The Day I Broke All the Treadmills

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This talk is about

IPv6-Only Enterprise Network

Image source: https://freesvg.org/magical-unicorn
Motivation

Running out of *private* IPv4 addresses

Dogfood and testing

Dual stack is hard

"Entities should not be multiplied without necessity."

William of Ockham
Project Scope

Guest Network

Guest WiFi
> 50% of all WiFi users

Wired Guest
Unauthorised devices
Design Elements

DNS64

Google Public DNS64
Provided via RDNSS

NAT64

Same devices as NAT44
Located at the site edge

SLAAC-Only Network
What % of users need IPv4?

Is a dedicated fallback network required?

How much IPv4 space can we save?

Pilot Goals

What would not work?

Any showstoppers?

Any impact on tech support?
High Demand for IPv6-Only networks

12 Pilot Sites Selection Criteria

- Wired Guest Host count
- NetOps team presence
- WiFi Guest Users Count
IPv6-Only Wired Guest Pilot

February - October 2019

Self-service portal to re-enable IPv4 on the port

Users are encouraged to report why they need IPv4
What I Broke Right Away
Most sites need <5 IPv4-enabled ports

A lot of IPv4 addresses saved

Wired Guest Pilot Results

Main IPv4 use case: Embedded systems/IoT

CPEs need CLAT enabled
User’s private IPv4-only LAN

INTERNET

NAT44 to private IPv4

Dual-stack Guest Segment

User’s CPE

NAT44
INTERNET

IPv6-Only Guest Segment

User's private IPv4-only LAN

User's CPE

NAT64

CLAT needed instead of NAT44
Layer Violation in 2019

Using Torx T15 screwdriver to enable IPv6 on an appliance.
Shall CPEs detect IPv6-Only/NAT64 and enable CLAT?

RFC7084: No

RFC8585#section-3.2.1: Yes
IPv6-Only Guest WiFi Pilot

Phase 1, Opt-In
June 2018 - March 2019
Dedicated SSID created
Call for volunteers issued

Phase 2, Opt-Out
April - October 2019
Guest WiFi is IPv6-only
Dedicated fallback SSID

Users are encouraged to report issues
Pilot Results
Phase 1 Results

~10% of users moved to new SSID

Users incentives to report bugs

15 bugs reported

3 bugs fixed
Phase 2 Results

- < 5% of users fanned back to dual-stack SSID
- ~25K peak device count
- 12 bugs reported
- 4 applications fixed
What % of Users Need IPv4?

**WiFi**

< 5% fall back to the dual-stack SSID

~10% is using 2.4GHz SSID which is kept dual-stack

**Wired**

< 5 devices/site normally, ex. For Gym devices
IPv4 Address Space Utilization

WiFi

DHCPv4 pools utilization dropped by 5-8 times

Matches ~15% of users staying on dual-stack networks

Wired

almost all address space reclaimed
What Does Not Work? (*)

1. Gym Treadmills
2. Spotify application on laptops upvote, please!
3. 3rd-party VPN systems
4. StarCraft II
5. MacOS internet recovery image

(*) Top 5 by number of user complaints received
Is Dedicated Fallback Network Needed?

Short answer: yes

Wired Network:

Users **MUST** file an request to get IPv4

Exceptions are granted for 18 months

WiFi: dedicated SSID is NOT the best strategy

(see “Lessons Learned”)


Are There Any Showstoppers?

Short answer:

No, as long as a fallback mechanism exists.

Long answer:

It depends.

Mobile devices work in 99.9% of all cases

Laptops might be a different story.
What’s the Impact on Support Team?

Almost none.

Keys to success: **Plan Ahead!**

- Let users know about the change
- Provide users with fallback mechanisms
- Provide the support team with
  - Troubleshooting flowcharts
  - Known Issues page
Lessons Learned
“Just disable IPv6” is never a good workaround.

How would you re-enable IPv6 on all those devices?
The only way to get IPv6 operational experience is to turn off IPv4
What Do Happy Eyeballs Hide?

Network Issues
- Packetloss “by design”: draft-ietf-v6ops-nd-cache-init
- Vendor Bugs/Broken IPv6

Process Issues
- IPv4-first Operations Mindset
- Designs with IPv4 dependencies
Early Adopters Are Crucial

Willing to try IPv6-only

Capable of reporting issues

Maximum issues found

Minimal user impact
IPv6(only) Support Requirement

IPv6/IPv6-only support requirements in RFPs must be:
- Explicit
- Specific

RDNSS Management over v6 464XLAT

“IPv6 Support”
Dedicated SSID/Network: Not Ideal

Dual-stack SSID naming is hard:

Less “attractive” than IPv6-only one

Intuitive enough so users would use it

- Guest-V4?
- Guest-IPv4?
- Guest-do-not-use-this-until-nothing-else-works?
Dedicated SSID/Network: Not Ideal

No control over SSID chosen by a device.

Devices switching between SSIDs.

Once SSID remembered - no way back.

Consider do not broadcast the fallback SSID
Dedicated SSID/Network: Not Ideal (III)

Even worse for wired LAN: twice more VLANs

Desirable:

IPv6-only and IPv4-enabled hosts coexistence

Hence, draft-ietf-dhc-v6only
No IPv6 support in systems/apps

No customers complaints

Systems & apps are not fixed

IPv6-only networks are not deployed
Majority of offices have IPv6-only Guest network
Do you believe in IPv6-only enterprise networks?

I've deployed them!

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