Broadband Solutions

Defining an IPv6-Ready CPE

May 2011

GENNET S.A.

Table of Contents

ACTIVITIES

Next Generation Access (NGA) equipment design, development, organization of production, marketing and sales.

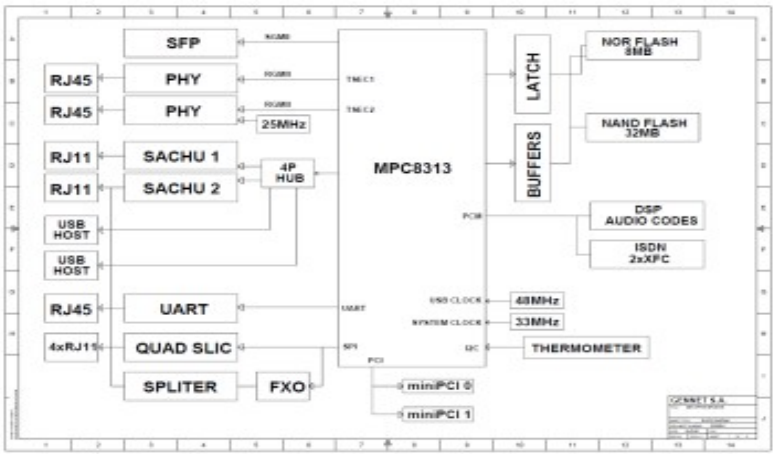
Product S/W and H/W development is performed in-house, in close collaboration with the major chip manufacturers.

S/W is based on embedded Linux.

H/W production is outsourced to specialized EMS firms in Europe or Asia.

CUSTOMERS

Broadband operators offering fast IP services. Installed base exceeds 200,000 units in 4 operators in Europe over the last 3 years.



Current IPv4 Architecture

IPv4-only
1 (or some) Global v4 IPs
NAT / Private Addresses / Block Incoming Connections
Stable (?) LAN Addressing
Single Address per Interface

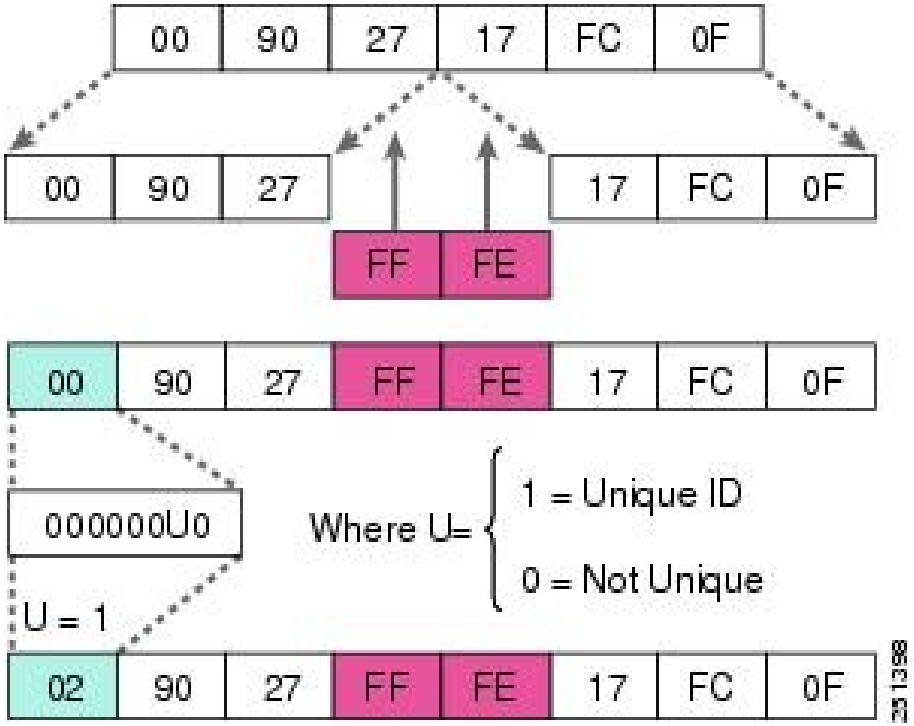
Future IPv4/IPv6 Architecture

Dual Stack (v4/v6)
Billions of Global v6 IPs
WAN Provisioning
LAN Provisioning
Multiple Addresses per Interface (LL,ULA,Global)
Stateful Firewall
Multicast Proxy Daemon

Stateless (SLAAC)

ICMPv6 Multicast messages

- IPv6 Prefix(es)
- Default Route
- MTU
- Lifetime
- DNS (through RDNSS)



Address (128 bits) = Link Prefix (64 bits) + EUI-64 (64 bits)

Privacy Extensions

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Auto-Configuration (2/3)

```
# ip address show dev eth0
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc
pfifo_fast state UP qlen 1000
    link/ether 00:22:41:1e:a8:d5 brd ff:ff:ff:ff:ff:ff          ← MAC
    inet 192.168.1.94/24 brd 192.168.1.255 scope global eth0   ← IPv4
    inet6 2a02:580:8000:9701:222:41ff:fe1e:a8d5/64 scope global dynamic
       valid_lft 86391sec preferred_lft 3591sec                 ← GLOBAL
    inet6 fdbf:468f:aaa0:474d:222:41ff:fe1e:a8d5/64 scope global dynamic
       valid_lft 86391sec preferred_lft 3591sec                 ← ULA
    inet6 fe80::222:41ff:fe1e:a8d5/64 scope link                ← Link-Local
       valid_lft forever preferred_lft forever
```

Auto-Configuration (3/3)

Stateful DHCPv6

- Client / Server model
- Link-scoped Multicast UDP
- DNS (and SIP,NTP,etc server)
- **Prefix Delegation**

Stateless DHCPv6

- Have IP – need parameters

IPv6 Auto-Configuration is Zeroconf on steroids

Acquiring WAN Addresses

PPP (**IP6CP**) **Link-Local** only → **Default route**

- Single or Multiple PPP session(s)

Global IPv6 through **SLAAC** (Auto-Configuration) on PPP (/64 or /127-128) → Management

Worst case scenario → **DHCPv6 IA_NA** (DHCPv6 Address Assignment)

Addressing LAN Clients

- Assign ULA addresses (SLAAC)
- When WAN side has acquired Global v6 IPs → provision Global v6 IPs to LAN

- Manual Addressing
- DHCPv6 Prefix Delegation + SLAAC (min subnet /64)
- DHCPv6 Prefix Delegation + Local DHCPv6 Server

Prefix is **at least** /56 → 72 bits available for LAN addressing!
(according to TR-177)

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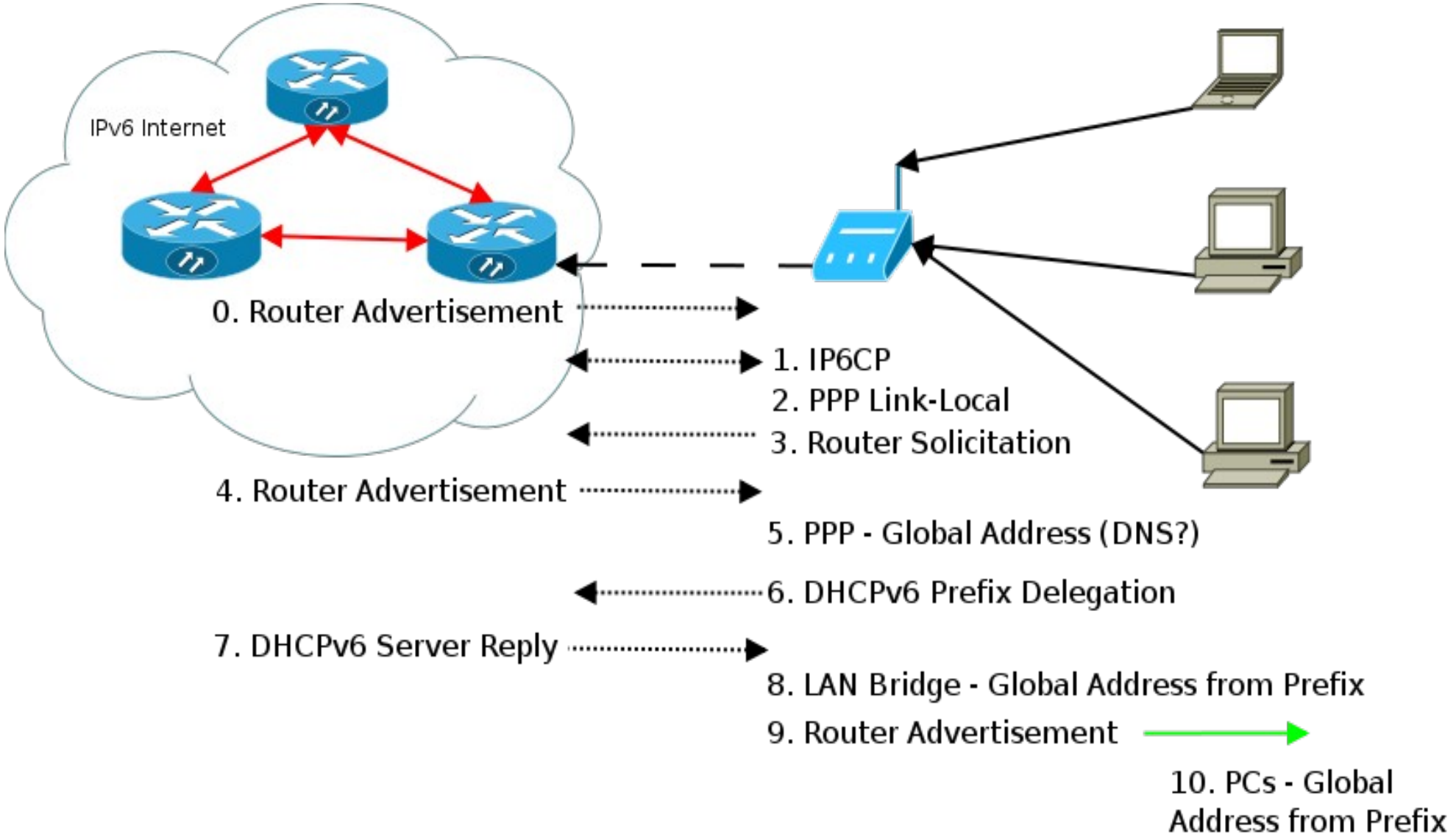
CPE Addressing Overview



CPE Features

Firewall

- Stateful
- Configurable by the user

DNS

- PPP (v4)
- WAN SLAAC RFC6106 (ex 5006)
- WAN DHCPv6
- User Configurable

QoS / IPsec / MLDv1,v2

Management

- WebGUI
- Telnet
- SSH
- TR-069

Transition/Translation Mechanisms

It's already TOO late!!

Accessing IPv6 from current IPv4 networks:

6to4 / 6rd / 6in4 (Tunnelbroker.net / Hexago / Sixxs.net)

Mixed IPv4 / IPv6:

Address-plus-port (A+P)

Accessing IPv4 from future IPv6 networks:

NAT64

Dual-Stack Lite

4rd

Sixxs.net Tunnel

```
[root@host ~]# ping www.ntua.gr
PING www.ntua.gr (147.102.222.213): 56 data bytes
64 bytes from 147.102.222.213: seq=0 ttl=56 time=35.630 ms
64 bytes from 147.102.222.213: seq=1 ttl=56 time=26.182 ms
64 bytes from 147.102.222.213: seq=2 ttl=56 time=26.210 ms
64 bytes from 147.102.222.213: seq=3 ttl=56 time=24.198 ms
64 bytes from 147.102.222.213: seq=4 ttl=56 time=26.184 ms
--- www.ntua.gr ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 24.198/27.680/35.630 ms

[root@host ~]# ping6 www.ntua.gr
PING www.ntua.gr (2001:648:2000:de::213): 56 data bytes
64 bytes from 2001:648:2000:de::213: seq=0 ttl=61 time=33.702 ms
64 bytes from 2001:648:2000:de::213: seq=1 ttl=61 time=33.132 ms
64 bytes from 2001:648:2000:de::213: seq=2 ttl=61 time=33.124 ms
64 bytes from 2001:648:2000:de::213: seq=3 ttl=61 time=35.184 ms
--- www.ntua.gr ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 33.124/33.785/35.184 ms
```

References

TR-124 Issue 2 - Functional Requirements for Broadband Residential Gateway Device
TR-187 - IPv6 for PPP Broadband Access
TR-177 - IPv6 in the context of TR-101
TR-181 Amendment 2 - Tr-069 Data model extension for IPv6

RFC6144 - Framework for IPv4/IPv6 Translation
RFC6204 - Basic Requirements for IPv6 Customer Edge Routers
RFC6092 - Recommended Simple Security Capabilities in Customer Premises Equipment (CPE) for Providing Residential IPv6 Internet Service
Happy-eyeballs-01 - Trending Towards Success with Dual-Stack Hosts
6man-node-req-bis – IPv6 Node Requirements

Outro

Say **NO** to Carrier Grade NAT!

Defend **end-to-end** Connectivity!

Questions

Thank you!

Questions ?

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