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Abstract:

This deliverable presents hardware and software specification of Home Gateway, the equipment that interconnects the Head End and the customer premises equipment.

Keywords:

Bridging, IPv6, PLC, QoS.

Revision History

The following table describes the main changes done in the document since its creation.

Revision	Date	Description	Author (Organization)
v1.0	11/03/2003	Document creation	Jean-Mickaël Guérin (6WIND)
v1.1	09/06/2003	Added SNMP, VLAN, bridging and QoS section,	Chano Gómez (DS2)
v1.2	16/06/2003	Added abstract, executive summary, conclusion	Jean-Mickaël Guérin (6WIND)
v1.3	23/06/2003	Updated to last template	Jean-Mickaël Guérin (6WIND)
v1.4	23/06/2003	Final Review	Jordi Palet (Consulintel)

Executive Summary

The Home Gateway (HG) is the equipment to interconnect the Head End (HE) to the customer premises equipment (CPE).

This deliverable gathers hardware and software specification to build the Home Gateway that includes basic and mandatory features for the project, according the results of WP2 "Integration of IPv6 Advanced Services over Power Lines" and WP3 "Network Architecture Design and Implementation", including IPv6 autoconfiguration, quality of service, bridging.

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1. INTRODUCTION

WP4 aims at designing and developing the devices able to support a large IPv6 deployment over PLC. These developments include the Head End, the Home Gateway, a Set-Top-Box and some adaptations for end devices. Deliverable D4.2 focus on hardware and software specifications of the Home Gateway.

The Home Gateway (HG) is the equipment to interconnect the Head End (HE) and a CPE.

The complexity of the Home Gateway will lie in the optimization of the hardware, as this equipment will be produced for a mass market. Code size will be carefully studied to limit the resources (memory, processor capacities, …), to make the best use of hardwired functions and keep them this side of reasonable limits to consider industrial applications in a further step.

A second key issue for the Home Gateway development will be a reduction of the configuration and the management of the device. Some zero-configuration mechanisms will be required to avoid local and manual configuration. The IPv6 built in auto-configuration mechanism will be a key feature to bring service zero-configuration. The management of the Home Gateway will have to be done from the Head End, as bringing management complexity at the Home Gateway side would lead to expensive solutions. Smart and secure mechanisms to implement end-to-end protocols such as CPE-based IPsec VPNs, to modify remotely and dynamically the service agreement between the provider and the user will be required.

For all these reasons, the platform to be used for the Home Gateway will be optimized.

According to WP3 work HG will act mainly as a PLC bridge.

2. HARDWARE SPECIFICATION

The Home-Gateway will be based on an industrial PC with an x86-compatible microprocessor and 2 PCI slots.

2.1 Hardware resources

The x86 microprocessor needs to be powerful enough to execute embedded Linux and handle Power Line traffic at line data rate (up to 45 Mbps).

2.2 Hardware Interfaces

The HG will feature the following interfaces:

- A PCI Head-End PLC card.
- A PCI CPE PLC card.
- An RS-232 port for console.
- Optionally, a keyboard, mouse and VGA port.

2.3 Hardware performances

The microprocessor must be capable of forwarding packets at up to 45 Mbps through each Power Line card. This means that it must be capable of:

- Receiving data through the CPE downstream channel at 27 Mbps.
- Transmitting data through the CPE upstream channel at 18 Mbps.
- Receiving data through the HE upstream channel at 18 Mbps.
- Transmitting data through the CPE downstream channel at 27 Mbps.

3. SOFTWARE SPECIFICATION

3.1 Software Architecture

For the reason explained before, the Home-Gateway will be a layer-2 bridge that will forward traffic between the HE and the CPEs. Layer-3 routing is not needed at this point, and including it in the design would increase the requirements of the device, with no obvious advantage.

The software architecture is based on the standard 2.4.12 Linux kernel, with customized drivers capable of managing the Power Line cards.

The driver is a loadable module, (not integrated in the kernel).

3.2 Software Modules

3.2.1 IPv6 Autoconfiguration

3.2.1.1 IPv6 Stateless Autoconfiguration

IPv6 specification describes the stateless address configuration as a possible way to configure IPv6 addresses. This method relies on the IPv6 address structure. IPv6 addresses are made of a prefix network and of an interface identifier. Prefixes networks are advertised on every link by routers while the interface identifier is built locally in the host from the MAC address of the card network. From these elements, every host can build its own IPv6 addresses.

3.2.1.2 Interaction with VLAN

VLAN stands for Virtual LAN and is useful to differentiate customers' traffic over a shared ethernet networks – ethernet frames are extended with a 16 bits tag, and a unique tag is assigned to each customer. According to the deliverable "IPv6 over PLC", a logical Ethernet layer is used to carry data. This makes a PLC network an ethernet-like network on which use of VLAN can be benefit. Since the DHCPv6 server is localized in the Head End [1], it could take advantage of getting the VLAN tag from DHCPv6 requests from CPEs, and then selecting the adequate IPv6 prefix according to VLAN tag.

This functionality can be used in several ways, depending on the needs of the network operator: One possible scenario would reserve one VLAN for end-users CPEs, another VLAN for network infrastructure equipment and another for VoIP traffic.

Another possibility would be connecting users in VLAN A to ISP A and users in VLAN B to ISP B. This would be useful in deployment scenarios in which the electricity utility plays the role of a carriers' carrier, with third-party ISP providing Internet and Telephony connectivity.

3.2.2 Bridging

Bridging is the act of connecting together multiple ethernets to appear as one large ethernet to the participating hosts. This is done by having one device with multiple ethernet interfaces, called a bridge, listen on all its interfaces for packets, including packets that are not destined to it, and selectively resend these packets on other interfaces. This process is totally transparent to the participating hosts.

Bridging is implemented using the standard Linux bridging capabilities.

Ethernet bridging functionality is part of the standard 2.4 kernel series. Bridging functionality either comes compiled into the kernel, or as a kernel module.

Some tools are also needed to actually setup the bridge. The tool for setting up bridging is called 'brctl', and it comes with the bridge-utils package.

A group of bridged interfaces can be viewed as another interface. Because all the participating ethernets are essentially made into one by bridging, and the local host is essentially only one host on that bigger network (as opposed to being one host on each of the networks it is connected to, as in the case without bridging), it makes sense to have the local host interact with this bigger ethernet by means of a virtual network interface, called the bridge interface or bridge port group interface.

Starting the brctl utility with the ‘addbr’ command does creating a bridge port group. Because every bridge port group is associated with a virtual ethernet interface, this command creates an ethernet interface with the same name as the bridge port group as a side effect.

brctl addbr br0

Slave interfaces are added to the bridge port group, using the 'addif' command.

brctl addif br0 eth0

brctl addif br0 eth1

An IP address can optionally be assigned to the bridge interface. The purpose of this is providing accessibility from other IP hosts in the network.

3.2.3 VLAN

VLANs can be used for separating logically the traffic from different users or services, even if they physically share the same Ethernet or Power Line network.

For compatibility with existing Power Line equipment, the Home-Gateway must support 802.1q VLANs.

The HG must support reception of tagged and untagged frames. It must also support tagging of untagged frames and untagging of tagged frames, if configured to do so.

3.2.4 Management

The Home Gateway must support remote management capabilities. The equipment can be managed using 2 methods:

- Telnet.
- SNMP.

3.2.4.1 SNMP Agent

The SNMP agent will be based on the open-source NET-SNMP agent [6], which is the standard for Linux. A new branch has been added to the standard MIBs supported by NET-SNMP, in order to implement the new managements functionality required by Power Line equipment.

3.2.4.2 MIB

Two main MIBs are required:

- MIB-II (RFC 1213).
- DS2 MIB (enterprises.6798).

DS2 MIB includes objects for adding/removing users from a network, monitoring channel quality, configuring physical modulation parameters, configuring VLANs, bandwidth allocation parameters, etc.

4. SUMMARY AND CONCLUSIONS

Hardware and software specification of Home Gateway have been described.

IP features have been defined including autoconfiguration, QoS, and Managenement.

Bridging capabilities is mandatory and the support of VLAN is of interest in the deployment.

5. REFERENCES

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