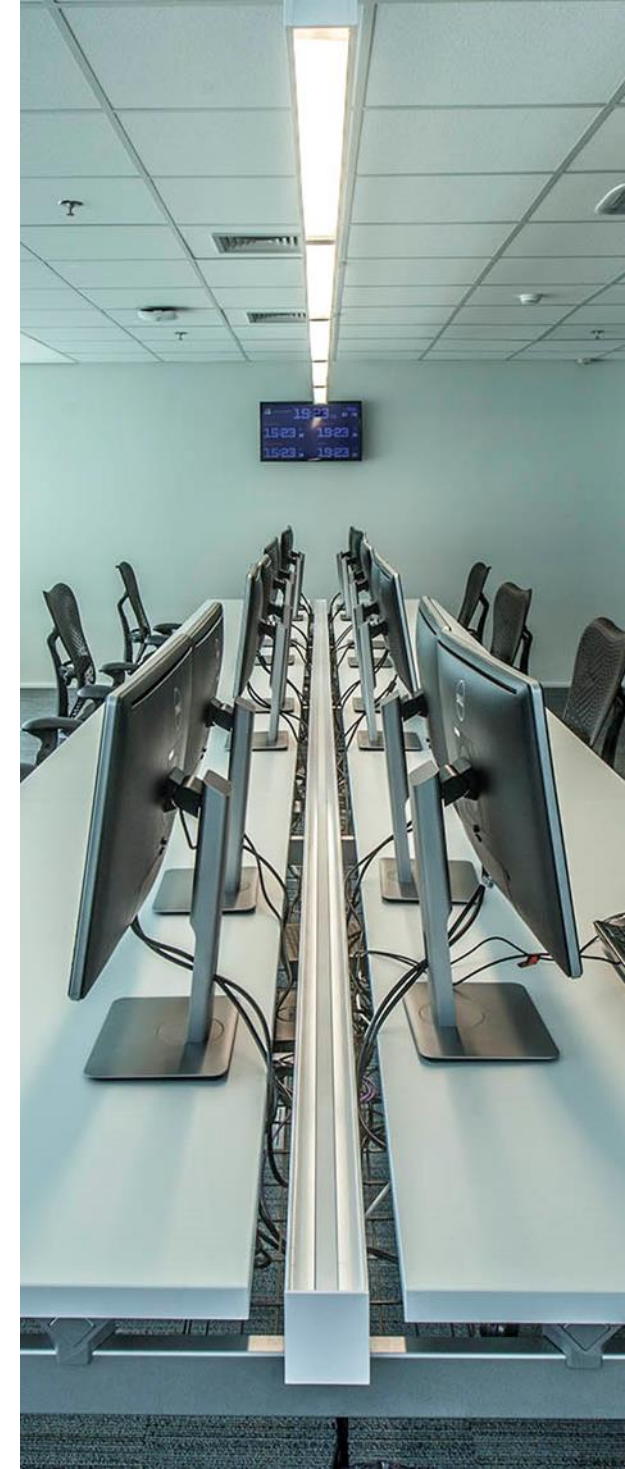
Agenda

- Network Overview
- Dual-Stack Status
- Moving to IPv6-Only



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 and services in Azure
- 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



Dual-Stack Story

IPv6 is always a story of *perseverance*...

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? All public space moved to Azure
 - Backbone network – Dual Stack rolled out
 - Converted to Single Topology IS-IS
- During 2016 retrofit IPv6 native pushed to all corporate networks
 - All managed labs dual stacked since 2011
 - Unmanaged labs and some other environments are a bit harder
- There are still many networks which are IPv4-Only... ☹️

Moving to IPv6-Only

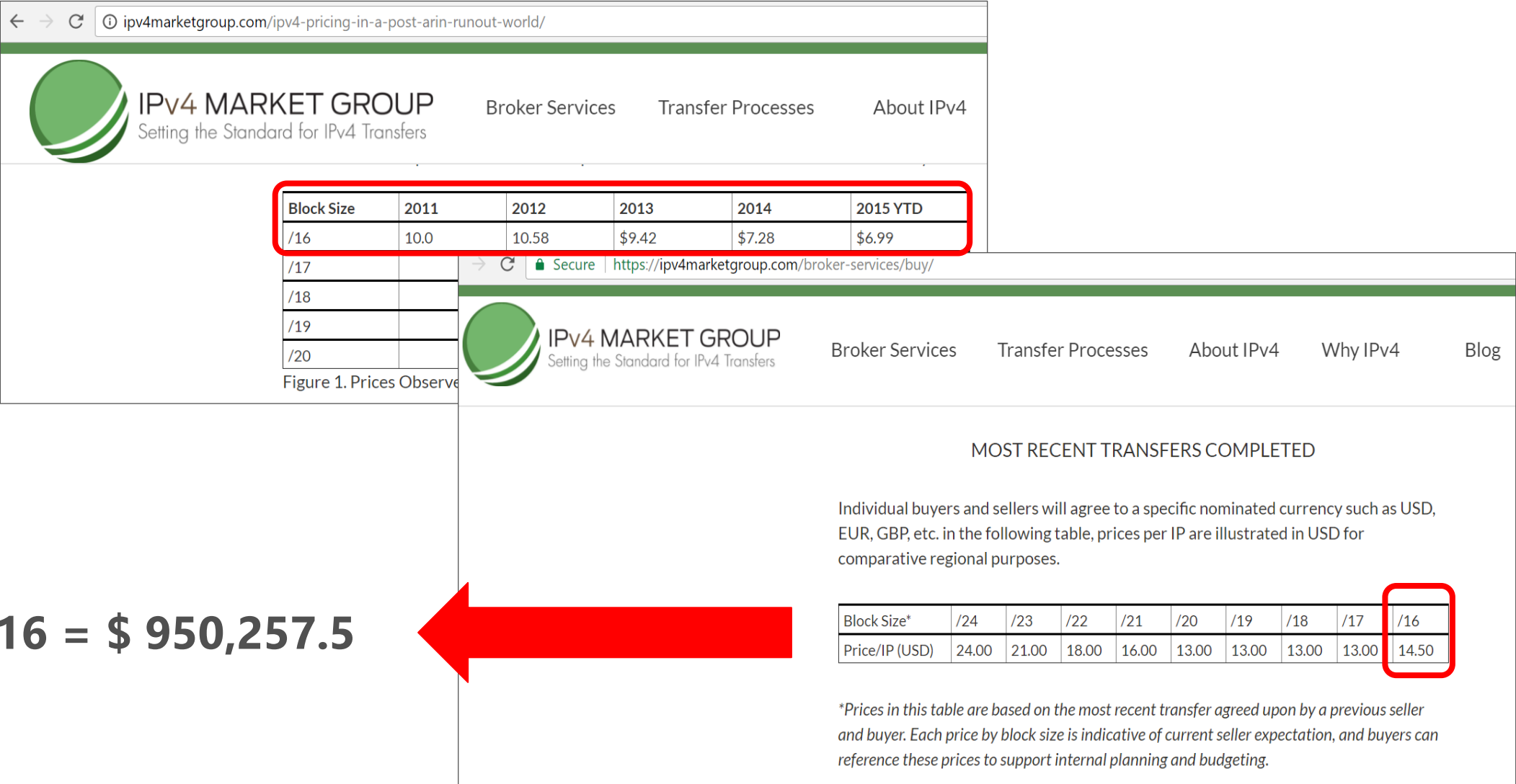
Motives

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?
 - >89 apps in Apple App Store
- Exhaustion of RFC1918 space
 - Countless items consume our IP addressing space
 - No large contiguous blocks available
 - IoT is not just a buzz word - Smart parking signs, Micro-herb greenhouses, Security cameras, Door access systems, anything that requires connectivity
- Overlapping RFC1918 space
 - Azure, Acquisitions
- Operational complexity of dual stack
- Strategic goal with management support



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



/16 = \$ 950,257.5

Dual stack is
IPv6 only
half done...



Moving to IPv6-Only

Past & Present

Wireless Guest IPv6-Only

- We needed to test what IPv6-Only looks like
 - What was going to break?
- We thought the application profile was much simpler
 - Web, email, etc.
- Could be used by internal development
- We assumed fewer Service Level Agreement issues expected versus the corporate network
- We wanted to get the exposure, move faster

This WAS the plan...



IPv6-Only on Wireless Guest cancelled 😞

- IPv6-Only leverages NAT64 & DNS64 to access IPv4-Only resources
- Majority of VPN clients doesn't work through NAT64
 - [RFC 7269](#) notes IPsec issues – a VPN needs NAT Traversal support in IKE and must use IPsec ESP over UDP
- Lesson learned: When your VPN concentrator is dual-stacked, IPv6 gets you out 😊

The result: roll out of [Dual-stack](#) in our [Wireless Guest globally](#)

["Scream tests" of IPv6-Only](#) in the next 12 months when vendors deliver IPv6-Only Features

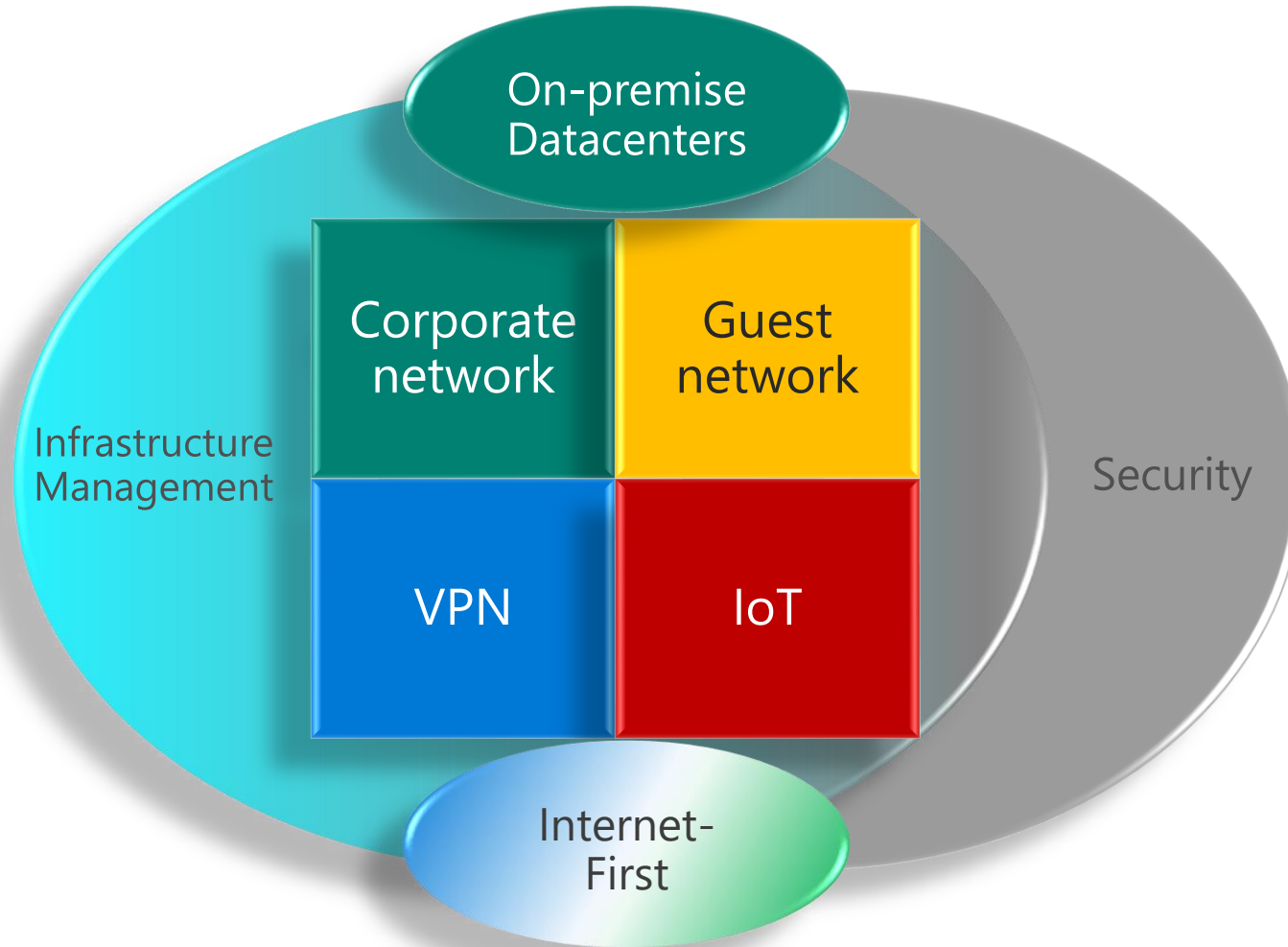
IPv6-Only SSID for Product Groups

- Production IPv6-Only network for Product Groups
- Helps to meet the industry and regulatory requirements for Microsoft products
 - Apple AppStore, US Federal Government
- Pure Internet connectivity with NAT64/DNS64
 - Test cases focused on consumers, services living on the Internet and in the Cloud
- Challenge with Android platform
 - Doesn't support DHCPv6
 - RDNSS needed on our building routers (upgrades in progress)
- Deployed in 11 locations
 - 6 more coming, 1 to be decommissioned already
 - Demand driven

Moving to IPv6-Only

aka "*The Future is Forever*" (©ISOC)

When I look at the Microsoft networks...



Everything needs IPv6, not everything will be IPv6-Only

Remote Access VPN

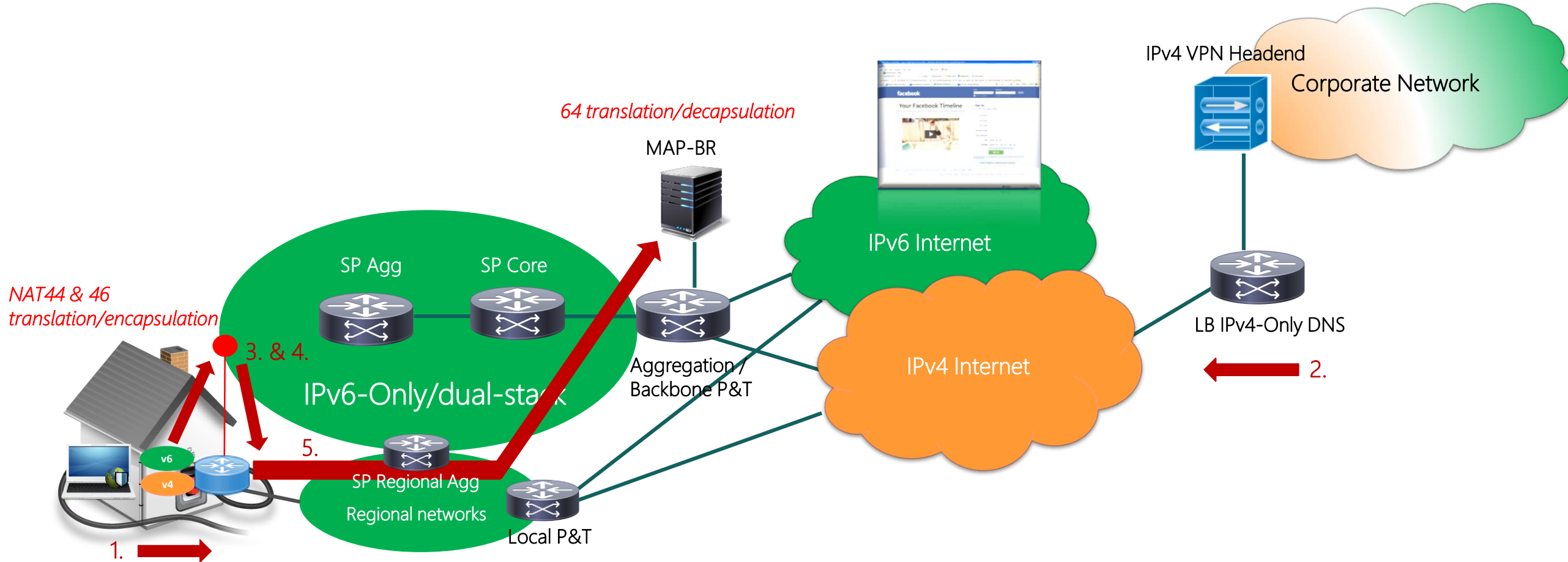
- NG-VPN dual-stacked on the inside
 - Rollout during H2 CY2017
 - Currently ~40,000 users
- NG-VPN concentrators IPv4-Only on the outside
 - Need to be dual stacked
 - Dependency on our load balancing solution
- VPN is a big consumer of IPv4 address space
- IPv6-Only (on the inside) Proof of Concept
 - NAT64/DNS64 for IPv4-Only corporate resources
 - OS & VPN integration is causing different user experience

Let's look into the (not-so-distant) future....

...where IPv4-as-a-Service is reality

IPv4 NG-VPN behavior in SP IPv4-as-a-Service network

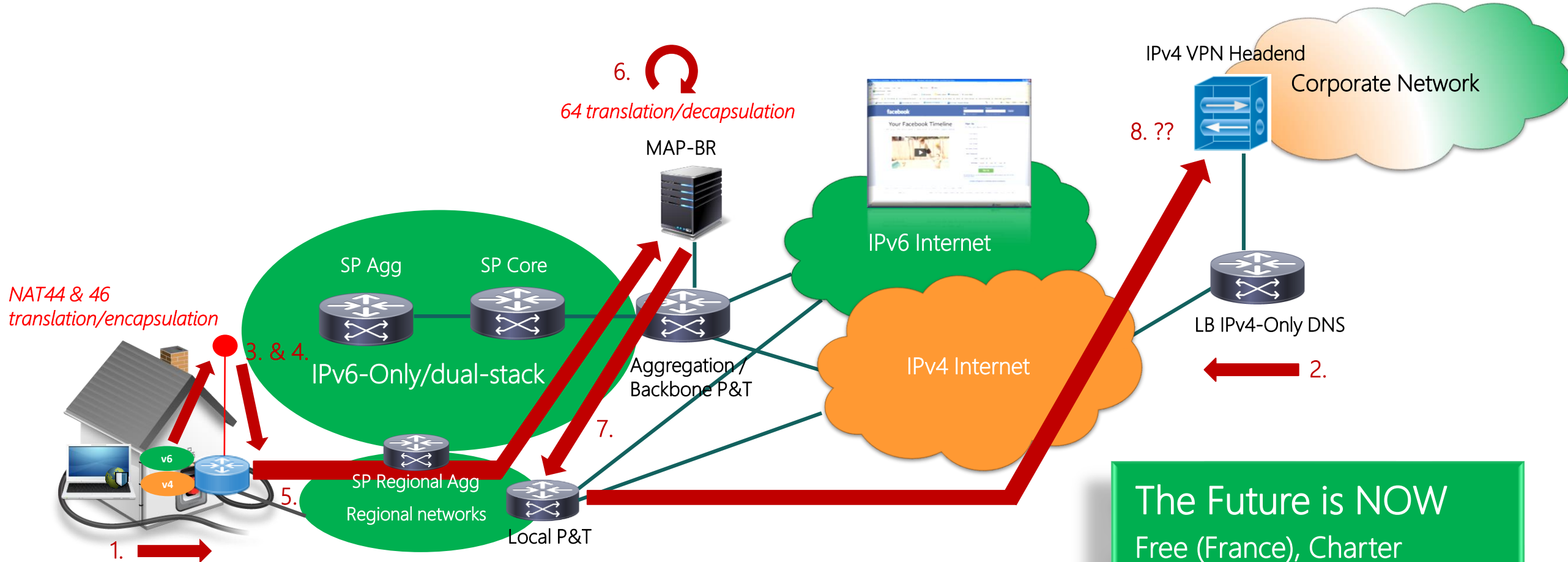
(MAP-T/E Example & IPv4-Only ATM and VPN Headend)



1. VPN client does VPN concentrator address resolution
2. Load-Balancer provides DNS A record
3. VPN session establishment over IPv4 is NAT44 translated on the home CPE
4. Then 4->6 header translation/encapsulation is performed on the home CPE
5. This traffic is forwarded over IPv6-Only/Dual-stack network to MAP Border Relay

IPv4 NG-VPN behavior in SP IPv4-as-a-Service network

(MAP-T/E Example & IPv4-Only ATM and VPN Headend)



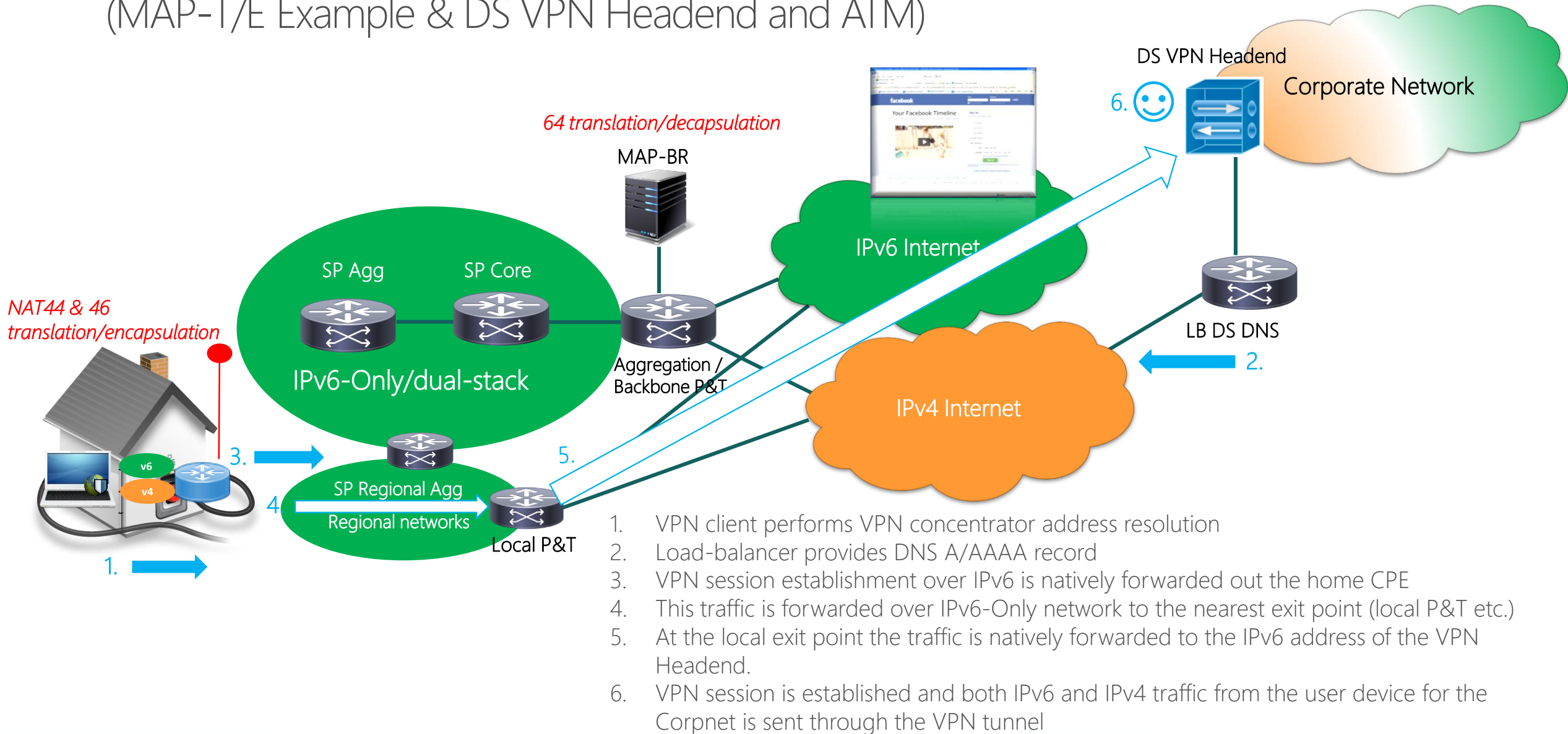
6. At MAP-BR the traffic is IPv6 traffic has header replaced with IPv4/decapsulated
7. The traffic is forwarded over IPv4 to the VPN headend
8. Will the VPN Headend accept this traffic?
 - The header has been tampered with (MAP-T)
 - What about Jumbo frames (in MAP-E), fragmentation (it is SW processed on the MAP-BR)??

The Future is NOW

Free (France), Charter Communications, Comcast (tests), your any given mobile ISP (BT/EE, T-Mobile US, Reliance JIO)...

DS NG-VPN behavior in SP IPv4-as-a-Service network

(MAP-T/E Example & DS VPN Headend and ATM)



It doesn't matter what IPv4-as-a-Service technology is used by the ISP, native IPv6 gets around it.

“Hitting the Walls” with IPv6-Only

- IPv6-Only VPN PoC
 - Our security vendor doesn't support IPv6-Only Client profile
- Wireless Guest and IPv6
 - Our guest portal vendor doesn't support Radius authentication over IPv6...
- WLAN Infrastructure Management over IPv6
 - One of our wireless vendors doesn't support AP dynamically discovering WCL over IPv6...
- Internet-First
 - Cloud Security providers have not heard of IPv6 yet. They do indeed live in clouds...
- Network/Infrastructure Management
 - Back to “Square 1” with IPv6-Only, aka Dual-Stack “Déjà vu”?
- The Story of a Docking station
 - Switch off IPv6 RAs in the network, please... ??? ☺

We keep going

- Corpnet Wireless IPv6-Only PoC
 - Segments of corporate network to be converted to IPv6-Only and tested on
- Measuring IPv6 traffic vs IPv4 to gain visibility
- Internet-First – enabling IPv6
 - Dual-stacked pilot in our IT building
 - Production is issue - Cloud Security Providers don't support IPv6 (in 2018!)
 - Challenge with multiple IPv6 prefixes (from the ISP and from the Corporate network) – source address selection?
 - Provisioning Domains IETF draft
 - <https://datatracker.ietf.org/doc/html/draft-bruneau-intarea-provisioning-domains>
- “No more IPv4” date – bad luck, do IPv6!



Internal communication is crucial

- IPv6 Newsletter
- IPv6 Position Paper
- IPv6 Strategy (work in progress)

Recognition matters

- Microsoft IT recognized as IPv6 World Leader 2017





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?

IPv6 Conclusion

IPv6 – No good or bad, there are just News...

- IPv6 is a long story of constant set backs and sudden victories
- It is easy to get disheartened, but NEVER give up
 - You MUST REMEMBER to look back, consider what you have achieved and appreciate it.
 - It will carry you going forward
- IPv6 is worth it
- Speaking publicly about the efforts also helps
- In medium to long term, only IPv6-Only makes sense

