

IPv6 mostly: A low risk option

Nick Buraglio

Planning and Architecture

Energy Sciences Network (ESnet)

Lawrence Berkeley National

Laboratory

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What is “IPv6 Mostly”?

IPv6-mostly is the technique of leveraging existing support for DHCP Option 108.

Option 108, or DHCPv4 Option 108 is defined in [RFC 8925](#), which as defined by the RFC is “...*a DHCPv4 option to indicate that a host supports an IPv6-only mode and is willing to forgo obtaining an IPv4 address if the network provides IPv6 connectivity.*”

What is “IPv6 Mostly”?

DHCP option 108 is supported in several DHCPv4 servers including the ISC open source server Kea.

IPv6-mostly leverages modern device operating systems use of what is called 464XLAT, or [RFC6877](#) (2013). 464XLAT has been used extensively in mobile networks around the world for almost 10 years giving it significant “production field time” in some of the most extreme network conditions.

What is “IPv6 Mostly”?

DHCP option 108 can leverage CLAT extensively to improve the end user experience.

CLAT is customer-side translator (XLAT) that complies with [RFC6145](#).

It algorithmically translates 1:1 private IPv4 addresses to global IPv6 addresses, and vice versa. This translation happens on the client itself, so there must exist a way to “trigger” the CLAT process to start. This is typically done via the presence of a DNS64 system (using `ipv6only.arpa`), or be the immediate router advertising `pref64` in its router advertisement.

Why is “IPv6 Mostly” lower risk?

- IPv6-mostly as implemented by DHCP option 108 allows for operating systems to “rise to their level of evolution”, meaning if they have the full capabilities to operate in an IPv6-only environment, they do so without user intervention
- Conversely, if a device does not implement and understand DHCP option 108, they happily move on with a dual-stack IPv4/IPv6 experience, again, with no user intervention.

How does this work in Practice?

- DHCP option 108 uses IPv4 DHCP to indicate that the network in question can support running without legacy IPv4.
- DHCP Option 108 contains a 32-bit unsigned integer that represents the number of seconds the client should disable DHCPv4
- Time to disable IPv4 should correspond correctly to the lease timer

How does this work in Practice?

In practice, option 108 allows the operating system to decide how much or how little it can support without needed input from the user, making the network fit the capabilities of the *host*, thus lowering the risk of incompatibility (and lowering the rate of problem reports)

How does this work in Practice?

- A network is configured with IPv4 and IPv6
- IPv4 DHCP is configured to announce option 108
- IPv6 can use either SLAAC or DHCPv6, SLAAC should support RDNSS
- Client requests DHCP
- If a device does not honor option 108 it just uses dual-stack.
- If a host does not understand IPv6 at all, it uses IPv4 dhcp and ignores the existence of IPv6
- If a system **does** honor option 108, it shuts off its IPv4 stack for the duration of time indicated and runs as single stack IPv6, typically with CLAT and using the upstream NAT64/DNS64

How does this work in Practice?

- **Client supports Option 108**
 - Client deactivates IPv4
 - Client Enables CLAT, installs RDNSS resolvers which support DNS64
- **Client does not support Option 108 but does support IPv6**
 - Client ignores option 108
 - Installs IPv4 DHCP address, IPv6 address. Uses IPv4 DNS servers from DHCPv4
- **Client does not support IPv6**
 - Client ignores option 108
 - Client installs IPv4 via DHCP and ignores the presence of IPv6

What Operating systems support DHCP option 108, and which do not?

Current Operating systems with option 108 support

- Apple MacOS computers running MacOS 13.1 or newer
- Apple iOS 16.0.3 and even Apple iOS 15.7 running on older devices
- Android 12 (and presumably Android 13) - worked on wired interfaces. Wireless has been problematic.

Current operating systems that do not support option 108 (by default)

- Microsoft windows (all)
- Linux (by default, clatd package is available)
- Android <12
- Older MacOS <13.1

These systems ignore option 108 and operate as dual stacked, unless IPv6 is explicitly disabled

This sounds weird. Why not just disable IPv4?

You totally can!

Just be aware that some devices do not enable CLAT

Operationally, this means that legacy software that uses only IPv4 literals (hard coded IPv4 addresses with no DNS), may have issues, and using IPv4 literals will fail (i.e. `ping 1.1.1.1`, `ssh 172.16.0.1` will not work at all)

Caveats

Anecdotal evidence points to old versions of Android (Android older than 12, tested as failing in Android 9) may have issues with option 108. This bears further testing, but testing has indicated on two occasions that this causes connectivity heartburn on these very old devices.

Summary

- Option 108 allows the network to adapt to the host capabilities
- Option 108 allows for the widest support for all platform protocol stacks
- Option 108 removes requirement for user intervention (i.e. “it just works”)
- Option 108 may have support issues with very old Android based devices
- Use of option 108 is both innovative **and** low risk.
- Will provide very interesting statistics on use of IPv6-only that can be tracked over time and across SCinet instances