

The Day I Broke All the Treadmills

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This talk is about



IPv6-Only Enterprise Network

Motivation

Running out of private IPv4 addresses

Dogfood and testing

Dual stack is hard



Source: www.wikipedia.org

"Entities should not be multiplied without necessity."

William of Ockham

Project Scope

Guest Network

```
graph TD; A[Guest Network] --> B[Guest WiFi  
> 50% of all WiFi users]; A --> C[Wired Guest  
Unauthorised devices]
```

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

```
graph TD; A[High Demand for IPv6-Only networks] --> B[12 Pilot Sites Selection Criteria]; B --> C[Wired Guest Host count]; B --> D[NetOps team presence]; B --> E[WiFi Guest Users Count];
```

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

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

~10% of users moved to
new SSID

Users incentives
to report bugs

Phase 1 Results

15 bugs reported

3 bugs fixed

< 5% of users falled back
to dual-stack SSID

~25K peak device count

Phase 2 Results

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-6man-grand](#)

Vendor Bugs/Broken IPv6

Process Issues

IPv4-first Operations Mindset

Designs with IPv4 dependencies

Early Adopters Are Crucial

Willing to try IPv6-only



Maximum issues found

Capable of reporting issues

Minimal user impact

IPv6(only) Support Requirement

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

- Explicit
- Specific



"IPv6 Support"



RDNSS
Management over v6



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:

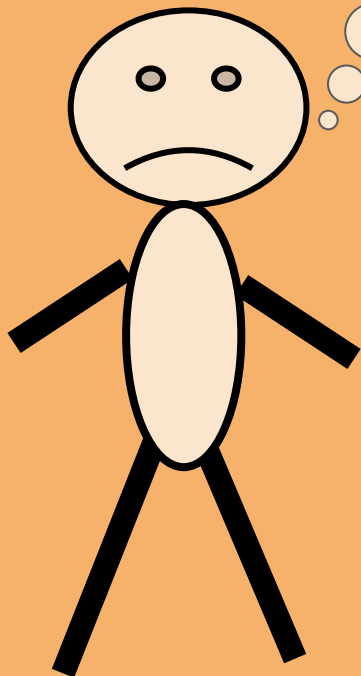
IPv6-only and IPv4-enabled hosts coexistence

Hence, draft-ietf-dhc-v6only

Oct 2020

Majority of offices
have
IPv6-only Guest network

Do you believe in IPv6-only enterprise networks?



I've deployed them!

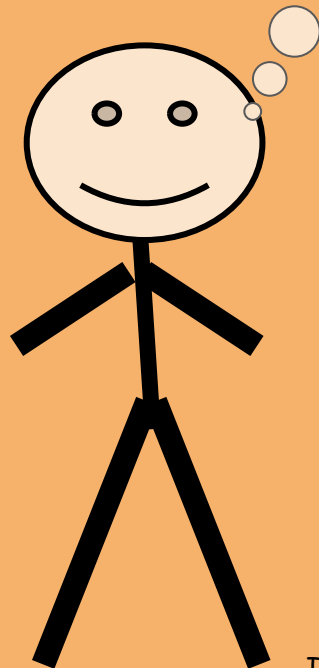


Image source: <https://freesvg.org/magical-unicorn>