IPv6 over Power Line for the Digital Home

Moscow, November 2004

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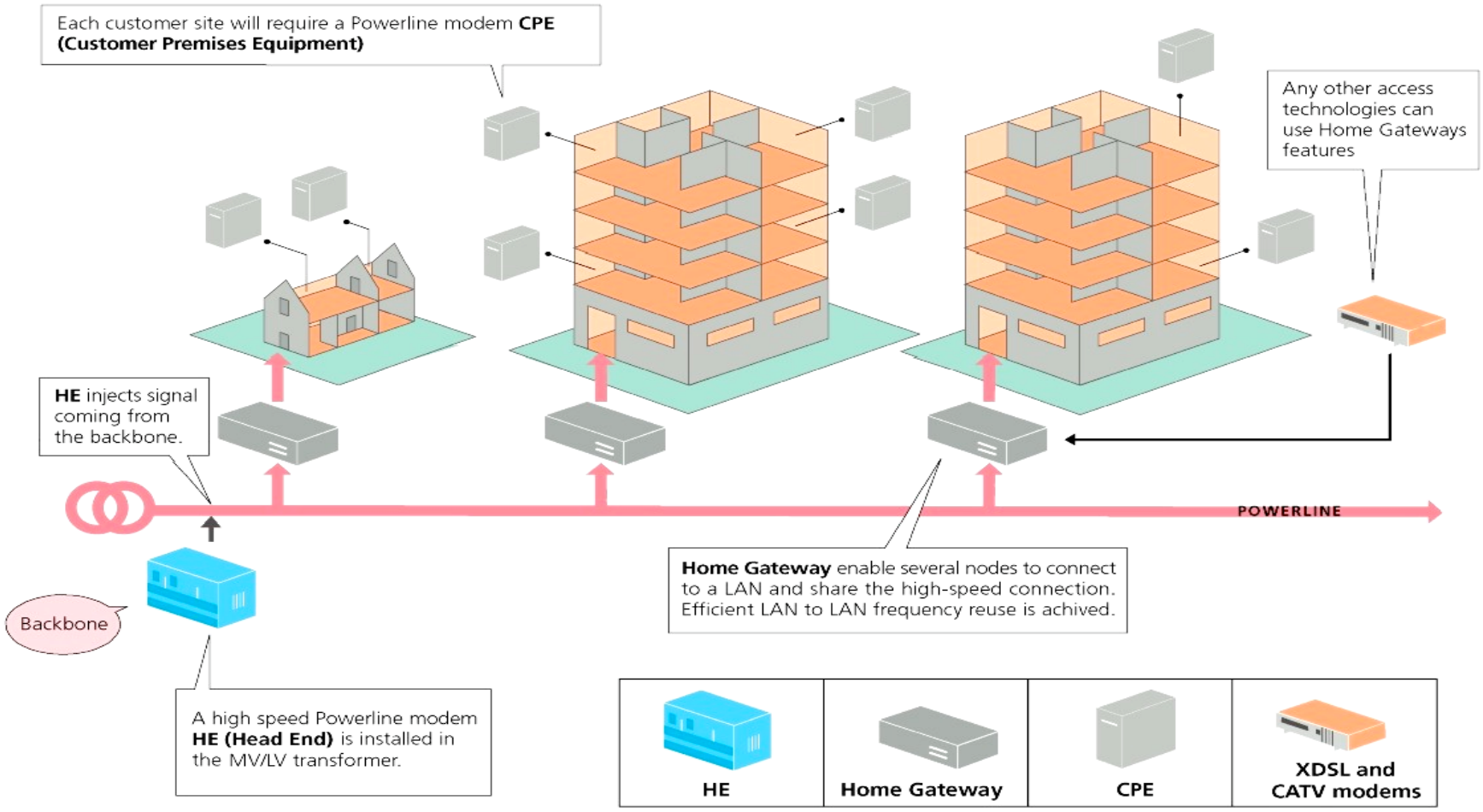
Consulintel

Typical PLC Network Topology



Next generation applications …

- Every device, even every application, one address !
- End-to-end (and secure end-to-end)
- True Interactive TV
- Intelligent environments
- Example: Intercom (voice or voice&video)
  - Can be easily “upgraded”
  - Can be installed at every place in the home
  - Connectivity with Internet (remote opening/control)
  - Several people using it simultaneously
  - Same device as the computer, PDA, cellular, VoIP phone, etc.
  - Can be used to communicate between neighbors
  - …

How? Take Advantage of IPv4

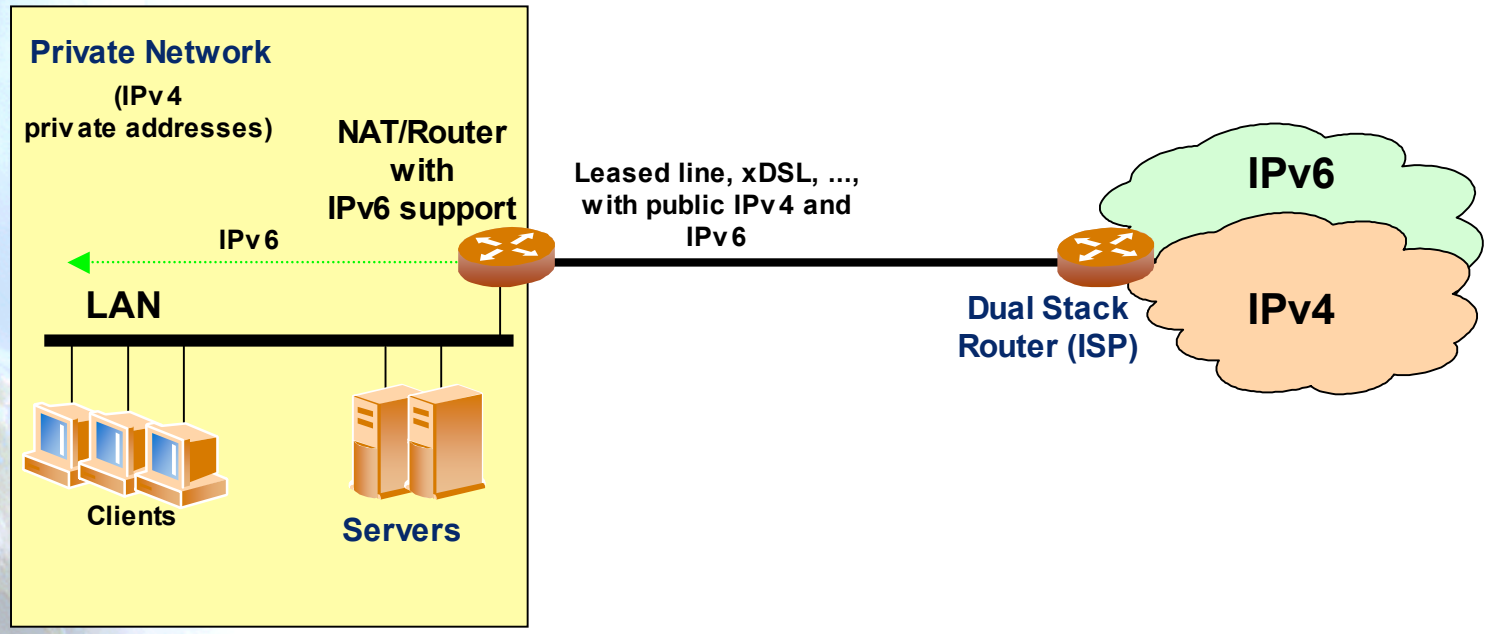
- Main rule: **Keep dual stack**
  - Until all the applications are ready
- Take advantage of IPv4!
  - Transition mechanism had been designed for it
    - Mainly tunneling
    - If possible avoid translation
- We don't use new IPv6 features ...
- ... but have end-to-end (secure) connectivity!
- Opportunity for old and new applications

Transition with Native IPv6

1. Configure router, if required
2. Security configuration, if required
3. Enable IPv6 in clients/servers
   - Today complete support in >85% Operating Systems
4. Configure DNS, if required

Dual Stack Example

- Native IPv6 and IPv4 (dual stack)

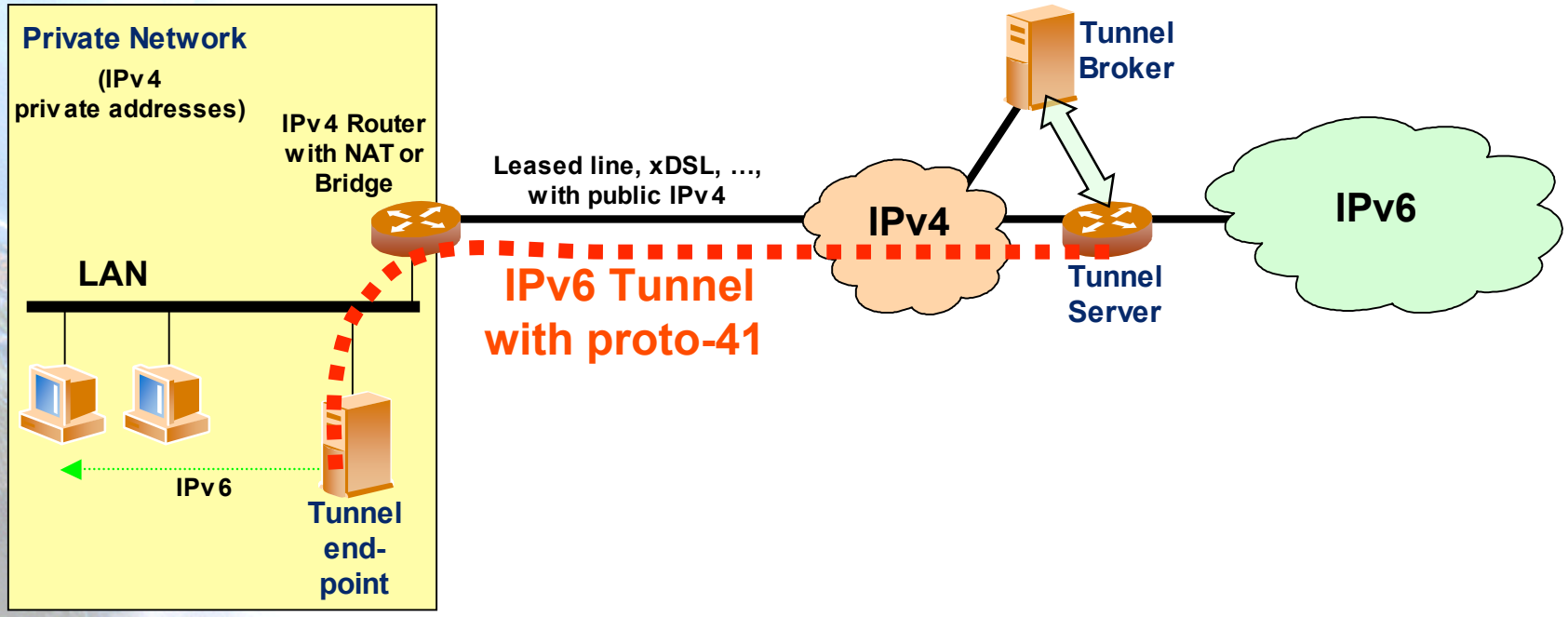


Transition without Native IPv6

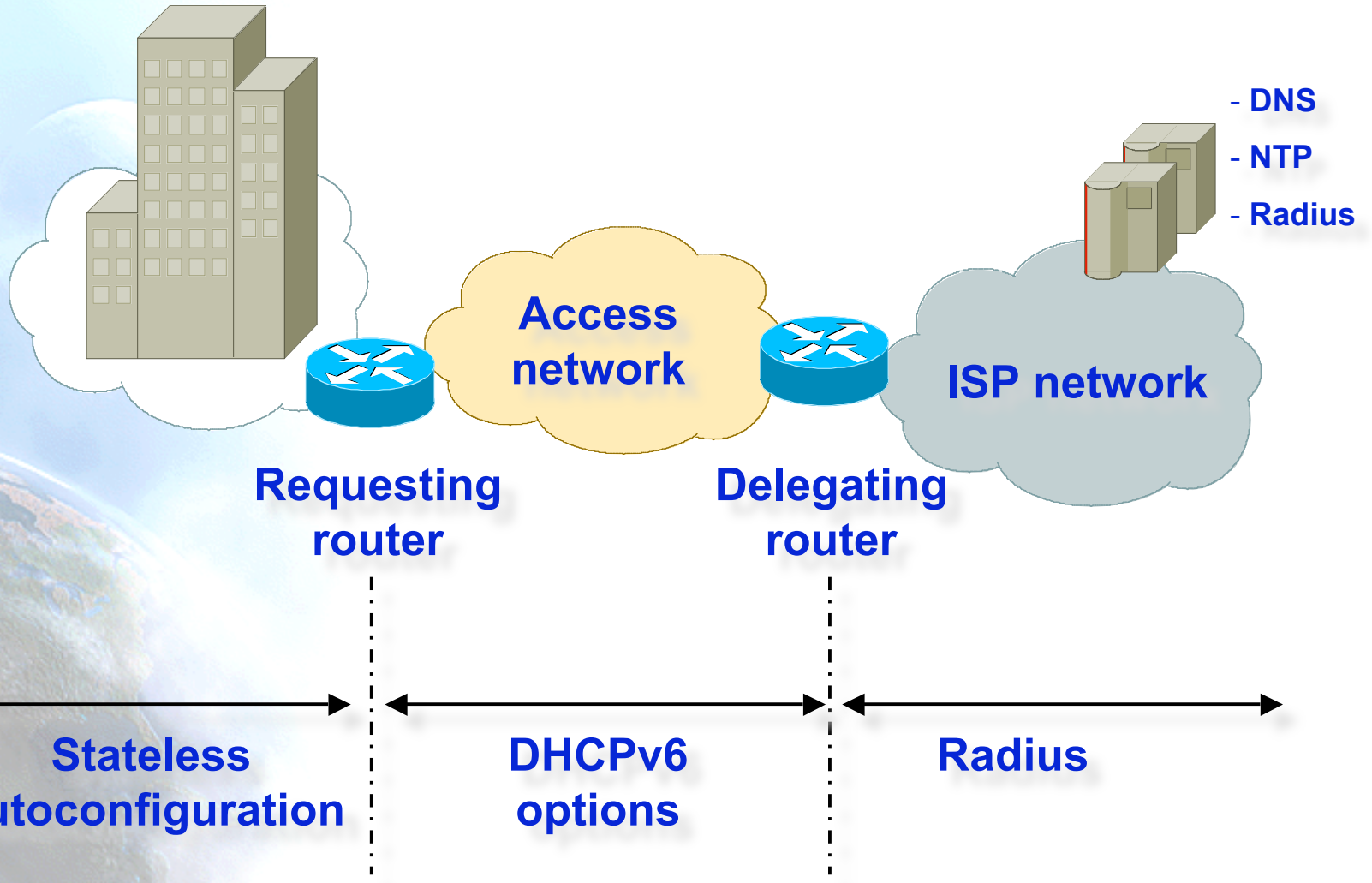
1. Make use of transition mechanism
   - Typically a Tunnel Broker/Tunnel Server
     - May require a combination with other transition mechanism if no public IPv4, example proto-41
     - The tunnel end-point can be in a PC behind the NAT
   - Other mechanism may be available
     - 6to4 is an option, specially if public IPv4 address or NAT with some IPv6 support
   - Teredo, if everything else fails
2. Security configuration if required
3. Enable IPv6 stacks in clients/servers
   - One of the PCs can become the IPv6 router for the rest of the network, providing RA
4. Configure DNS, if required

Tunneled IPv6 Example

- All the devices can use IPv6



DHCPv6 Prefix Delegation



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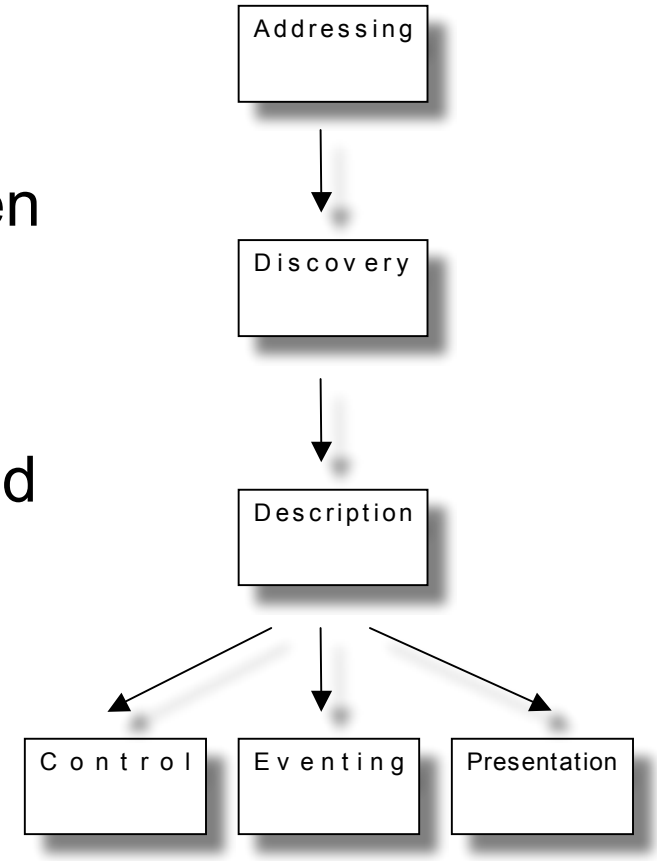
UPnP (Universal Plug & Play)

- Enables discovery and control of network devices and services
- Based on open TCP/IP standards: HTTP, XML, SOAP
- Zero-configuration
- Independent of any particular operating system or programming language:
  - No API definition

UPnP (II)

- Defines:
  - How the devices and control point have to be designed
  - The communication protocol between them
- Addressing:
  - Devices and control points get a valid IPv6 address
- Discovery:
  - Multicast Devices advertises and control points searches:
    - FF02::C:1900



UPnP (III)

- Description:
  - The Devices have an XML file that describes:
    - Name, type, manufacturer, a list of services that contain, etc.
  - Control Points obtain it (HTTP)
- Control:
  - SOAP is used to get the status or to invoke actions over the devices
- Event:
  - Control Points can receive a message when the status of a device change
- Presentation:
  - The devices could have an HTML page to facilitate human access to them

6-Plug

- Secure access to the home or industrial devices with IPv6
  - No problems with NATs and private networks !
  - Using proto-41-forwarding to a tunnel broker
- Use port 80 (433 if SSL)
  - No problems with proxies !
- Tomcat 5.0 web server (with IPv6 Support)
- Windows XP, CE, and Linux/BSD platforms
- Java Server Pages (JSP) Technology
- Java 1.5 (with IPv6 Support)
- Siemens UPnP SDK 1.1 (with IPv6 Support)

6-Plug Security

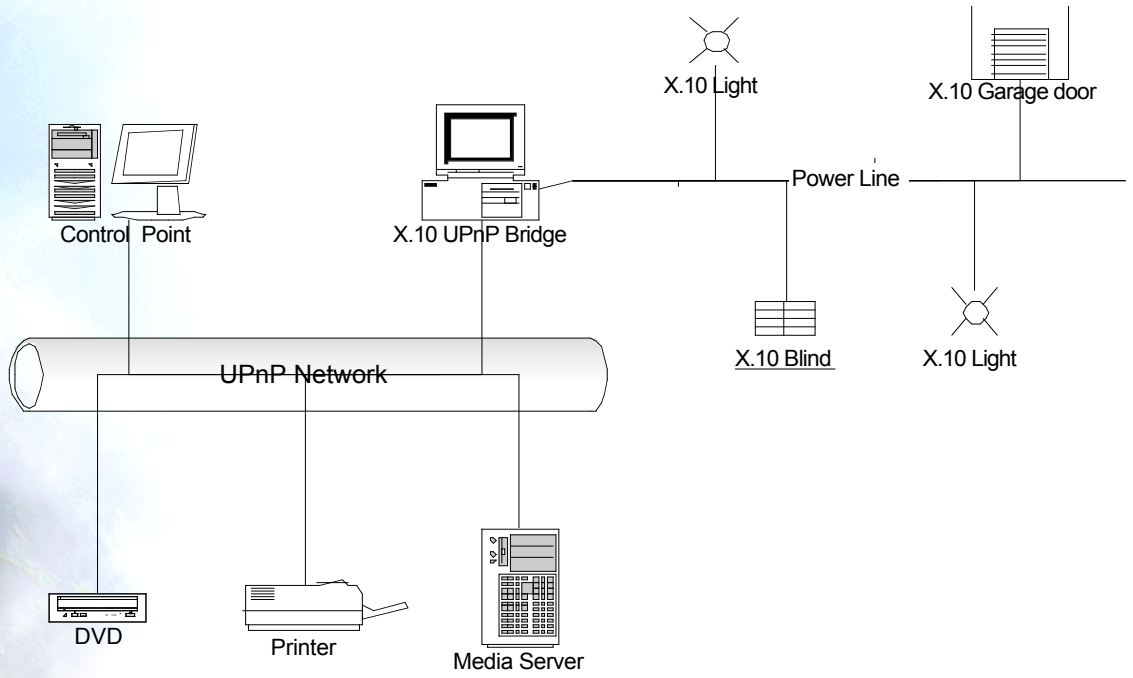
- SSL Support
  - Web server authentication by digital certificate
  - All transactions encrypted and logged
  - Possible client authentication by digital certificate
- Login and password client authentication when no digital certificate used
- UPnP security:
  - Private/public keys architecture
  - Authorization for actions invocations over the devices at home UPnP network

X.10

- X.10 is a control technology that allows the transmission of digital information over the power line wiring
- The transmitters use zero crossing point of the AC power line to send the messages.
  - Binary 1 is represented by a 1 millisecond burst of 120 kHz
  - Binary 0 by the absence of 120 kHz
- The bandwidth is 50 bps (60 bps at USA)
- Each receiver device has a House Code (A-L) and a Key Code (1-16) that identify itself at the network
- We can switch on/off any electrical devices (dimming is also possible)

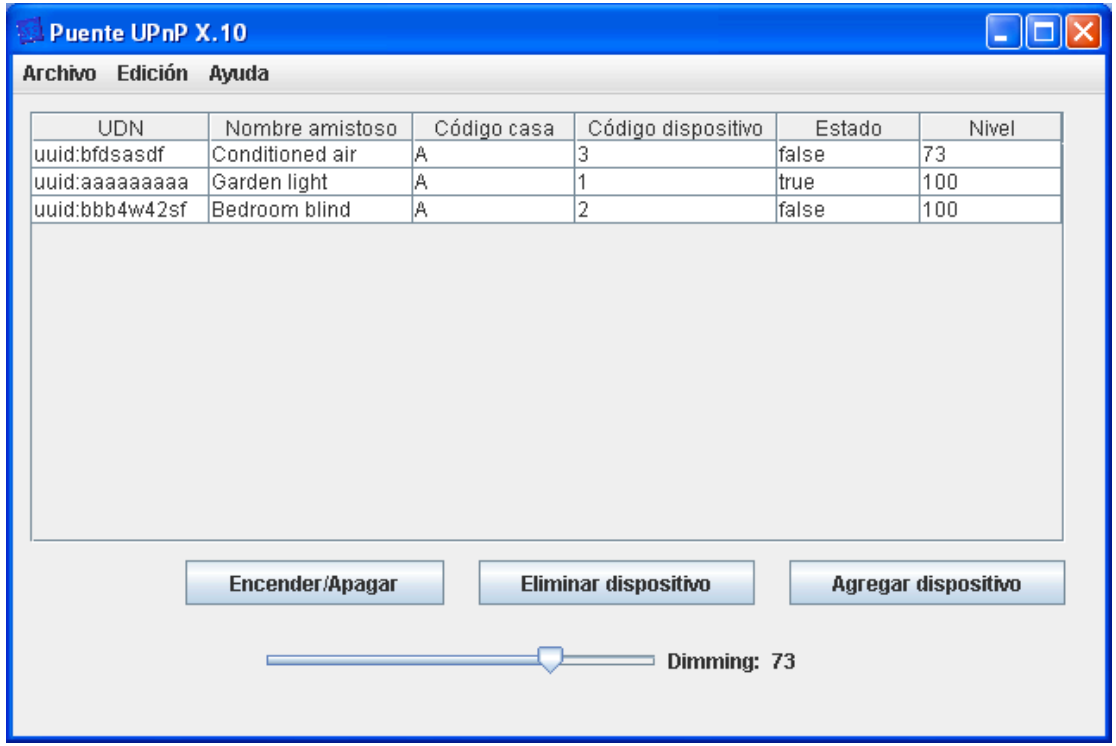
X.10 to UPnP Bridge

- The bridge allows us to present every X.10 device in the UPnP network
- The UPnP Controls Points could execute actions over them and watch their status



X.10 to UPnP Bridge (II)

- When the bridge receives an action invocation from an UPnP Control Point the bridge connects by serial port to the X.10 adapter to send the commands to the devices



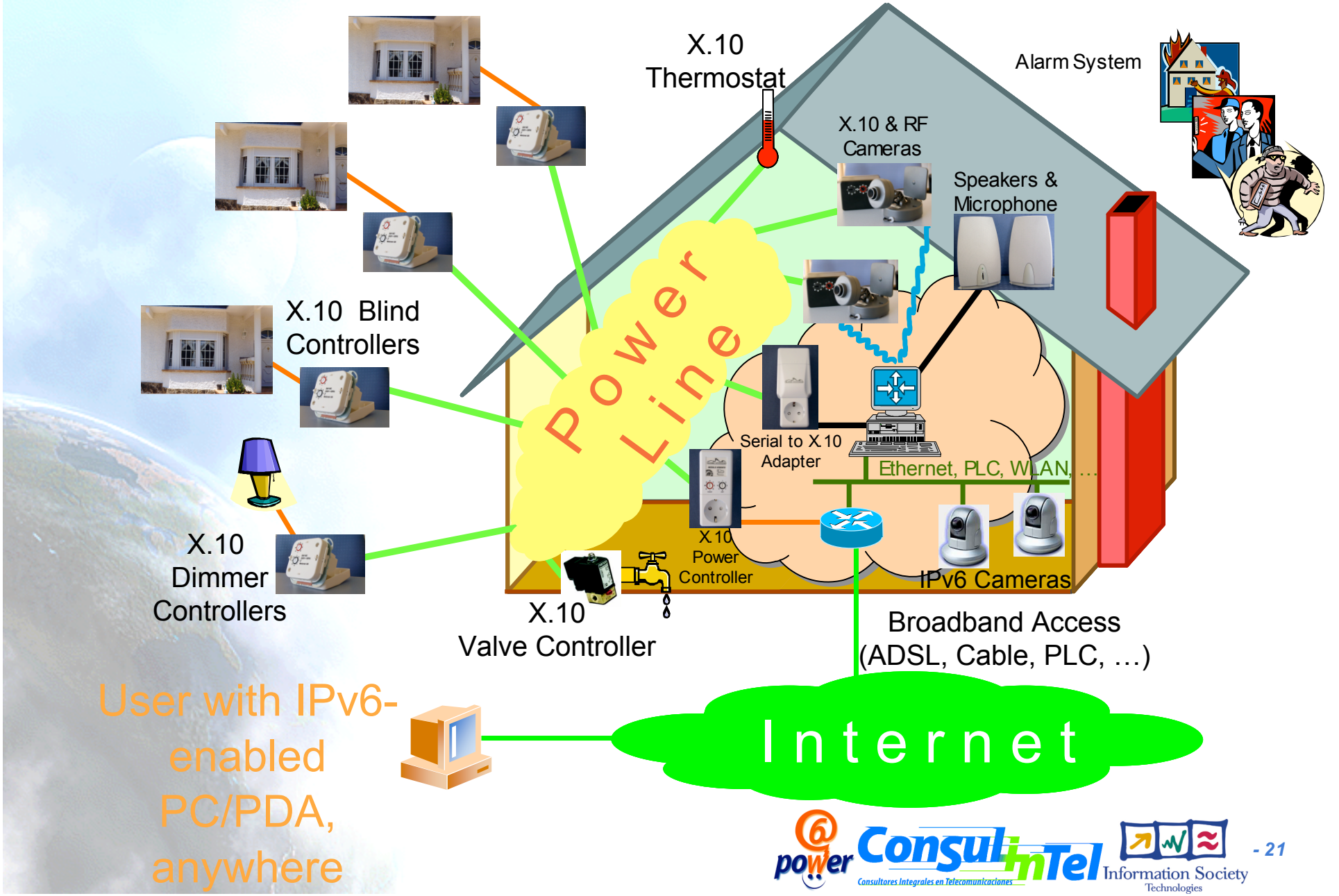
Other Control Technologies

- Other bridges to UPnP are under design
  - EIB (European Installation Bus):
    - Transmission media: Low voltage (24V) cable
      - 9.600 bps
    - Other available medias: Power Line, radio frequency, infrared, …
    - Support up to 65.000 devices
    - API Falcon to access to the EIB network
  - LonWorks:
    - Based on the Echelon Neuron Chip
    - Available with different transmission medias
  - and more in the roadmap
- But … new IPv6 enabled devices avaliable:
  - IPv6 Cameras (LAN & WLAN)
  - IPv6 Set-Top-Boxes (with also interface to X.10 or others)

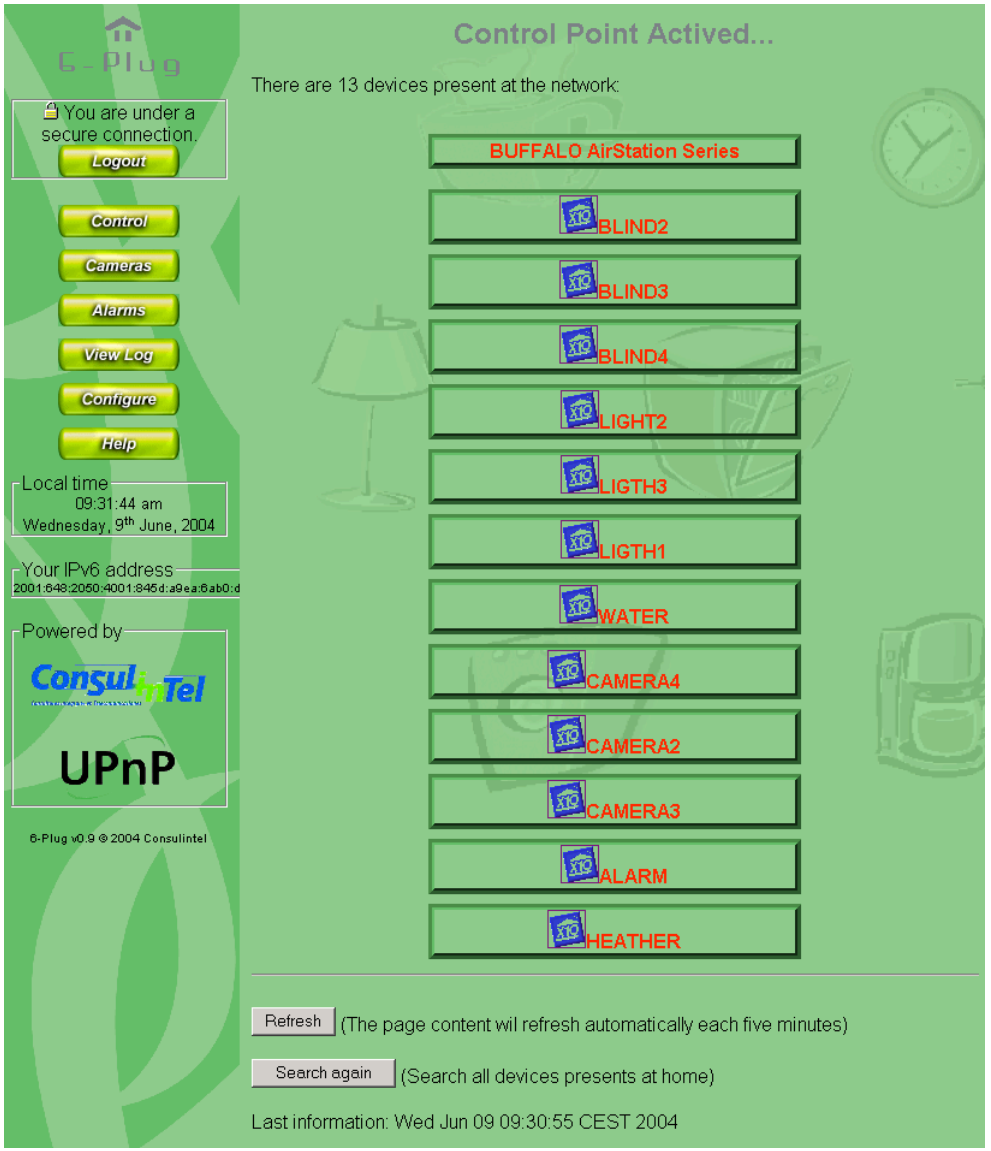
IPv6, Transition and Coexistence

- Keep dual stack if possible
  - IPv4 with NAT, will be here probably for many years
  - IPv6 end-to-end (including security)
- Use IPv4 to transport IPv6 if no native connectivity available
  - ISPs could not offer native service immediately
  - But IPv6 is still very useful and offers end-to-end
- Not using IPv6 is an opportunity (business) loss
- Old applications revived with IPv6
- IPv6 is not only about addressing but also about INNOVATION

IPv6-enabled Home Network



The Demonstration



IPv6-enabled Home Appliances

- There is an incredible market for any kind of IPv6-enabled appliances, with technologies like PLC and WiFi:
  - Cameras
  - Audio
  - Alarm systems
  - Sensors (intrusion, smoke, gas, water, ...)
  - Controllers
  - Dimmers
  - Switches
  - Electro-valves
  - Door-locks
  - Temperature
  - Pet feeders ;-)
- What about the kitchen and the living room ?
- Ambient Intelligence is HERE !

Are you missing your piece of the cake ?

6POWER: Objectives

- Research native IPv6/IPv4 and related protocols or advanced network services (QoS, security, multicast, mobility, …) support over broadband Power Line.
- Large-scale deployment of very high speed broadband PLC over 45 Mbps !
- Support for emerging technologies: Home automation, VoIPv6, multi-conferencing, audio/video streaming, advanced “next generation” digital set-top-boxes, next generation services (high-speed interactive TV, secure e-commerce, virtual shopping, infotainment and related applications)
- Field Trial and Evaluation, network prototypes, interconnected with other IPv6 trials.

ISOC Paper

http://www.isoc.org/briefings/013

Addressing the Digital Divide with IPv6-enabled Broadband Power Line Communications

ISOC MEMBER BRIEFING #13

May 5, 2003 *by Jordi Palet*

Definition
Power Line Communications (PLC) allows transmission of data over power lines. PLC is potentially the network with the deepest capillarity in the world, since power lines are almost ubiquitous.
IPv6 provides a package of highly scaleable enhancements to the Internet compared to the capabilities of the existing IPv4 protocol, which is today only sustained by Network Address Translation (NAT). NAT has unfortunately created unexpected barriers during the massive growth of the Internet, consequently breaking the initial end-to-end communications concept.

However, this massive IPv4 deployment happened mainly in rich countries, creating a digitally divided society. IPv6, associated with other scaleable technologies like PLC, is key to redressing the balance and alleviating the digital divide, enabling more people and entire countries to access information and knowledge, which in turn will allow them to benefit from the global economy, and create new knowledge and services.

Background
New access technologies, like PLC, that have been evaluated for some years, have failed to support the legacy Internet paradigm. These technologies now have a new opportunity with IPv6, because IPv6 will give value to their deployment.

Power Line Communications has been around since the 1930's but was never seriously thought of as a medium for communication due to its low speed, low functionality and high deployment cost. However, new modulation techniques supported by recent technological advances have finally enabled this medium to become a realistic and practical means of communication.

Recently, new technology has led to integrated circuits and modems entering the market, providing high speeds over power line infrastructure at reasonable and falling cost.

Although several broadband PLC technologies have been successfully developed, there is no standard yet. Some vendors provide "low-speed" (up to 2 Mbps) data rates using single-carrier technologies (GMSK, CDMA). Some technologies are based on multicarrier modulations (OFDM) and offer higher data rates, notably a 45 Mbps OFDM PLC chipset, which is the highest data rate available at this time.

In December 2002, at least one PLC technology vendor announced that during the second half of 2003, a new generation of broadband PLC technology providing 200 Mbps of physical layer data rate would be available as a commercial product.

Technical Issues of PLC
The main advantage of PLC over other technologies is that no new cabling is required, as all the cables are already there. Every building, be it offices, apartments or houses, has the network already installed. This permits a computer,

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http://www.6power.org/noticias_ipv6.php
http://the.honoluluadvertiser.com/article/2002/Nov/22/bz/bz01a.html

Relevant IETF RFCs
Over 50 RFCs have been published by different IETF Working Groups, including those directly implicated in the standardization of IPv6, but also some others. A new WG is being formed, Zerouter, that will facilitate the large scale deployment of networks, facilitating the autoconfiguration of the devices at both, the customer end, and the ISP network itself.

From OnTheInternet
http://www.isoc.org/oti/articles/1201/g8.html
http://www.isoc.org/oti/articles/1201/wilkinson.html
http://www.isoc.org/oti/articles/0601/rao3.html
http://www.isoc.org/oti/articles/0601/wang.html

Thanks !

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- Madrid 2005 Global IPv6 Summit, soon more info at:
  http://www.ipv6-es.com

- 6POWER Project Coordinators
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