Powerline Publishing

# 2003 Update on the Powerline Industry

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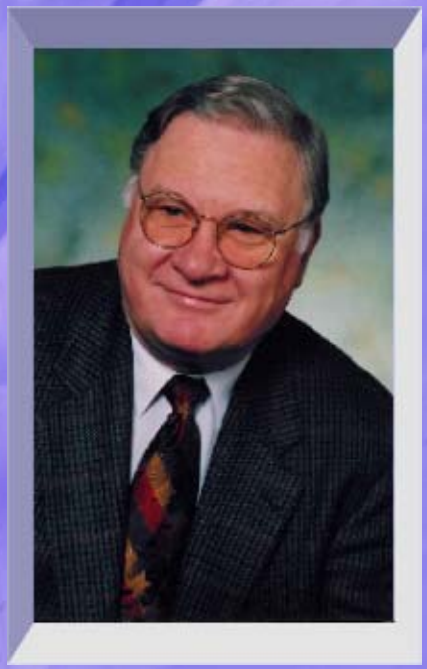
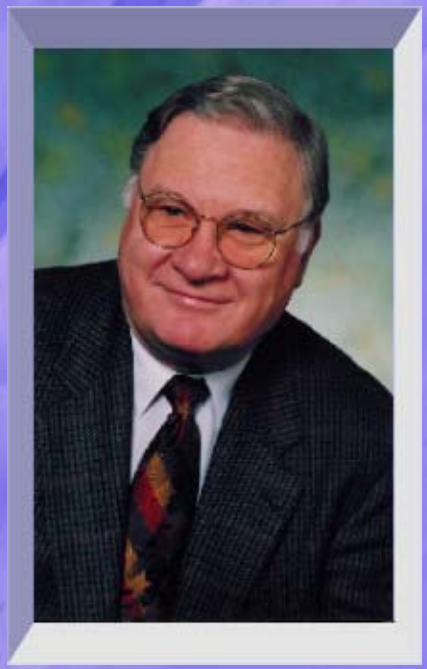
# FOREWORD



***'2003 Update on the Powerline Industry'*** **is the second Powerline overview to be authored by Dr. Peter Krawarik, Systems Physics Consultants. This product provides a fast track resource to vital information to the continuing developments in the Powerline arena, from a uniquely independent and global perspective.**

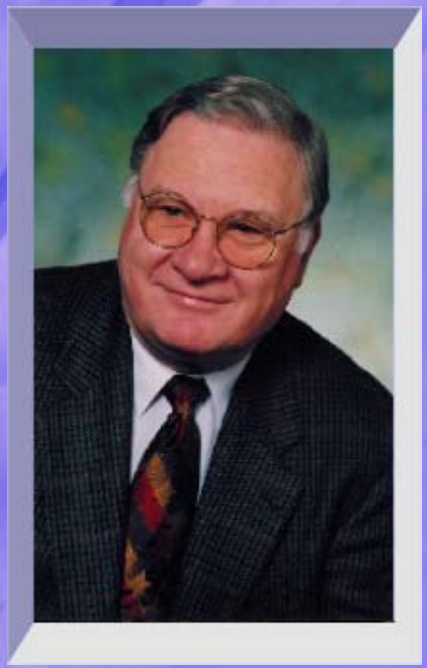
# FOREWORD



Dr. Krawarik, formerly of Ericsson Austria AG, has over 34 years management experience in large and small companies. Today he is a consultant specializing in Telecommunications and Business Development. A former Director of IPCF he has kept up with the field of PowerLine Communications.

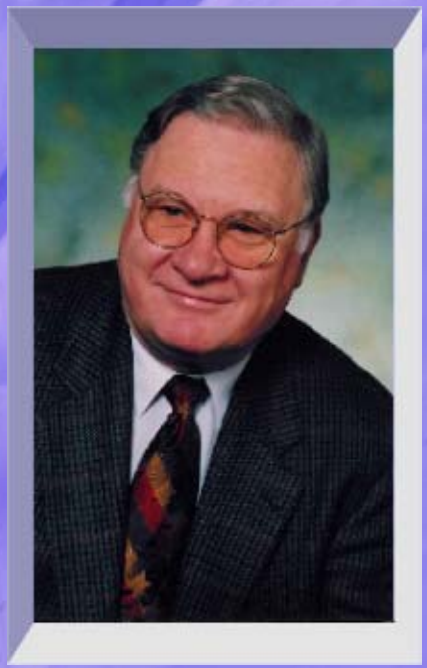
Peter is an expert in strategy development. During his time at Ericsson he initiated extensive Powerline Communications programs in the company and is fully conversant with the difficult commercial and strategic issues facing the developing Powerline Communications industry.

# FOREWORD



Those who have been involved in the Powerline Communications Industry will know by now that it is a complex industry, particularly from a technical, regulatory, legal, commercial and strategic perspective. Entrants into this marketplace include the investor, manufacturer, power distributor or service provider, all of whom are presented with significant hurdles, brought about by the dynamic nature of this growing arena. Standards and regulatory issues continue to be a major concern to all involved in the industry.

# FOREWORD



With no allegiance to a specific PLC technology or solution, Peter is able to provide refreshing clarity on this complex arena. He is well connected within this small but diverse industry. Having been involved with Powerline since its inception, Peter is able to provide an invaluable, in-depth insight into the developing Powerline industry. Such insight and independence allows Peter to provide technical and business development consultancy of real value to the diverse players in the Powerline arena.. Peter can be contacted through Millenniavision or directly:

www.millenniavision.com
www.krawarik.com

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## CONTENTS

# Industry Overview

## What has changed

Both Europe and the US are bullish about broadband, yet Powerline now is in the last place of all technological solutions.

There is no revolutionary change. A few companies left the Powerline community, a few new ones joined. Pacific-Asian companies became active.

# Industry Overview

## What has changed

Ascom, the Bern-based company is facing problems with its Powerline technology. Powerline was a key part of the company's revival strategy (Ascom executives predicted in 2001 that it would achieve sales of between SFr200-300 million. It actually generated an operating loss of SFr67 million). And towards the end of 2002 doubt continues about the viability of Powerline, as reports that German electricity utility, RWE AG, reveal that it will stop using Ascom's Powerline technology.

# Industry Overview

## What has changed

Siemens announced that it was pulling the plug on development of its version of digital power line technology, although intended to keep its options open about re-entering the market at some future date. The company said it saw a greater potential market in developing ADSL products instead. Siemens cited regulatory delays as the reason for its decision as it saw no chance of an immediate mass market application for Powerline, thereby making the growth of the market “uncertain”.

# Industry Overview

## What has changed

The German utilities group, RWE, is reported to be winding up its Powerline service. Only launched last year, attempts to find a buyer for its Powerline service are ongoing. Apart from technical problems, it is reported that the closure of the Powerline service follows the increasing use by security services of the frequencies which were to have been used by Powerline. Sector experts indicate that, while Powerline had hoped to attract 120,000 customers by the end of 2002, only 2,000 customers were counted early this year, although the company disputes that demand for the service was insufficient to merit its continuation.

# Industry Overview

## What has changed

In the market, Access applications are further delayed because regulation and standards making are exceedingly slow to come. From todays view it begins to look doubtful if PLC access will be able to compete with xDSL and cable on the grounds of economy, regulatory hurdles and timing, at least in Europe.

In-house applications, by contrast, are less encumbered by regulation and those PLC-LANs (P-LANs) are being successfully introduced world wide.

# Industry Overview

More than 80 “trials” have been conducted worldwide in Access alone, mostly in European countries. The major Powerline vendors have come to call these “Introductory Systems” rather than trials. With legalisation of Powerline in many countries now accomplished we must speak of Introductory Systems rather than trials.

Public acceptance has been slower than anticipated. In the European market there is no primary need for Powerline as alternative competitive systems are already in place, or, becoming economically attractive.

# Industry Overview

The PLCforum has today about 100 international members and meets about 4 times a year. Up to 2002 it was dominated by Telecommunications Network Operators and large Electrical Utilities. Its primary interest thus was PLC access.

The PLCforum maintains liaison with ETSI, the EC, the international standards bodies and the UTC in an effort to establish itself as focal point for the industry.

plcforum

www.plcforum.org

# Industry Overview

While the principal purpose of founding the PLCforum had been to have only one worldwide organization, there are still several organizations that jointly look out for this industry.

The interests of the in-house Powerline applications seemed underrepresented by the PLCforum, particularly for the US, where the majority of PLC efforts are focussed on in-house PLC applications and products.

# Industry Overview

The HomePlug Alliance based in the US keeps its membership at close to 70 companies and meets two times a year. It has developed its 1.0 specification on schedule and is proceeding to certify implementations by member companies.

HomePlug™ Powerline Alliance

www.homeplug.org

The US based UTC is also active, as are other associations. But those are not dealing exclusively with Powerline.

UTC UNITED TELECOM COUNCIL

www.utc.org

# Industry Overview

Work in standards organizations is proceeding on “schedule” but for many progress is much too slow. CENELEC is supposed to develop the specifications for layers 1 and 2, where emmission levels and power density spectral use are concerned.

ETSI should work out the higher layers of the interface. One problem has been that layer 1, the “physical” layer, depends heavily on the chip implementation and is, in most cases, considered proprietary.

That so far has stymied all efforts to get to true interworking standards.

# Technological Developments

## RF Spectrum

The same RF spectrum of 2 – 30 MHz used in the Manchester, UK trials by NOR.WEB still forms the basis for solutions.

Generally, the spectrum between 2 to 11 MHz is considered for the priority use by access applications, 13 to 20 Mhz for in-house and 20 to 30 MHz reserved for special applications.

Thus, a formula for interworking between access and in-house applications has been established.

# Technological Developments

## *Modulation techniques*

**Modulation techniques are better understood. Multi-frequency carrier technology, such as OFDM is in use, but some spread spectrum approaches have also been tried successfully. A number of vendors are still secretive about their favoured modulation scheme.**

# Technological Developments

## *Design of a Powerline Interface*

The design of a Powerline interface is achieved in a layered fashion. The physical layer and the Media Access (MAC) layer are implemented in Powerline chip sets. The Powerline channel is a difficult and variable environment, so the MAC layer must implement the dynamic measurements necessary to adapt the transmission requirements of the communications channel to the Powerline channel. The actual communication services are then designed to live on top of the MAC layer. Since the physical and MAC layers are vendor proprietory in most cases, that means troubles for interworking of in-house systems from different vendors.

# Technological Developments

## Food Chain

Several Powerline chipset vendors have established themselves.

Powerline system integrators package those chipsets into product.

The significant system features are therefore determined by the system integrators. Main.Net is a case in point.

# Technological Developments

## Food Chain

Inter-sytem interworking and interworking of systems by different vendors is being addressed by ETSI and others, but would require to open up the still proprietary specifications for the physical and MAC layers and in consequence, their standardization. This is not likely to occur in the immediate future.

# Technological Developments

## *Access / Inhome*

**Initially, the applications split into in-house and access systems. Now it appears that a user just has to stay with one vendor to avoid difficulties.**

**The HomePlug Alliance in the United States announced in July 2001 its HomePlug Specification 1.0 as the standard for in-house solutions, endorsed by about 30 vendor companies.**

# Technological Developments

## Access / Inhome

Europe continues to concentrate on access systems, driven by the PLCforum. There is evidence however, that this split may become less meaningful as time goes on: it has been stated by some access vendors that it was difficult to market their product without a compatible in-house solution. For some vendors today who deploy dynamic power level adjustment, the same technology implementation is used for both access and in-house, thus making such a distinction unnecessary.

# Technological Developments

## Access / Inhome

Main.net has developed such a powerful Powerline system product (based on Itran chipsets) that they claim their product can be used equally well for access as it can be used for in-house systems. It allows in fact to “re-use” parts of the spectrum by dynamically lowering the transmission power level address dependent such that the same spectrum can be used again in relatively distant parts of the overall system.

# Technological Developments

## *Access / Inhome*

**With the “frequency band split” convention of using the lower 10 MHz for access (there is generally only one access vendor in a local system) and allocating a comparable bandwidth for in-house systems, the interworking between access and in-house seem all but resolved.**

**Operating different in-house systems in one local area is a more difficult issue, no good solution has been found yet.**

# Technological Developments

## *Access / Inhome*

**With adaptive modulation level mechanisms, transmission through electric meters and even transformers has been demonstrated.**

**While HomePlug concentrated on the in-house market, their chip sets are designed to be also usable for access purposes later on. Using sophisticated modulation schemes a throughput of perhaps 15 Mb/s can be readily achieved using the frequency spectrum of 5 – 22 MHz with the modulation power still within the limits of FCC Part 15 rules, covering the majority of typical in-house applications in the US. Using 13 – 22 MHz, only 8 Mb/s may be achievable, however.**

# Technological Developments

## Access / Inhome

A weakness of this technology for access is that the limited information throughput of, currently, about 2 Mb/s is shared by all customers on a substation transformer, which will surely lead to inadequate bandwidth for some customers. Forrester Research has pointed that out as a severe weakness, markedly considering the competition of the emerging DSL and cable services.

# Regulatory Developments

## *Complexity*

**Regulation occurs on local, regional, national and worldwide levels. There are regulatory bodies such as the IEC or FCC, there are standards-making entities such as CENELEC, CISPR and ETSI and there are national and local authorities that control regulations on a political level.**

**Powerline is a product re-using existing networks that were not designed for such use, in dimensions that were neither foreseen nor intended for those networks. Regulation tries to cover the new issues resulting from the Powerline overlay over the existing networks.**

# Regulatory Developments

## Emissions

For the purposes of regulation, there are emissive (radiation) aspects that come into play because an RF modulation is used on the electric networks and RF radiates as those networks are neither perfectly terminated and adapted coaxial conductors, nor perfectly matched antenna structures.

# Regulatory Developments

## Emissions

Here the argument is crucial if the resulting radiation is "unintentional" or "intentional". If it is held to be unintentional, then it is subject to existing regulations as "RF frequency noise". The regulator has set fairly stringent values that RF noise must not exceed (dependent on frequency). Those values are so low that for Powerline applications, given the "leaky" network structures, modulation levels that are permissible no longer give an adequate range of transmission on the networks. An albeit costly remedy is to use repeaters to increase the range.

# Regulatory Developments

## *International / Country Specific*

**Most countries take the values established internationally and then add their own "safety pillow" of extra restrictions just to be on the safe side. For that reason, the FCC Part 15 in the US can specify relatively lenient values (that the Powerline industry could live with) while a country like the UK can have much more stringent values that are absolutely prohibitive for Powerline applications.**

# Regulatory Developments

## *International / Country Specific*

**More and more, Powerline engineers in Europe suggest that a good solution would be to adopt the FCC Part 15 levels world wide. But, so far, standards organizations remain opposed to this idea.**

**In Europe we shall see "harmonised" standards eventually that apply to all EC members. The EC is reviewing this area of rule making actively. Alas, that will take some time, experts expect such standards now for 2004 or later.**

# Regulatory Developments

## Temporary Laws

Regulatory activity, especially standard making, is a painfully slow process. It takes years before new regulation can be applied. Some countries have, either tacitly or by legal action, jumped the gun and have given the Powerline industry some temporary laws to operate until regulation kicks in.

# Regulatory Developments

## *Temporary Laws*

***Germany*** **- The NB30 law in Germany was passed on March 30, 2001 and legalised Powerline applications in Germany. Ascom claimed that all their systems abided by NB30. This was the basis for the strong activity by RWE in Germany in 2001/2002, RWE has now exited that market, only the systems in Mannheim (Main.Net) and those implemented by EnBW in the south remain..**

# Regulatory Developments

## *Temporary Laws*

***Sweden*** **took the tacit approach. Where there is no plaintiff there does not need to be a judge. If nobody complains about RF interference, then there is no reason to set up and enforce restrictions.**

# Regulatory Developments

## Temporary Laws

***Austria*** **ruled in July 2001 that the Powerline industry could go ahead, as long as they would abide by all applicable regulation of the EC. That was a ambigous political statement. No regulations of the EC were immediately applicable, but those in the offing would be prohibitively stringent. There were several pockets of market activity in Austria, by EVN, by the City of Linz and by TIWAG in Tyrol. In all cases the number of connected customers remained relatively small.**

# Regulatory Developments

## EC / Harmonised Standards

So what applicable regulation, akin to the German NB30, does the EC have? None, so far. A mandate for CENELEC exists to develop PLC standards. The Commission did not object to PLC, thus tacitly accepted it. Moreover, the European Parliament recognized PLC as an accepted legal way of electronic communications (wire based broadband systems).

Harmonised standards may be expected by 2004 or later.

# Regulatory Developments

## EC / Harmonised Standards

Radiation is not the only concern of the regulators. Certain regulations pertaining to conductive modes of electricity can also be applied, particularly since we are dealing with electric networks that are based on conduction.

# Regulatory Developments

## EC / Harmonised Standards

The standard EN50083 is for cable based systems and can be construed to apply to Powerline systems. The CENELEC standard EN55022 set limits for the voltage or current on a conductor, in a given frequency range. Network structures that represent ill-matched antennas for RF frequencies are then governed by another set of rules and restrictions.

A way will have to be found to write rules consistent with and harmonised with a set of regulations that have all been made before we had PLC, but specifically adapted to the requirements of the Powerline technology.

# Regulatory Developments

## EC / Harmonised Standards

On a practical level, electromagnetic radiation, for instance permissible under NB30, cannot be actually generated on the network on the grounds of conductive electrical restrictions that come from EN55022. That impacts the permissible modulation voltage, which via the network impedance (that is variable in the frequency range of interest) gives us the modulation power. Thus, regulations coming from different regulatory areas are also not compatible.

# Regulatory Developments

## EC / Harmonised Standards

**EN55022 is a European standard. Complying with it in Powerline applications means that a reasonable business on that basis is all but impossible. Regulatory relief is therefore very much needed.**

# Regulatory Developments

## *Co-existence - Inhome / Access*

**The question of coexistence continues to be the most important issue for the standard making bodies if Powerline is going to be a viable mass deployed technology. Standards making bodies have been working on this issue for more than a year now.**

**Coexistence means that in-house systems can coexist with access systems without mutual interference; that in-house systems can coexist with other in-house systems nearby without interference…**

# Regulatory Developments

## *Co-existence - Inhome / Access*

**The method adopted for in-house to access coexistence is the frequency band split. The frequency spectrum is split into a lower area (below perhaps 10 – 12 MHz) for the use of access systems, and the rest above the split point for in-house systems. This method implies that a narrower frequency band is available for each of the two application areas, therefore less information throughput, perhaps 7 – 8 Mb/s may ultimately be expected for access, and even less for in-house. The modulation levels will have to be about 10 dB lower for the higher frequency band, as more radiation is expected there.**

# Regulatory Developments

## *Co-existence - Inhome / Access*

**It continues to take an enormous effort and require great vigilance by all of the Powerline protagonists to collectively influence and control the standards making activities such that regulation of a particular, pertinent aspect, does not inadvertently go into a direction that may be adverse to the future viability of Powerline.**

# Market Developments

## Business Models

We have Powerline technology, even third generation systems, we have a better understanding of the regulatory situation, but what about the business propositions of Powerline?.

A sort of “food chain” has established where Powerline technology chipset vendors deliver to system packagers or integrators, who market to a range of customers, utility network operator based ISPs, telecommunications companies, even private customers for in-house systems.

# Market Developments

## Business Models

The combination of access and in-house applications with the diverse information applications provides a rich option space for business models. Business models are indeed the most important concept. If a company wants to enter the Powerline business, they need a business model first and foremost.

# Market Developments

## Business Models

For companies who come from the electrical utility sector, this may represent a significant first hurdle. These companies do not have the necessary expertise inside their own organization. Their culture, their way of thinking is different from that of a Telecommunications Company or ISP. Commercial viability depends on the skill and dedication of the future operator to embrace the necessary change process.

# Market Developments

## Business Models

A PLC operator business must be developed; that requires the application of BUSINESS DEVELOPMENT. Business Models will lead to a Business Plan, which in turn will lead to the Business. The uncertainty has actually increased for operator candidates, because of the lack of required skills.

Even for those operators who have already successfully started a business based on Powerline, the situation remains critical, since the business plan made often unrealistic assumptions about the market. Some large players have come and gone.

# Market Developments

## The Power Utility

The accepted practice is that a Business Consultant accompanies the Operator Candidate for analysis, goal formation, and establishment of a suitable business model and elaboration of business plan. Business Development is an essential tool to bring about the necessary adjustments. That process does take time, a year at least in our experience. There are only a few companies that managed that transition, over the past year. Not all have ben able to sustain the momentum.

# Market Developments

## The Power Utility

***Sydkraft*** **- One example is Sydkraft, from Malmö, Sweden. It set out about four years ago, built up an organisation that could deal with the issues, employed Business Development methods and are very successful in becoming a Powerline operator company.**

**The learning process should not be underestimated. It may be necessary to secure outside help, as a rule, because the professional expertise is rarely at hand. With the regulatory smoke clearing a bit, one large company after the other is entering the field.**

# Market Developments

## The Power Utility

***RWE*** **- In Germany, RWE wanted to deploy 10,000 units in 2001. Their actual deployment stayed far short of the goal, in 2002 the company exited the business again.**

***EVN*** **- In Austria, EVN was also was talking about 10,000 end customers connected IN 2001. Here again, the target could not be reached, PLC is no longer one of the priorities of the company.**

# Market Developments

## The Power Utility

**The examples mentioned highlight the fact that it continues to be a challenge to make a viable business case in the segment of PLC access systems, at least in the European markets.**

# 2003 and Beyond

Soon it will be a question of market shares. Interest in the Powerline technology has been worldwide. Acceptance has not come readily in most markets, by customers (for PLC access applications). Some big system vendors operate internationally already. The question is, are those few early adopters right or should it still not to be taken for granted that a good business case can be made with Powerline?

# 2003 and Beyond

While there is already healthy competition in the technology arena and Powerline technology has been accepted, in principle, by the regulators, there is still relatively scarce information available on the business aspects of Powerline and on the conditions that need to prevail for a good sustainable business.

The few companies who are successful guard the business know-how as a secret of their success and are therefore reluctant to share it with others. Which makes outside professional help even more important for any company seriously considering entering the Powerline arena.

# 2003 and Beyond

Despite all euphoria, the rollout of Powerline services happens only slowly. Compared with the speed that price competitive DSL services in are introduced, Powerline is running into severe problems. The price models for current offerings of Powerline service are data throughput sensitive, which makes Powerline too expensive, compared with DSL. Worse, in areas where cable is available, cable services out-compete even the DSL offerings on bandwidth and on price.

# 2003 and Beyond

The one sector of Powerline communications that has a brighter outlook is the in-house segment. The reasons are simple: with the existing technology, even complying to the regulations that exist for emissions, a Powerline LAN, a P-LAN can be implemented easily enough. The user bit rate on the P-LAN will be similar to the 10 Mb/s LANs in widespread use.

# 2003 and Beyond

Marketing in-house PLC systems is different from the access market. The customer is usually the end user. As long as no PLC access system is in use locally even more bandwidth may be available, because in the absence of an access system the in-house system could also use the lower part of the RF spectrum. Several vendors will allow that option.

Care has to be taken where there are other in-house P-LANs operating in the vicinity. It will probably still take another two years before the interworking issues are sufficiently under control to allow a less constrained deployment of P-LANs.

# PLC Technology Developers, Worldwide

**The following pages provide an overview and introduction to key PLC Technology Developers, worldwide, with links to their websites.**

# PLC Technology Developers, Worldwide

Adaptive NETWORKS

www.adaptivenetworks.com

**Adaptive has a wide variety of chipset-based implementations to suit different applications and integration efforts. Adaptive provide products with different speeds and capabilities as well as a variety of form factors to satisfy any integration requirements. All of these products are based on the same foundation of field-proven, robust powerline technology and specifically designed with ease of integration in mind.**

ALCATEL
ARCHITECTS OF AN INTERNET WORLD

www.alcatel.com

**As a world leader in the high speed access and optical transport market, Alcatel is a major player in the area of telecommunications and the Internet.**

# PLC Technology Developers, Worldwide

www.ambientcorp.com

**Ambient's proprietary and patent pending technologies place it in the leading position to capitalize on this emerging new industry. This is achieved through Ambient's proprietary PLC coupler and telecommunications technology, which establishes a "last mile" solution to every premise and building.**

www.amperion.com

**Amperion, Inc. is the premier medium-voltage powerline networking equipment company. Amperion develops networking hardware and software that enables the delivery of high-speed broadband data over medium-voltage powerlines.**

# PLC Technology Developers, Worldwide

ascom

www.ascom.com

**Worldwide more than 60 customers – energy supply companies, systems integrators and telecommunications providers use Ascom's Powerline technology.**

Asoka usa

www.asokausa.com

**Asoka's USB Adapter allow you to utilize your existing home power outlets and turn your home into a high-speed home network – up to 14 Mbps. Just connect the computer to an Asoka USB Adapter using a USB cable, plug the other end of the USB Adapter into any power outlet; within minutes, your family members and you can enjoy sharing file and printers, play multiple-player games, and share your broadband access – all at the same time.**

# PLC Technology Developers, Worldwide


www.cisco.com

**By joining Internet Home Alliance, Cisco will be able to build on the company's vision to provide consumers anywhere, anytime Internet access in the home. The Internet Home Alliance is the ecosystem enabler that will help to make the Internet lifestyle a reality. Cisco, along with other Alliance members, will benefit from the industry growth fuelled by this initiative.**

# PLC Technology Developers, Worldwide

www.cogency.com

Cogency's powerline integrated circuits are an inexpensive, scalable, robust, and high performance solution for creating products with home networking capabilities. The OFDM technology used by Cogency, addresses the challenges presented by using AC powerlines as a vehicle for data communications.

www.corinex.com

14 Mbps Power Line PC Network - the Corinex Intelligent PowerNet products introduce a new innovative solution for data communications. This unique technology offers users a wide range of networking options by using digital powerline technology enabling 14 Mbps data rate at distances of up to 200m for indoor solution.

# PLC Technology Developers, Worldwide


www.conexant.com

Conexant Systems, Inc is a worldwide leader in semiconductor solutions for communications applications. The Conexant CX11647 device is an integrated physical layer transceiver or PHY. It is designed to use existing AC electrical wiring within the home as a networking physical medium.


www.curenttechnologies.com

Current has developed its proprietary PLC solution, resolving transmission issues over both low voltage and medium voltage electric distribution lines. Current is one of the first companies to announce the deployment of a proprietary, safe, commercially viable transformer-bypass solution that can transform an electric distribution network into a broadband communications platform.

# PLC Technology Developers, Worldwide

DATASOFT® Embedded Designs

www.datasoft.at

**DATASOFT is a renowned ISDN, Internet and powerline operation. DATASOFT system GmbH arranges its functions into four divisions: project management, software development, hardware development and consulting services.**

DOMOSYS CORPORATION

www.domosys.com

**Domosys is a leading provider of power line technology to the residential, utility, and commercial markets. Domosys' PowerBus™ technology is a two-way, peer-to-peer communication protocol for control networks. It allows everyday devices to exchange information with each other over a shared medium.**

# PLC Technology Developers, Worldwide


www.ds2.es

**DS2s mission is to be the leading supplier of chipsets and software to this emerging market. Our IPR (Intellectual Property Rights) for access and LAN (Local Area Network) solutions using the medium and low voltage electricity networks are sought after by router and telecom manufacturers, utilities and electrical equipment manufacturers. DS2s technology supports transmission speeds of up to 45 Mb/s, the fastest on the market.**

# PLC Technology Developers, Worldwide


www.easyplug.com

**Easlyplug offers to firms both finished products or communication modules. Home Network, Infrastructure control, Local Loop and Audio/Video broadband. Using Powerline, all these applications are available to your customers faster, safer and cheaper than any other media.**


www.echelon.com

**Echelon's PLT-22 power line networking technology has been adopted as an open American National Standards Institute (ANSI) standard as the ANSI/EIA 709.2-A-2000 Control Network Powerline (PL) Channel Specification. Designed to send information between everyday devices like appliances, electric meters, water heaters, security systems, and lighting systems through a home or building's AC power wiring, this technology employs advanced digital signal processing and error correction techniques to ensure reliable signaling.**

# PLC Technology Developers, Worldwide


www.eichhoff.de

**New…..PLC-combiner for the CENELEC-band. Within the next years PLC technology for the exchange of information and data will be introduced in the fields of electrical household appliances, heating systems etc.. The frequency range between 90kHz to 150kHz (USA up to 500kHz) in the CENELEC-band will be preferably used for this type of data transfer. For the low loss in- and out-coupling of PLC signals at the mains entrance Eichhoff has developed a special PLC combiner.**


www.elcon-system.de

**Serving both network users and providers, ELCON Systemtechnik GmbH designs, manufactures and supplies telecommunication equipment.**

# PLC Technology Developers, Worldwide

endesa

www.endesa.se

**Endesa is conducting tests with two different technologies (1.5 and 50 Mbytes/sec) for the transmission of voice and data through its electrical networks, which will enable the provision of services to domestic customers and small and medium enterprises, the installation of digital measuring systems, etc.**


www.enikia.com

**By providing the technology to run Ethernet-speed communications over the existing powerline network in a home, Enikia delivers a stunningly elegant solution for networking and home automation.**

# PLC Technology Developers, Worldwide

www.goerlitz.ag

The PLC transmission technology from GÖRLITZ AG operates in the supply area of a utility's low-voltage island in exactly the same way with a passive (unfeeded) cable system.

www.hp.com

A powerline network uses existing AC power wiring in the walls to create a network that will connect your computers at speeds as high as 2 million bits per second. Because you've got a power outlet near every computer that you want to connect, all you need is an adapter for each machine.

# PLC Technology Developers, Worldwide

www.ilevo.com

**Ilevo believes in a world where people and devices are seamlessly connected to deliver the most powerful communications network ever seen. Ilevo's innovative solution enables utility companies to use any existing power lines to offer end-users fast, reliable, convenient and cost-effective high-speed data and voice communications. Ilevo has successfully finalized multiple field trials and is currently installing its first product line in different utility networks on an international basis.**

www.inari.com

**Inari offers a fully scalable and interoperable family of Powerline network controllers, is at the forefront of Powerline innovation, assuring developers rapid market entry and success with proven Powerline solutions.**

# PLC Technology Developers, Worldwide

Intellon
NO NEW WIRES.™

www.intellon.com

**Intellon Corporation, the world leader in powerline networking, announced in September 2002 the world's first HomePlug-certified powerline wall module access point reference design, the RD51X1-AP. Using Intellon's INT51X1 next generation HomePlug 1.0 integrated circuit, the reference design creates a bridge between 802.11b wireless and HomePlug powerline networks, allowing users to optimize WiFi coverage in a home or small business. The backbone powerline network permits users to position a single access point at the best location to optimize their WiFi range and coverage or to add additional WiFi access points as needed to improve coverage in weak areas.**

# PLC Technology Developers, Worldwide

***IntraCostal System Engineering Corporation***

**www.intercostal.net**

**IntraCoastal System Engineering Corporation is a world leader in Power Line Communications (PLC) and a provider of low cost PLC solutions. Using a proprietary method of transmitting data over existing power lines, IntraCoastal`s patented technology enables the ubiquitous acceptance of PLC communications by overcoming inherent obstacles in power line.**

ITRAN Communications Ltd.

**www.itrancomm.com**

**ITRAN, a leading-edge semiconductor company, designs, develops and markets proprietary mixed-signal integrated circuits for Home Networking (HN) applications. ITRAN's initial product lines are high-speed and low-speed power line modem chips for communicating data, voice and video over existing electrical wiring infrastructure.**

# PLC Technology Developers, Worldwide

JOOHONG

www.joohong.co.kr

**JOOHONG Information & Communications Ltd. is a leading developer of technologies that enhance broadband systems and solutions over multiple network environments. Using the experience with the first-generation of high-speed data over cable products, JOOHONG is now designing and developing products based on Bluetooth, IMT, ATM NIC, and PLC.**

LANergy

Www.lanergy.com

**LANergy specialising in the research, development and marketing of advanced power line communications solutions and open standards based management software. Its *Appian* range of Powerline adapters allow you to get the convenience of a 10Mbits/s Ethernet, without the disruption of Cat 5 cabling. Its *Cassian* range of management software will make network and service management a breeze.**

# PLC Technology Developers, Worldwide


www.lina.net

In the fall of 2002 Lína.Net intends to offer an Internet connection through the electrical system. This is done by modifying the Power plant's power lines so they can be used for data transmitting.

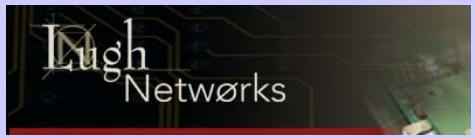

www.linskys.com

Linksys PowerLine Solutions offer new approach to 'No New Wires™ Networking'. The three powerline products that Linksys will ship soon, provide the basic hardware needs to connect a desktop or laptop PC to a broadband connection as well as talk with other powerline and Ethernet devices.

# PLC Technology Developers, Worldwide


www.ltnlcc.com.tw

**The LA9102 is a network adapter with USB interface to the PCs. It utilizes the physical media of powerline for data transmission. Ideal for convenient home networking, it is a no-new-wire solution. The LB0501 is a powerline to Ethernet Bridge for mixed Ethernet and powerline network environment. Built-in a 5-port 10/100Mbps Switch, your can connect your legacy Ethernet devices to the LB0501.**




www.lughnetworks.com

**Lugh Networks is an engineering and product development firm specializing in home powerline networking. Lugh Networks builds solutions that enable consumers to share audio, video, and data content through existing electrical outlets.**

# PLC Technology Developers, Worldwide

www.mainnet-plc.com

**Main.net designs and manufactures a complete broadband communication solution to support telecom services over the power line grid of the power utility.**

www.metricom-corp.com

**Metricom Corporation designs Application-Specific Integrated Circuits (ASICs). Metricom also provide customers with both Field-Programmable Gate Array (FPGA) and ASIC design services.**

# PLC Technology Developers, Worldwide

www.nsine.com

nSine's robust high-speed solutions are extremely low cost, making it economic to embed internet connectivity into mass-market appliances as well as to network home PCs. By delivering reliable high bandwidth performance at a cost usually associated with low data rate technologies, nSine allows the rapid adoption of a single powerline solution for all applications.

www.matimop.or.il

NAMS is ranked as a technological leader in energy measurement, PLC applications, prepayment systems, and remote metering via a variety of interfaces.

# PLC Technology Developers, Worldwide

NETGEAR®

www.netgear.com

**In 2002 NETGEAR announces availability of Powerline networking products for the home based on the industry standard, Home Plug™. NETGEAR's Powerline home networking solutions allow families to share Internet access, such as broadband cable or DSL, using existing electrical outlets. Customers can now extend the Internet anywhere in the home by simply plugging into their 110V electrical outlets, eliminating the need for additional wiring. NETGEAR's Powerline products include the NETGEAR Powerline Ethernet Adapter (XE602) and the NETGEAR Powerline USB Adapter (XA601).**

# PLC Technology Developers, Worldwide

PHILIPS

www.philips.com

**2002 News - Intellon Partners with Philips in World's First Wi-Fi (802.11b) Wireless-to-HomePlug Powerline Gateway.**

PhonexBroadband

www.phonex.com

**Phonex Broadband Corporation has been designing, manufacturing, and marketing technologies that transmit telephone, data, audio, and video reliably over electrical wiring for over 12 years. The unique set of technologies offered by Phonex Broadband are highly proprietary and offer the compelling solution of installing technology without adding new wires. Phonex chipsets are currently in over 7 million nodes throughout the world, making it the undisputed leader in sophisticated home networking solutions over the electrical wiring grid of buildings.**

# PLC Technology Developers, Worldwide


www.polytrax.com

**Ploytrax's PTX² iPower, from the PolyTrax ASOP series, enables PCs to be interlinked and connected to the Internet using the existing powerline in a building. In addition, with the development of PTX² mPower, PolyTrax is also offering the facility for transmitting music via the power socket. The PolyTrax ASOP products are particularly suitable for telecommunications companies, Internet Service Providers and Multimedia Content Providers as well as for power supply companies and electricity wholesalers.**

# PLC Technology Developers, Worldwide

## PowerNet

www. powernetsys.com

PowerNet has advanced a unique approach for a standard networking system. The PC-Less Adapter provides interoperability of networking protocols and systems. The PC-Less Adapter i ntegrates network adapters with stand-alone communication modules, which facilitate video, voice and data sources over the power-line at data rates of up to 10Mbps.


www. powertec-ag.de

With more than 750.000 used products in the field Home Automation, Facility Management and Security the powertec AG benefits from its 10-year-lasting experience in the powerline-technology. Among the communication via the electricity lines other core activities are the development and use of systems for a remote meter reading, for a lighting system steering, for a facility management and for a tunnel security.

# PLC Technology Developers, Worldwide

POWERWAN

www. powerwan.com

**PowerWAN's system enables utility providers to leverage existing infrastructure to address the current growing energy needs, while developing new business in Broadband delivery. Using PowerWAN's solution, every business and home gets fully connected across the existing networks.**

REDCOM® LABORATORIES, INC.
Research and Development in Communications

www. redcom.com

**Redcom design, manufacture, and market products for private networks (international gateways, private exchanges, and power line carriers), public networks (central offices), wireless, call management, emergency/rapid response systems, programmable switching platforms, government systems, ISDN, and testing devices.**

# PLC Technology Developers, Worldwide

RWE Powerline

www.rwe-powerline.de

**RWE Power Net offers - High Speed Internet via a Plug & Play enabled modem - Transmission rate of up to 2 Mbps - Up to 30 times faster than ISDN - Internet access through any socket in the home - "Always on" - without inconvenient dial-ups - No need for complicated wiring and additional installations -Surf the World Wide Web while you make telephone calls over the fixed-lines network - 24-hour support at the telephone hotline.**

Schlumberger

www.ask.slb.com

**The Multi-Energy Telemanagement System (ETS-ME) realizes the benefits of Power Line Carrier technology to allow multi-energy utilities and building administrators a flexible and cost-effective communication channel using the existing distribution network.**

# PLC Technology Developers, Worldwide


www.selta.com

**Selta is not only a manufacturer of a complete line of PLC products (line traps, coupling devices, PLC terminals, teleprotection equipment), but it is also able to support the Customer in the design of a PLC system. In particular SELTA has developed a program to verify the characteristics of the HV lines in the PLC frequency range, with calculation of link attenuation, corona noise, optimum coupling, influence of HV line faults on signals attenuation, etc.**

# PLC Technology Developers, Worldwide

www.teamcom.no

Teamcom AS has more than 50 years of experience in the field of Power Network Communications (PNC). The company provides everything from a single equipment delivery to complete turnkey systems, and can also provide services in terms engineering, installation, commissioning, training and financing on a world-wide basis.

www.telkonet.com

Telkonet is a high technology systems application developer with a primary focus on high speed networking over electrical power lines for the commercial market. The Company has designed a third generation of products to address the market for office buildings, hotels, schools, shopping malls, and other commercial buildings.

# PLC Technology Developers, Worldwide


www.xeline.com

**Xeline is now presenting full-fledged PLC product line from PLC chipset to integrated application product.**

# The PLC Community

PowerlineWorld www.powerlineworld.com a global online community facilitating the development and deployment of Powerline Communications (P.L.C.) products and services. It's aim is to stimulate the creation and development of the P.L.C. market through the exchange of information and to provide a global meeting point and signpost for the various organisations and individuals participating in this embryonic industry.

Powerline World provides facilities for the online exchange of views and ideas via its threaded discussions. The site is also regularly updated with news, information and free downloadable documents.