Article **ECORFAN Journal-Mexico**
COMPUTING December 2010 Vol.1 No.1 91-106

Internet broadcast by light cables

ZAMORA- Eduardo *†

Universidad de Londres, Orizaba 139, Cuauhtémoc, Roma Norte, Cuauhtémoc, 06700 Ciudad de México, D.F., Mexico

Received April 07, 2010; Accepted May 07, 2010

The modern technologies of illumination used in the fiber optic network allows that the same fibers that are used for the administrative technical applications, to have the potential to provide services to third. This I articulate denotes to the well-known technology like PLC or PLT (Powerline Communication/Powerline Telecommunication) that is a process to insert or to inject a signal of greater frequency (1-30 MHz) to the electrical signal (60Hz) in the lines of copper used to trasmit electrical energy. This allows that interference is not generated with the electrical service since they work in very different ranks of frequency.

PLC, PLT, frequency.

Citation: Zamora, E. Internet broadcast by light cables**.** ECORFAN Journal-Mexico 2010, 1-2:91-106

*Correspondence to Author (email: zamora@yahoo.com.mx)
† Researcher contributing as first author.

Introduction

Mexico was the first Latin-American country to have access to this network. The 28th of February of 1989, a link was made through a private analogic line of 9600 bits per second to form an internet node with the University of Texas, in San Antonio, USA.

This way the ITESM had the first name server for the .mx domain. The same year the UNAM, through their institute of Astronomy (IA), established an agreement to link to the network of the National Science Foundation in the United States, which was realized through the Mexican satellite Morelos II between the IA and the National Center for the Atmosphere Research (NCAR) with residence in Boulder, Colorado; also, the first link to connect the local area networks between the Institute of Astronomy and the Department of Academic Computing Services of the UNAM was made, using optical fiber links. It was in 1993 when the CONACYT and the Autonomous Technological Institute of Mexico connected to the internet through a satellite link to the NCAR.

Until then only educational and research institutions had access, but in 1994 the company PixelNet was the first to offer the service commercially. The Broadband in Mexico and its suppliers. In Mexico access to broadband Internet is predominantly via ADSL and Cable.

- ADSL: companies that offer this modality are: Telmex, Alestra, Terra and Maxcom. Telmex is offered with its Prodigy Infinitum service, Terra and Alestra use Telmex's network to provide their service. Connection speeds ranging from 512 Kbps up to 5 Mb / s.

- Cable: The companies that offer the service are: Cablecom, Cablemas with Cablered, Cablevision, Cablevision Monterrey Intercable, Megacable with Megared and Telecable with Cybercable. Speeds range from 256 Kb / s to 50 Mb / s. Through mobile: Movistar offers the service using UMTS / HSDPA.

- Telcel through WCDMA / UMTS and Iusacell through CDMA / EVDO.

- 3G connection through the computer: Iusacell offers 3G Internet service on its CDMA network through EVDO since 5 years ago at a maximum speed of 3.1 Mb / s. Telcel also does but on its UMTS network since 2008 with a maximum speed of 1.8 Mb / s. Movistar announced the availability of its UMTS / HSDPA network in November 2008 with a top speed of 14.4 Mb / s.

- Through Satellite: Jaba Networks Satellite Communications in Critical Situations, global network, and Pegaso Broadband.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

- Wireless Internet: E-Go of MVS provides wireless Internet service; it also has agreements with Alestra (Masternet) and Axtel (known before as Avantel with its Netvoice service) to use its infrastructure. WideLAN provides wireless Internet service in the city of Tepic, in the state of Nayarit. Accesa Communications is a company that provides wireless Internet service in the city of Merida in the state of Yucatan, Mexico.

- WiMax: The paid TV provider by coaxial cable, Ultravisión was the first WiMax in Mexico since 2006 [3] Currently offered in the cities of Aguascalientes, Coatzacoalcos, Matamoros, Puebla, Tampico and Veracruz. However, Axtel is the largest Wimax services provider in Mexico with coverage in 39 cities nationwide.

The innovation of telecommunications

The tremendous acceptance in recent years that the access to internet has shown has exploded the number and type of services offered using IP as the network protocol. Many of these services require unattainable band widths for the user until only a few years ago, which explains the success of technologies such as ADSL have obtained and are still obtaining. However these solutions are linked to the subscriber loop holdings, currently held by the dominant operator. PLC can compete in this segment with advantage in both cost and bandwidth, and contribute to a true liberalization of the subscriber loop.

Companies like DS2, design chips capable of transmission speeds up to 200 Mbps over lines of Low and Medium Voltage, rivaling metropolitan and access networks, while allowing telecommunications operators to extend its range of final services including voice, video and data transmission -what is known as Triple-Play- on the same infrastructure. The deployment without the need of civil work of this equipment in existing electrical distribution lines (with a population coverage of higher than 90%) makes PLC into a very competitive alternative in cost and performance over current broadband solutions.

Status of the research

It's implemented in other countries in Europe, South America and some cities in Mexico, as it is waiting for bids from other entities.

In European countries, China and Japan, this technology is already installed with an internet transfer rate of 7MB of "upload" and "download". These computer terms are to indicate the upload and download of information from or to the network.

Approach

The internet connection at home virtually always passes through the air in the form of a WiFi signal. The benefits are too many to stay anchored to the cable network, at least when we want to access the network in each and every one of the places in the house without running wires everywhere.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

However, it is not always possible to have wireless connectivity or it gives us more problems than solutions.

Then the PLC technology (Power Line Communications) or communications thorough the power line are the best alternative nowadays.

The PLC technology will allow us to access the Internet and create a data network using only the cables of the wiring at home. Thus, each outlet will be an access point.

Introduce new technology that is being used in different countries, and that the project is about to get implemented here in particular.

Broadband over Powerline (BPL, for short) is the service that is provided through the existing distribution network of electrical power of low and medium voltage.

The transmission of the BPL is comparable to DSL and cable modem. BPL can be provided to homes using existing electrical connections and outlets.

The BPL is an emerging techinology, currently available in very limited areas. It has a significant potential because power lines are installed virtually everywhere, alleviating the need to build new broadband facilities for each consumer.

General objective

Explain the evolution of internet access in Mexico, defining all ISPs out there at the moment; and the implementation of internet through light networks and wiring. Also, the structure that the service has both at home and at external connections.

Some prototypes that have been used in other countries will be seen and how are they used. And their benefits.

Specific objective

To see the benefits of optic fiber information networks through electric light connections. Since this service uses infrastructure already avaliable for the distribution of light in the country and the increased users, data transfer thorugh a faster bandwidth than other market competitors.

Development

PLC stands for Power Line Comunication, the technology that allows the transmission of voice and data over the existing power grid. This system currently allows data transmission at speeds up to 200 Mbps.

The electrical network is the largest in the world, it is made up of thousands of miles of cable, it reaches over 3,000 million people and even offers services to those places where there is no phone.

Use this extensive network for voice and data transmission, connect to the Internet at high speed and use the telephone line into any outlet is a tangible reality by this technology.

Currently, this technology offers an alternative to broadband since PLC use infrastructure that is already deployed, such as electric cables. Just a simple plug is enough to be connected. It offers high speed, provides multiple services with the same platform and allows one to have a permanent connection.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Additionally, when using electrical cables, as the transmission medium, home wiring behaves as a data network where each plug is a potential point of connection to the world of Internet. PLC stands for Power Line Comunication, the technology that allows the transmission of voice and data over the existing power grid. This system currently allows data transmission at speeds up to 200 Mbps

The electrical network is the largest in the world, it is made up of thousands of miles of cable, it reaches over 3,000 million people and even offers services to those places where there is no phone. Use this extensive network for voice and data transmission, connect to the Internet at high speed and use the telephone line into any outlet is a tangible reality by this technology.

Currently, this technology offers an alternative to broadband since PLC use infrastructure that is already deployed, such as electric cables. Just a simple plug is enough to be connected.

Also, it offers high speed, provides multiple services with the same platform and allows one to have a permanent connection.

Additionally, when using electrical cables, as the transmission medium, home wiring behaves as a data network where each plug is a potential point of connection to the world of Internet.

Theoretical Framework

PLC technology is simply a set of elements and transmission systems, based on a classical transport and power distribution infrastructure, it allows us to offer services of a classical telecom operator to the customers.

Between 1 and 1.5 Mbps can be achieved for the particular user. Thus it becomes possible to offer Internet services, data transmission at high speed and even IP telephony. Although its use for internet access its something new, the fact of using the electrical infrastructure for the transmission of data is nothing new.

Power companies have been using this technology for many decades, to reach the most remote locations of their generation networks, such as hydroelectric centrals or remote transformers located on any mountain of the geography, where of course the telephone network doesn't reach. High voltage lines are used then to transmit data, with very small velocities, but enough for the remote.

What is new is that the research teams have recently achieved rates up to 3 Mbps using a new chip, which has once again awakened the possibility of providing information at high speed through the electric network.[6]

General principles of operation

PLC technology is simply a set of elements and transmission systems, based on a classical transport and power distribution infrastructure, it allows us to offer services of a classical telecom operator to the customers.

[6] Información general PLC, Foro de PLC, (2008) Web: "http://www.plcforum.org"

Between 1 and 1.5 Mbps can be achieved for the particular user. Thus it becomes possible to offer Internet services, data transmission at high speed and even IP telephony.[7]

The idea is simple: conditioning the current electricity infrastructure so that it can transmit two types of signal simultaneously is enough: The low frequency (50 or 60Hz) for power transmission and the high frequency (1MHz band) for data transmission, both circulating through the copper wires.[8]

The new adapted network is called High Frequency Conditioned Power Network (HFCPN), allowing simultaneous transmission of energy and information.[9]

In electrical substations (or local transformers) servers that connect to the Internet generally via optic fiber are installed. The network layer protocol is IP without any conversion. Of the three parts into which the grid is composed (sections of low voltage, medium and high voltage), only the low voltage section is used (or what in the telephone network is known as the last mile).

Stretch connecting houses with transformer substations (or what would be the telephonic equivalent to a local central).[10]

This technology uses the electrical network to send and receive digital information at high speed, which makes conventional electrical outlets into potential connections to the telecommunications network for broadband applications.

The CFE, along with various private and educational institutions, has assessed the scope and feasibility of the PLC technology, both with teams that use the DS2 technological standard as well as with Homeplug, to be implemented as a telecommunications network.

Similarly, the work needed to determine the potential of the PLC technology in applications related to the improvement of the operation of the electrical service has begun.

Cooperation agreements have been celebrated in order to analyze the feasibility of PLC as a telecommunications network on projects with social purposes in rural locations, as in the case of the agreement signed between CFE and the Government of the State of Veracruz, to operate with social purposes, a pilot project with PLC technology in the town of Zongolica.

Derived from various technological tests conducted by the CFE, it has been concluded that PLC is a technically feasible alternative to last mile broadband access, which can be used to provide access to broadband services over the IP protocol.

What's more, the NAtional Polytechnic Institute has concluded that the exploitation of PLC technology in Mexico is technically feasible and that the incidental radiation accompanying the technology does not pose a risk to health and in general to the telecommunication environment.

[7] Competencia y regulación de la energía, Noticias de PCL (2008) Web:"http://www.competenciayregulacion.cl/news.php?edicion=18&news=112"

[8]Encarta, Electricidad(2010) Web: "http://es.encarta.msn.com/encyclopedia_761566543_3/Electricidad.html"

[9] Electro industria, Web: "http://www.emb.cl/electroindustria/articulo.mv?xid=392&rank=1"

[10] HFCPN: High Frequency & Conditioned Power Network. Red eléctrica acondicionada para las altas frecuencias.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

On the commercial side, the CFE has been exploring mechanisms so PLC technology can be marketed in Mexico. Because of this, we have identified a business model in which the CFE adopts a neutral position in the telecommunications market and makes PLC technology available to various telecom operators, under non-discriminatory conditions and strictly on the market basis.

However, the application of this model has been suspended until the PLC technology will stand at a level of matirity sufficient to make it economically viable.

However, we have worked with various authorities, both from telecommunications and competition, to promote the use of PLC technology as an alternative to increase connectivity in the country. On this point, the Federal Competition Commission, the Ministry of Economy (COFECO) issued a notice supporting the project and providing general guidelines; For its part, the Federal Telecommunications Commission (Cofetel) informed the CFE of the rules to be used for the approval of PLC equipment.

We have continued with the promotion of PLC technology between dealers and the analysis has begun for the implementation of electrical applications, assuming that with the convergence of telecom and electrical applications, the PLC technology would have greater economic viability.

Elements for the provision of internet by PLC

First of all, we must know that power grids convert (by transformers located at the substations), the voltages of medium voltage (used for the transport of energy) to 220V low voltage lines as close as possible to the users.

In order to avoid the losses that occur at low power.[11]

PLC technology is simply a set of elements and transmission systems, based on a classical transport and power distribution infrastructure, it allows us to offer services of a classical telecom operator to the customers. Between 1 and 1.5 Mbps can be achieved for the particular user.

Thus it becomes possible to offer Internet services, data transmission at high speed and even IP telephony. It is enough to condition electrical infrastructure so that these two kinds of signals transmit without affecting each other; the low frequency (50-60 Hz) for power transmission and the high-frequency (1 MHz) for data transmission, both flowing through the copper pair.

The new adapted network is called High Frequency Conditioned Power Network (HFCPN), allowing simultaneous transmission of energy and information. In electrical substations (or local transformers) servers that connect to the Internet generally via optic fiber are installed.

[11] Banda Ancha, (2010) Web: "http://www.mincomunicaciones.gov.co/mincom/src/user_docs/Archivos/Sectorial/ComBandaAnchaOrbitel.pdf"

The network layer protocol is IP without any conversion. Of the three parts into which the grid is composed (sections of low voltage, medium and high voltage), only the low voltage section is used (or what in the telephone network is known as the last mile).

Stretch connecting houses with transformer substations (or what would be the telephonic equivalent to a local central). [12]

Transformers

Each transformer distributes, typically between 3 and 6 low voltage lines, with an average length of about 250 meters. Each provides power to about 50 customers.[13]

Single electric power phase meter based on a completely electronic meassure core, has a pulse output of the "Open Collector" type that enables remote automatic reading of the measurement information.

User modem

Each user must install a modem to enable the sending and receiving of data over the power line.[14]

There is the option for the user to install a home gateway, between the modem (placed near the counter input) and a possible internal LAN, so that it enables different users to share the connection and at the same time to interconnect among them using any electrical outlet or plug in the building.

In turn, any external data source (xDSL, coax, wireless, bluetooth) can be connected to the home gateway for it to distribute and manage multiuser connection.[15]

The PLC modems transmit at ranges of high and medium frequency (carrier signal of 1.6 to 30 MHz). Asymmetric modem speed is generally from 256 kbit / s to 2.7 Mbit / s. In the repeater situated in the meter room (in the case of supply in a building) the speed is up to 45 Mbit / s and can be connected to 256 PLC modems. In the medium voltage stations, the speed from the network control centers ("head end") to Internet is up to 135 Mbit / s. To connect to the Internet, electric companies can use a "backbone" optical fiber or wireless links.

Head Modem

The header PLC modem located in the medium voltage substation of the electrical operator, engages and disengages the data signal of the electrical signal.

[12] Comisión Interamericana de Telecomunicaciones, "Aspectos de la Tecnología de Comunicación por Linea de Potencía (PLC)". (2008) Web:"http://www.citel.oas.org/newsletter/2008/diciembre/plc_e.asp"

[13] Huidrobo José M y Davis Roldán. (2005)"Serie Telecomunicaciones redes y Servicios de banda ancha, Tecnología y Aplicaciones, Primera Edición, Editorial MCGraw-Hill, (2005), 133-134, 255-259.

[14] Dgtv, "Manuales de Plc", (2010) Web: "http://dgtve.sep.gob.mx/tve/serv_edusat/manuales/pdf/energia.pdf"

[15] Rediris, "Plc", 2010 Web:"http://www.rediris.es/rediris/boletin/68-69/enfoque4.pdf"

Since the low voltage electrical network is shared by 4-6, the head modem will handle all the traffic from those users, dynamically placing the capacity of the data channels available to the users based on their instantaneous demand and the type of data traffic to send; since traffic such as real-time data (such as voice or video) that require a minimum delay, are given priority over other types of traffic.[16]

The transformer substations will be joined together by PLC or other technology, linking one of them to the service center connected to the Internet or to other telecommunications networks, and from which you can also remotely monitor and control the PLC equipment installed and manage data about the customers such as meassure reading.

Finally, the operator must also, in some cases, install in the meassure room of each building, a residential gateway; which is a repeater responsible of amplifying the signal and retransmit it to all outlets of the homes or offices.

Graphic 1 Head Modem[17]

The client, when hiring the service, must purchase and install a small PLC modem where data transmission equipment will be connected, such as a PC. This modem will have a port to be connected to the plug and another, usually USB (although, depending on the model, can be RS-232 or Ethernet) to be connected to the PC the same way as an ADSL modem.

The PLC modem is responsible for separating the low frequency signal of the power supply (50 Hz in Europe and 60 Hz in the U.S.) from the one that carries the data (1.6 to 30 MHz currently). This operation is very similar to the ADSL splitter, which separates the traditional analog voice signal (which occupies the band 300-3400 Hz) from the data.

To do this, the modem has two filters inside, one low-pass, which will allow electricity to circulate and to which appliances, televisions and other household appliances will be connected to; and a high pass that separates the carrier wave of information.

[16] Tecnología PLC, J. R. González y, F. J. Vieira. (2010) Web:"http://www.rediris.es/rediris/boletin/68-69/enfoque4.pdf"

[17] Tecnología PLC, J. R. González y, F. J. Vieira. (2010) Web:"http://www.rediris.es/rediris/boletin/68-69/enfoque4.pdf"

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

The latter will be treated by the modem in order to turn it into useful data for the PC (video, image, voice, etc.) as an IP protocol.

This filter is also responsible for cleaning the variable noise generated in the network by all connected appliances and that could introduce very significant distortions in the data, and to provide privacy to the data communication based on VLAN and also protection through encryption mechanisms.

Due to the architecture of the low voltage network, the bandwidth is shared by all subscribers connected to a single transformer substation; so if the head modem in the processing center can support 45 Mbps and serves 150 subscribers, of which 30% opt for PLC as a form of Internet access, each of them can reach at least 1 Mbps, although the rates may be higher when the rest of subscribers are not connected.

On the side of the electric company, and the transformer substation, you must also place the data reception modem. Whereby a high speed connection powerful enough to serve all users is guaranteed.

From this point, and through a fiber or a radio link, we will connect with the service provider (ISP). Shown in the figure under the acronym HE.[18]

Architecture of a PLC access network.

- The network topology is in bus, causing that the bandwidth provided by each processor, must be shared by all the users who hang from it. There is an average of 150 homes in Europe per transformer[19].

- Any plug or plug of the house is a communications port provided you have a PLC modem. It incorporates two filters inside to separate signals carrying information (high-pass) and electric current (low-pass).

- There are some distance limitations for both the interior to the house section as well as to the the access section, these being about 400 m to the access section and 50 m for the in-home portion (in home).[20]

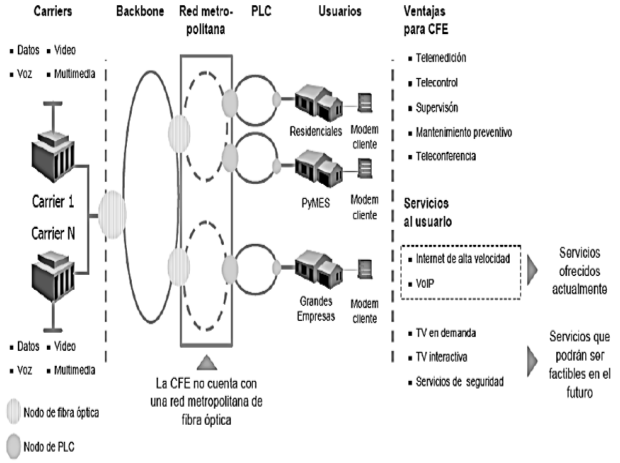
- The access controller or PLC head modem is responsible for interconnecting the different service networks (Internet, television, telephone) with the low voltage line.

[18] IEEE Std 802.1Q-199 "IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks" Mar, (1999)

[19] Tanebaum, Andrew."Computer Network", Third Edition, Prentice Hall, New Jersey. (1996) Pág.102-169

[20] Barreto Alexis. "Estudio y análisis de las distintas tecnologías, De acceso que un proveedor de servicios de internet puede implementar", tomo ii, (1999), pág. 218, 233, 257, 306.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682



It can be seen that all carriers of information will be transmitted via optical fiber to all users, PLC is responsible for connecting lines of low and medium voltage to the fiber optic network. The backbone is part of the metropolitan network to which the entire PLC system will connect to.

Note that the Internet will not be provided by CFE, but by leading companies in this service. CFE would make available the electricity network converted into PLC, this by using medium and low voltage equipments, couplers and user equipment (modems), which are placed in residences, industries and large companies, all of this, in order to give a good service and signal quality.

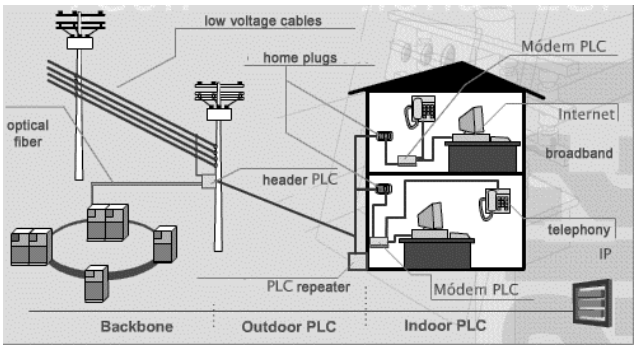
Services will be provided to the client using the low voltage network commonly called "last mile". Note that this system will help to improve the operations of CFE and in turn give access to the end user ("Last Mile") to broadband and voice services over the IP protocol.

Each area has a substation transformer, three medium voltage wires and 4 low voltage wires.

The 3 medium voltage wires enter the transformer, which is responsible for reducing the voltage and from this the 4 low voltage wires will come out, of which 1 is neutral and the others are alive.

Employing the above, different combinations will be done in order to feed the houses that surround the substation.

Now in Figure 6.8 we can see that in the transformer is placed a PLC system with a transmitter / receiver, which receive signals from the satellite for later transmission through the cables. For the signal to stay with a good quality and not suffer much attenuation, repeaters will be placed every 200 meters.[21]



Graphic 2

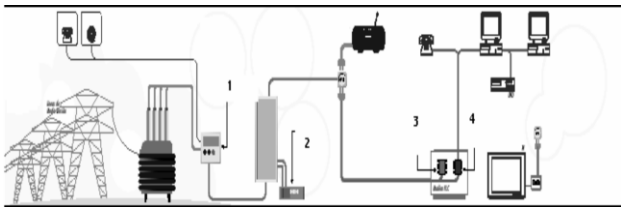
How does it work?

The grid can be considered to be divided into three classes of sections: high, medium and low voltage, or subscribers stretch.

[21] CFE, "Arquitectura PLC" (2010) "http://catarina.udlap.mx/u_dl_a/tales/documentos/lem/santos_p_sc/capitulo6.pdf "

The PLC technology does not use all of the electrical network for data transmission, but only the low voltage section, due among other things to the fact that the data signals can not pass through the transformers. In the processing center or electric substation there will be a node connected to Internet through a "Backbone" of optical fiber or wireless. There the optical signal is converted into an electrical signal through the PLC head.

Then through the light cable two signals arrive at homes: the low frequency ones, that transmit power, and the high-frequency signals that transmit data. If the distance from the subscriber to the PLC head is greater than 300mts one repeater PLC is required, which would be connected a the measurement center.



Graphic 3

1. PLC head**
2. PLC repeater
3. Low band filter
4. High band filter
5. MODEM (made by 3,4)

Interconnection with other technologies

As mentioned above, the PLC technology is no substitutive but it can complement others already installed on both the entry section and in the house (in-home).

The graph shows how we can use this technology to reach both the building (access sections) as well as to distribute Internet access via cable that reaches us up to the building.

What we need to do to start using this technology is to get us a PLC adapter kit. We will place one next to the modem or router and since then Internet will be distributed through the electrical system of the house along with the electricity.

When we want to connect a computer to the Internet we only have to place another adapter into a nearby outlet and from it takes the Ethernet cable that will go to the corresponding port.

For Blu-Ray players with a BD-Live profile, multimedia hard drives or gaming consoles, it is an economical solution if we compare it with what it would cost us to get Wifi adapters, which certainly do not exist for all teams. In addition, the adapter can be used with the equipment you want.[22]

For those who really want to get rid of the wires, there are already in the market PLC extenders that connect to a plug to recieve the connection to Internet but then emit the signal to the laptop for example without needing to connect the Ethernet cable.

HomePlug

Currently two standards are imposed on the market: HomePlug and DS2 (UPA). Both have managed to reach 200 Mbps in household electricity networks.

[22] Javier Penalva, 13 De Febrero De (2009), Web: "http://www.xataka.com/hogar-digital/especial-plc-alternativa-a-la-conectividad-wifi-ii"

These figures are theoretical, and as we shall see in a couple of tests we've done, the speed you get will depend on the distance and status of the installation of our house.

HomePlug is the specification that has more compatible products on the market, and thinks not only about Internet but also about VoIP and HDTV as key elements to carry together with the electricity.

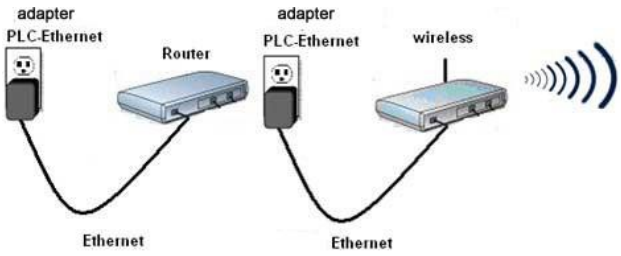
It is compatible with most home network technology because it is based in Ethernet. HomePlug technology does not interfere with other technologies. In fact, much work was done to ensure that products with HomePlug technology could coexist with other methods of home networks.

Because outlets are found on almost every wall of a house, is a logical choice as a conduit for the data connection.

HomePlug technology also eliminates some of the problems with wireless networks, allowing access points at the most convenient locations in the house, reducing the need for multiple wireless access points.

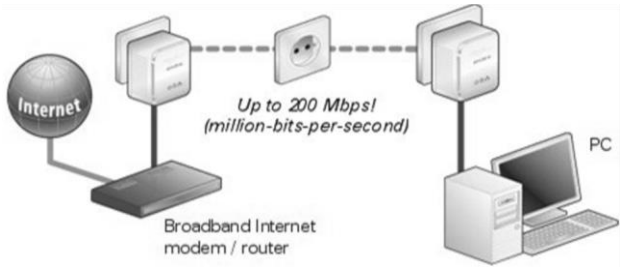
Using the PLC in conjunction with WiFi connectivity

WiFi and PLC are far from technologies that can not exist simultaneously. Typically, the first is replaced by the second, but if we want, we can take advantage of both.



A clear example is to bring WiFi connectivity to areas of the house that need it the most. Imagine a house with several floors where the WiFi router is in the living room of the first floor and we want to have WiFi installed in an office on the second or third, where we can have Wifi signal coverage problems.

What we can do is move the fixed point where the WiFi router is positioned to the desired level, and still enjoy WiFi where we need it most.



Transmission speed is not bad at all, it can be up to 200 Mbps, and the connection is permanent and a perfect complement to ADSL and wireless connectivity.[23]

Contributions

The development and implementation of PLC technology would allow the following benefits and applications to develop:

[23] Xataka, 13 De Febrero De (2009), Web: "http://www.xataka.com/hogar-digital/especial-plc-alternativa-a-la-conectividad-wifi-ii"

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

- Expansion of the broadband market.
- Use of existing electrical infrastructure.
- Expansion of products and services through PLC.
- Innovation when implementation of a cutting edge technology is done by a company.
- Creating closed and secure connections between ISPs and customers.
- Optimization of the use of optical fiber infrastructure.
- Creation of PLC networks with wider coverage than the telephone network.
- Implementation of PLC networks without requiring the development of civil works to ensure that each outlet is a potential node of connection.
- Transmission of voice, data, image and electricity; all at the same time and by a single driver.
- Simplicity and economy for system development.
- Internet always on.
- Execution of multimedia applications through the Internet. Exploitation of IP telephony.
- Creation and development of remote monitoring and security services.
- Service integration.
- The technical services of appliance manufacturers, they will learn the possible malfunctions and budget the group repairs.
- Implementation of video conferencing between customers and company.
- Use of IP protocols, without having to travel to their home.
- Economy on the installation of telephone networks and computer networks.
- Creation of virtual networks to transmit voice and data within the organization.
- Enabling PLC work in a broadband IP network.
- This allows each subscriber to be identified in the universe of users who are using the service while allowing the use of technologies and services based on the IP protocol.
- Speed and economy in the deployment of PLC.
- Integration and regional coverage.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

References

Banda Ancha, (2010) Web: "http://www.mincomunicaciones.gov.co/mincom/src/user_docs/Archivos/Sectorial/ComBandaAnchaOrbitel.pdf"

Barreto Alexis. "Estudio y analisis de las distintas tecnologias, De acceso que un proveedor de servicios de internet puede implementar", tomo ii, (1999), pág. 218, 233, 257, 306.

CFE, "Arquitectura PLC" (2010) "http://catarina.udlap.mx/u_dl_a/tales/documentos/lem/santos_p_sc/capitulo6.pdf "

Comision Interamericana Telecomunicaciones, "Aspectos de la Tecnologia de Comunicacion por Linea de Potencia (PLC)". (2008) Web:"http://www.citel.oas.org/newsletter/2008/diciembre/plc_e.asp"

Competencia y regulacion de la energias Noticias de PCL (2008) Web:"http://www.competenciayregulacion.cl/news.php?edicion=18&news=112"

Dgtv, "Manuales de Plc", (2010) Web: "http://dgtve.sep.gob.mx/tve/serv_edusat/manuales/pdf/energia.pdf"

Electro industria, Web: "http://www.emb.cl/electroindustria/articulo.mv?xid=392&rank=1"

HFCPN: High Frequency & Conditioned Power Network. Red electrica acondicionada para las altas frecuencias.

Hogar Digital, Imagen 3, (2009), Web: http://www.xataka.com/hogar-digital/especial-plc-alternativa-a-la-conectividad-wifi-ii

Hrasnica, H. "Broadband Powerline Communications: Network Design", John Wiley & Sons, (2004). USA.

Huidrobo José M y Davis Roldán. (2005)"Serie Telecomunicaciones redes y Servicios de banda ancha, Tecnologia y Aplicaciones, Primera Edición, Editorial MCGraw-Hill, (2005), 133-134, 255-259.

IEEE Std 802.1Q-199 "IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks" Mar, (1999)

Informacion general PLC, Foro de PLC, (2008) Web: "http://www.plcforum.org"

Javier Penalva, 13 De Febrero De (2009), Web: http://www.xataka.com/hogar-digital/especial-plc-alternativa-a-la-conectividad-wifi-ii

Programacion de cable for Z-WorlPK. Imagen 3, (2010) http://www.lammertbies.nl/comm/cable/plc.html

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Programacion de PLC. Imagen 2 Izumi, (2010) " http://www.lammertbies.nl/comm/cable/plc.html"

Ramos Escamilla Maria. Dinamica Economica Actual. (Cap.3. Optimizacion de los Recursos con un Tecnologia Expansiva). Editorial.ECORFAN.México.2010

Rediris, "Plc", 2010 Web:"http://www.rediris.es/rediris/boletin/68-69/enfoque4.pdf"

Tanebaum, Andrew."Computer Network", Third Edition, Prentice Hall, New Jersey. (1996) Pág.102-169

Tecnologia PLC, J. R. Gonzalez y, F. J. Vieira. (2010) Web: "http://www.rediris.es/rediris/boletin/68-69/enfoque4.pdf"

Tecnologia PLC, J. R. Gonzalez y, F. J. Vieira. (2010) Web: "http://www.rediris.es/rediris/boletin/68-69/enfoque4.pdf"

Xataka, 13 De Febrero De (2009), Web: http://www.xataka.com/hogar-digital/especial-plc-alternativa-a-la-conectividad-wifi-ii