Análise da implementação do IPv6 no OpenWrt sob o aspecto da RFC7084

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Motivation

- IPv6.br Project

  - IPv6 training course

    - Internet service providers, government and other companies related to the Internet
    - Many students told us that one of the main problems is the Last Mile
    - Many costumers edge Router still doesn't have IPv6 implemented
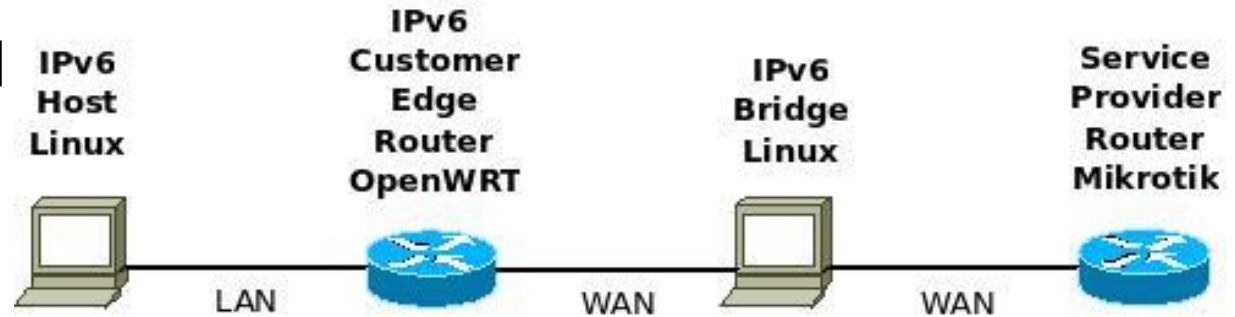   - So why not try OpenWrt ?

RFC7084

- Basic Requirements for IPv6 Customer Edge Routers

  - Created: November 2013

  - Category: Informational

  - 64 requirements

Experiments

- Machines

  - IPv6 Host and Server
    - Ubuntu/Linux 14.04

  - IPv6 Customer Edge Router
    - OpenWrt Chaos Calmer 15.05
    - TPLink TL-WR842ND VER 1.1.

  - Service Provider Router
    - Mikrotik version 6.34.2

Experiments
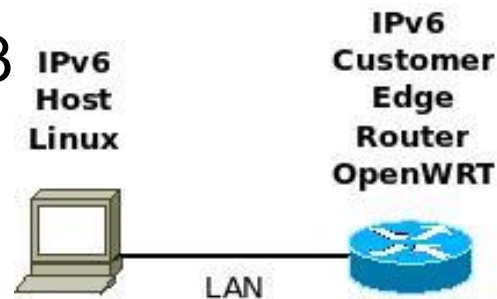
- Topology 1

- Topology 2

- Topology 3

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Results

- General Requirements

Test	Result
G-1	Fail!
G-2	It works!
G-3	It works!
G-4	It works!
G-5	It works!

Results

- **General Requirements**

  - G1 - An IPv6 CE router is an IPv6 node according to the IPv6 Node Requirements specification [RFC6434].
    - OpenWrt is not able to perform Duplicate Address Detection procedure with link-local address.

Results

- WAN-side Requirements

Test	Result
W-1	It works!
W-2	Fail!
W-3	It works!
W-4	It works!
W-5	It works!
W-6	It works!

Results

- WAN-side Requirements

    - W-2: The IPv6 CE router MUST generate a link-local address and finish Duplicate Address Detection according to [RFC4862] prior to sending any Router Solicitations on the interface. The source address used in the subsequent Router Solicitation MUST be the link-local address on the WAN interface.
        - OpenWrt has created two Link-local address from which one was used to make Duplicate Address Detection procedure and another to send Router Solicitation messages.

Results

- Link-Layer Requirements (WAN-side)

Test	Result
WLL-1	It works!
WLL-2	It works!
WLL-3	It works!

Results

- Address Assignment Requirements (WAN-side)

Test	Result
WAA-1	It works!
WAA-2	It works!
WAA-3	It works!
WAA-4	It works!
WAA-5	It works!
WAA-6	Fail!
WAA-7	It works!
WAA-8	It works!
WAA-9	It works!
WAA-10	It works!

Results

- Address Assignment Requirements (WAN-side)

  - WAA-6: If the IPv6 CE router receives a Router Advertisement message (described in [RFC4861]) with the M flag set to 1, the IPv6 CE router MUST do DHCPv6 address assignment (request an IA_NA option).
    - OpenWrt has an option to turn off DHCPv6 client which disables the router to take futher actions when it receives a router advertisement message with the M flag set to 1.

Results

- Prefix Delegation Requirements (WAN-side)

Test	Result
WPD-1	It works!
WPD-2	Fail!
WPD-3	It works!
WPD-4	It works!
WPD-5	It works!
WPD-6	It works!
WPD-7	It works!
WPD-8	It works!

Results

- **Prefix Delegation Requirements (WAN-side)**

  - WPD-2: The IPv6 CE router MAY indicate as a hint to the delegating router the size of the prefix it requires. If so, it MUST ask for a prefix large enough to assign one /64 for each of its interfaces, rounded up to the nearest nibble, and SHOULD be configurable to ask for more.
    - OpenWrt is able to to send a hint to the delegation router however it is able to request smaller prefixes than /64 (for example: /65).

Results

- ULA Requirements (LAN-side)

Test	Result
ULA-1	It works!
ULA-2	It works!
ULA-3	It works!
ULA-4	Fail!
ULA-5	Fail!

Results

- ## ULA Requirements (LAN-side)

  - ULA-4: By default, the IPv6 CE router MUST act as a site border router according to Section 4.3 of [RFC4193] and filter packets with local IPv6 source or destination addresses accordingly.
    - OpenWrt is not able to act as a site border router because it doesn't filter any ULA packets at all.

  - ULA-5: An IPv6 CE router MUST NOT advertise itself as a default router with a Router Lifetime greater than zero whenever all of its configured and delegated prefixes are ULA prefixes.
    - OpenWrt has an option to always announce itself as a deafult router even when it has only ULA prefixes configured/delegated.

Results

- LAN-side Requirements

Test	Result
L-1	It works!
L-2	It works!
L-3	It works!
L-4	Fail!
L-5	It works!
L-6	It works!
L-7	It works!

Test	Result
L-8	It works!
L-9	Fail!
L-10	It works!
L-11	It works!
L-12	Fail!
L-13	It works!
L-14	It works!

Results

- LAN-side Requirements

  - L-4: An IPv6 CE router MUST NOT advertise itself as a default router with a Router Lifetime [RFC4861] greater than zero if it has no prefixes configured or delegated to it.
    - OpenWrt has an option to always announce itself as a deafult router even when it has no prefixes configured or delegated to it.

  - L-9: Unless the IPv6 CE router is configured to support the DHCPv6 IA_NA option, it SHOULD set the M flag to zero and the O flag to 1 in its Router Advertisement messages [RFC4861].
    - Considering the fact DHCPv6 IA_NA option is not configured, OpenWrt is not able to send Router Advertisement with M flag set to zero and the O flag set to 1

Results

- LAN-side Requirements

  - L-12: The IPv6 CE router SHOULD make available a subset of DHCPv6 options (as listed in Section 5.3 of [RFC3736]) received from the DHCPv6 client on its WAN interface to its LAN-side DHCPv6 server.
    - OpenWrt is able to forward DHCPv6 Options between interfaces but not all of them (example SIP option).

Results

- 6RD Requirements

Test	Result
6RD-1	It works!
6RD-2	It works!
6RD-3	It works!
6RD-4	Fail!
6RD-5	Fail!
6RD-6	It works!
6RD-7	It works!

Results

- 6RD Requirements
  - 6RD-4: A CE router MUST allow 6rd and native IPv6 WAN interfaces to be active alone as well as simultaneously in order to support coexistence of the two technologies during an incremental migration period such as a migration from 6rd to native IPv6.
    - Openwrt is able to configure 6rd and native IPv6 WAN interfaces however it is not able to forward several packages to different destinations.
  - 6RD-5: Each packet sent on a 6rd or native WAN interface MUST be directed such that its source IP address is derived from the delegated prefix associated with the particular interface from which the packet is being sent (Section 4.3 of [RFC3704]).
    - Same error as above.

Results

- DS-Lite Requirements

Test	Result
DLW-1	It works!
DLW-2	It works!
DLW-3	Fail!

Results

- DS-Lite Requirements

  - DLW-3: If the IPv6 CE router is configured with an IPv4 address on its WAN interface, then the IPv6 CE router SHOULD disable the DS-Lite Basic Bridging BroadBand (B4) element.
    - OpenWrt has not disable DS-Lite Basic Bridging BroadBand element when it has IPv4 address configured on its WAN interface.

Final remarks

- Security Requirements
  - They were not tested because they are not mandatory (should)

- Conclusion
  - OpenWrt is able to work with IPv6.
  - However there are some errors that may affect the operation of some applications

- Future
  - Contact the OpenWrt's community
  - Test with other vendors

Thank You !!!

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