# Building an open-source IPv6 configuration architecture for OpenWrt


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# Why OpenWrt?


Image: “Internet Reboot” by Karl Baron; cropped; CC BY 2.0

SOHO router firmware quality greatly varies
- → often outdated kernel & userland
- → countless security issues

At the same time, requirements grow
- → IPv6
- → AQM
- → 4G modem support
- → …

→ Building an open reference platform

# OpenWrt in a nutshell


→ over 10 years of fun with embedded devices

→ Linux with a custom build system & userland

→ registered as project of Software in the Public Interest

→ shipped on millions of devices worldwide

→ loosely associated group of core developers + individual and company contributions

# The Good ol’ Days…


Image: “legacy-caution” by Phil Benchoff; CC BY 2.0

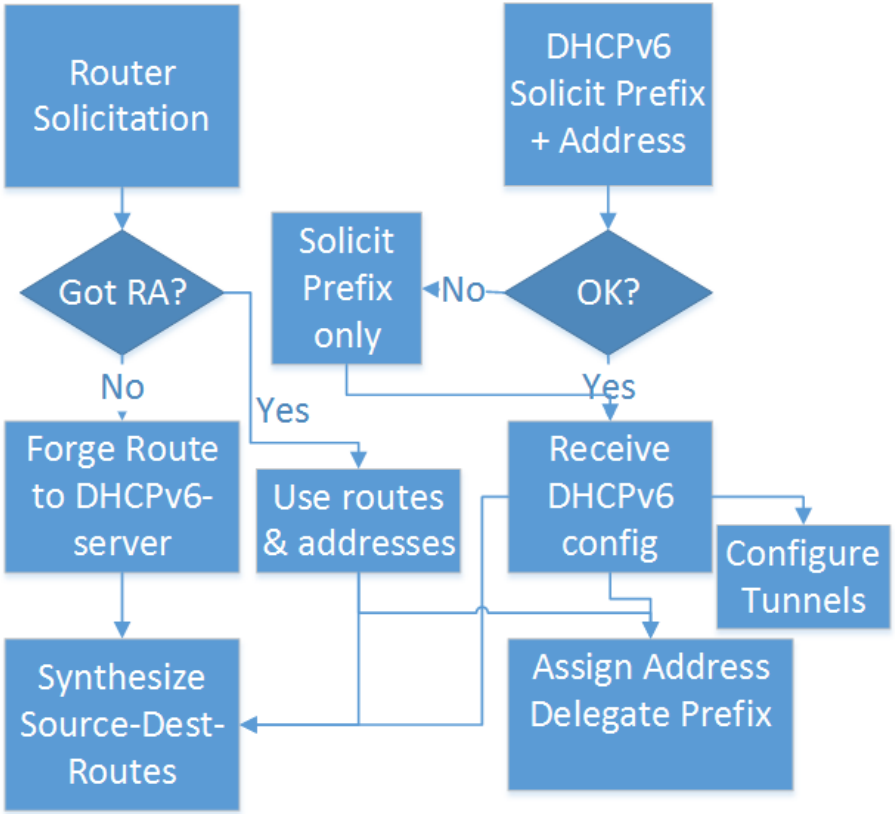
Static Configuration

NAT hides dynamic changes

Straight-Forward Bootstrapping

- DHCP or IPCP (PPP) from ISP
- DHCP to clients
- Clients hostnames registered

# … and the new era




Address prefixes using DHCPv6-PD

Router addresses using RA or DHCPv6 (heuristics / trial & error?)

RA for routes (but sometimes not)

Routes and address update intervals and lifetimes vary from several days to only a few seconds (!)

Various IPv4 / IPv6 transitioning technologies (...)

→ odhcp6c project

# All roads lead to IPv6…

| **Protocol** | 6in4 | 6rd | Dual Stack | DS-Lite | LW4over6 | MAP-E | MAP-T | 464XLAT |
|---|---|---|---|---|---|---|---|---|
| **Config** | Static | DHCP | Native | DHCPv6 | DHCPv6 or DHCP over DHCPv6 | DHCPv6 | DHCPv6 | DNS |
| **IPv4 NAT** | IP NAT | IP NAT | IP NAT | no NAT | IP NAT | Port Range NAT | Port Range NAT 46 | NAT 46 |

Did I mention GRE, AYIYA, 4rd, …?

And transitioning between transitional mechanisms?

→ requires a flexible network configuration daemon (netifd) and firewall (fw3)

→ and a whole lot of pluggable and stackable protocol handlers

# … and some lead to configured clients

| | Router Adv. | DHCPv6 |
|---|---|---|
| Addresses | stateless (/64) | stateful |
| Routes | default, on-link, more specific | - |
| Prefixes | - | routers |
| Dynamic Updates | yes | optional |
| RDNSS / Domain | extension | extension |
| Servers | many per link, all used | many per link, only 1 used |

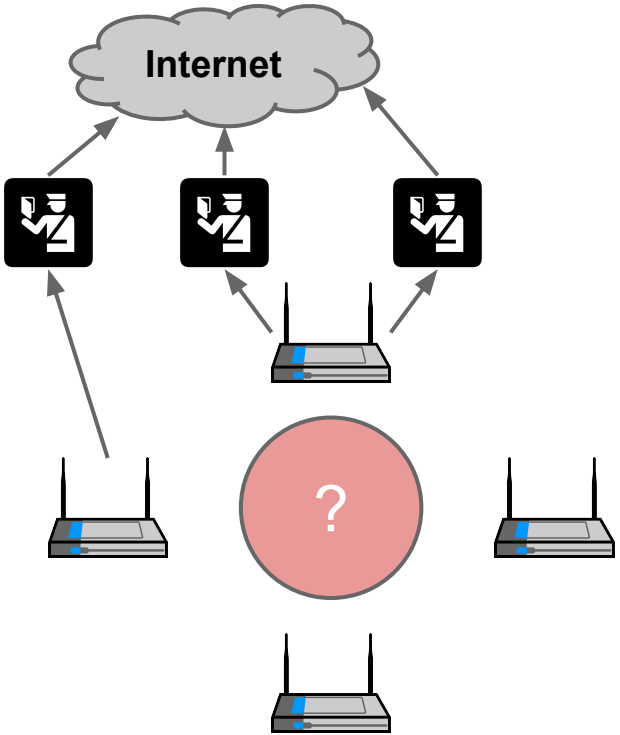
RAs as least common denominator

Plus different flavors of DHCPv6

- many platform quirks
- hostname registration (or not)
- prefix delegation (or not)
- work around lack of dynamic update capabilities

→ odhcpd project (under refactoring)

# ~~Permit A~~ BCP 38 & multi router networks




Source-Addresses & Multi-Homing

→ Stateless IPv6 NAT?

→ Source-address aware routing!

→ synthetic source-dest-routes

Multi Router SOHO networks

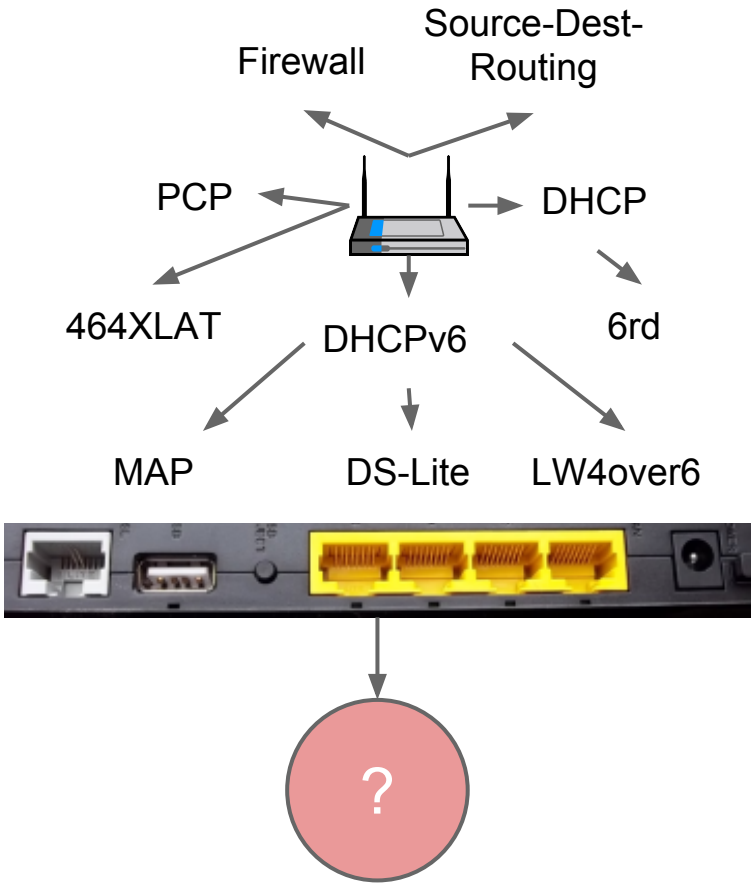
→ Vast layer 2 bridges?

→ What about link types?

→ DHCPv6-PD + NAT44-cascade?

→ What about topologies?

# Beyond a single router…




We can build relatively universal more or less self-configuring IPv4 + IPv6 SOHO routers!

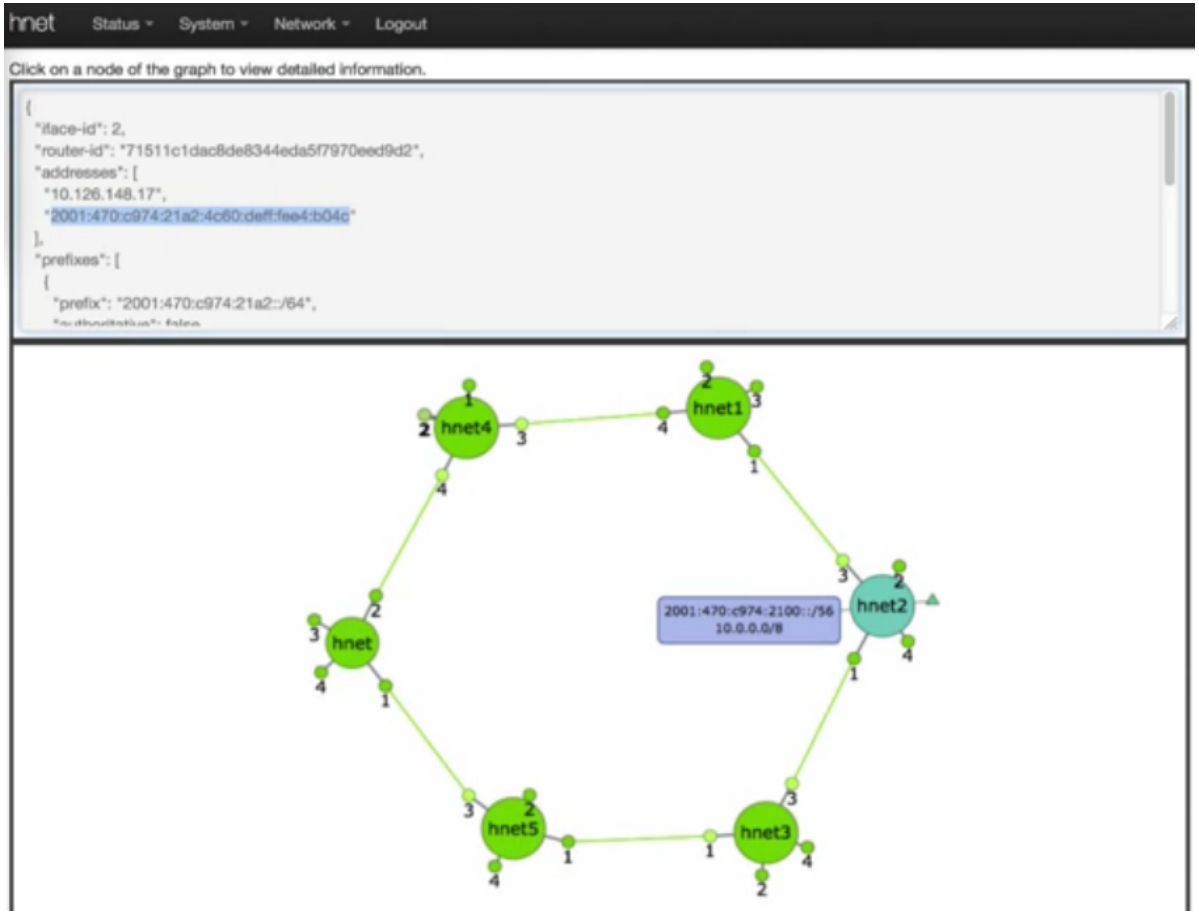
Can we take this one step further?
Getting rid of WAN-port and LAN-bridge?

Can we scale this up to arbitrary networks?
"Plug & Play" routers?
But who "owns" the network(s)?

→ Find a consensus among equal routers
→ DNCP: a distributed consensus protocol

→ Specify requirements for interoperability
→ HNCP: autonomous networks using DNCP

# … to an autonomous network!




→ Topology Detection

→ Border Discovery & Setup

→ Routing Setup

→ Naming & Service Discovery

→ Status Distribution

→ Security Bootstrap

Go To
→ www.homewrt.org
→ IETF homenet WG

# Preparing for the future?

More routers and devices (IoT)?

Multipath TCP utilizing multi-homing?

Dealing with more heterogeneous link types (Ethernet, WiFi, Powerline, ...)?

Clients and applications actively selecting uplinks for certain services?

...

# Thank you for your attention! Questions?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