Powerline telecommunications: Mission impossible?

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Abstract:
Powerline teleommunications, or PLT, would allow utilities to provide high-speed Internet, voice, and data services to customers via transmission and distribution lines. There is just one catch: No one has been able to make PLT work commercially. Because of notorious economic failure in the past, few utilities are even willing to admit that they are even field testing the technology. Regulatory concerns for utilities are discussed.

Full Text:

[Headnote]
PLT could allow energy companies to provide Internet, voice, and data via the grid, but technological hurdles and fierce competition remain obstacles.

HUMORS OF MYSTERIOUS TECHNOLOGY trials, talk of clandestine technology alliances, and an overall shroud of secrecy surrounds the mission among U.S. utilities to develop powerline telecommunications.

Powerline telecommunications, or PLT, would allow utilities to provide high-speed Internet, voice, and data services to customers of all classes via transmission and distribution lines. That would allow utility executives to fulfill their dreams of competing head on with telecommunications companies for services and investment dollars. Last, but certainly not least, PLT via the electric grid could help slake America's insatiable thirst for bandwidth.

But there is just one catch: No one has been able to make it work commercially. And because of notorious economic failures in the past, few utilities are even willing to admit they're involved in field testing the technology. Is PLT just a Pipe dream?

PLT History of Developments and Debacles

PLT has been around since the 1920s. Its primary use has been the protection of transmission lines; however, it has also been used for telemetry, remote system control, and voice communication,

according to the United Telecom Council.

Commercial applications of PLT range from building control, automation, and monitoring to low-cost business security systems. Residential applications are limited to intercoms and, to a lesser extent, home security and automation. These slow, low-bandwidth applications use analog modulation techniques, according to a report by the UTC.

In the same way that executives today hope PLT will allow the provision of Internet services to rural communities where fiber is too expensive to lay, industry participants in the '20s saw PLT as a means of providing affordable telephone service to rural communities. Experts note, however, that even as breakthroughs have been made during the last decade, those successes in PLT have been followed by much-publicized economic failures.

Take for instance the effort by Nortel and United Utilities in the United Kingdom. Between 1995 and 1997, Dr. Paul Brown of Norweb Communications developed a means of overcoming interference on powerlines that made high-speed data transmission appear possible. On March 25,1998, Nortel and United Utilities (the parent company of Norweb) formed a company called NOR.WEB DPL to further develop and market Brown's breakthrough, Digital PowerLine (DPL).

[Table]

Competing PLC Technologies and Data Transmission Speeds

Although project trials in Manchester, England, confirmed that the DPL technology worked, problems arose when lampposts near the powerlines acted as antennae, picking up users' downloads and re-broadcasting the data as radio waves. Those radio waves interfered with the broadcasts of the British Broadcasting Corporation, as well as the Civil Aviation Authority and the British Government's electronic communications center.

"The British Parliament, many powerful constituencies, and the press eventually broke [NOR.WEB] up. Nortel made the mistake of taking on Parliament when they should have admitted it [was] an anomaly exhibited as part of the test trials;' says one engineer in retrospect.

Last year, the venture closed its doors. At the time, a Nortel spokesperson said that although the company was able to prove the DPL technology, it was never economical She added that the partners had abandoned powerline work.

But others tell a different story. An engineer who worked for Nortel during the field testing says the company made the technology work in the U.K., and perfected it in the United States with Southern Co., just as Nortel pulled the plug on the operation in mid-1999.

"Nortel pulled out because it no longer wanted to invest in a technology that competed against rival investments in cable, xDSL, and wireless, There was just not enough money to invest in a another competing technology," says the engineer.

He adds that the sale of NOR.WEB DPL assets has attracted many bidders in the telecom industry.

Nevertheless, Nortel's notorious economic failure has driven many of the utilities doing work in PLT underground, say analysts. They suggest utilities' secrecy is driven in part by not wanting to raise false hopes among shareholders. Other experts say the secrecy is due to myriad regulatory, financial, and

technological uncertainties that the industry has yet to answer with regard to the technology.

A few companies admit to having experimented with PLT, however. In the late '90s, UtiliCorp United paid Novell $10 million to develop PLT, but after three years of development by Novell that project also closed. Technology company Enikia is holding trials with U.S. utilities this summer, and has commitments from some European utilities to do testing with them. (See sidebar, "New Players: Will the Latest Hope for PLT Success Pan Out?") Enikia is keeping the identity of the utilities conducting the U.S. and European trials a mystery.

BG&E and AEP: Just Looking?

"Most utilities are in a wait-and-see mode;' says Wayne Cooper, director of business development at Baltimore Gas & Electric. "We think that the technology has a lot of potential, but there are a lot of technical hurdles to overcome:'

Although Cooper keeps up with advances in PLT technology, he says none of the current offerings has been proven to work in commercial systems in North America. He notes that companies such as Media Fusion and Dynamic Telecommunications claim major breakthroughs. (See sidebar, "MediaFusion: Real Science or Science Fiction?)

Several energy companies have even met with Media Fusion about possible partnerships, according to an industry source who wished to remain anonymous. Those companies include AEP, BG&E, Pennsylvania Power & Light, Cinergy, and the Southern Co. All of those companies have opted against such a partnership, says the source.

Says Cooper of the technology companies claiming PLT breakthroughs, "None has convinced me so far. I can tell you we are very skeptical about it. We will remain so until they can prove themselves."

Cooper also points out that beyond technological hurdles, making the technology economical is a problem.

"I think PLT probably offers a means to bundle a lot of services including energy and high-speed access. But there is a lot of competition out there. There are wireless applications being widely used Wireless Internet is about to explode. DSL is a fairly proven technology," he says.

Steve Greene, manager of technology development, AEP Communications, adds that the main obstacle is to find the partner who has developed technology that will work with North American infrastructure.

"If you look at our infrastructure and figure three to four customers can be fed by the same transformer, and look at the European model and see that 200 to 300 customers can be served by the same transformer, it makes the economics a lot different;' he says. "We need a technology to get the data signal transmitted around the transformer in order to make sense."

Although both BG&E and AEP say they would be interested in partnering with IT firms to develop the technology, neither has conducted technology trials as of yet.

"We can leverage the billions of dollars in assets, and offer these attractive services to customers. It is just a matter of finding the right company with the right technology," AEP's Greene says.

"AEP has been looking at the technology for the last 12 to 15 months and [become more) focused for

the last 6 months"

Greene says utilities are interested in the higher stock valuations possible through involvement in PLT work. For instance, he notes, on the day a German utility announced its successful PLT trials in Europe, its stock jumped 15 percent. He notes, "That obviously catches our attention because we are looking to do the same thing."

Nevertheless, Greene says he understands utilities' reluctance to go public with their involvement in the technology. He says most utilities are taking a cautious approach to make sure that the technology works, and then once it's proven, to see if they can even roll it out without jeopardizing their competitiveness.

"People are very cautious in their ability to deliver what they promised. You see with other cases such as Nortel making some of the promises and missing deadlines and projections. I think that really rubs shareholders and the market itself in the wrong way;' he explains.

But Greene has no illusions that PLT someday might become AEP's core business.

"I would say it is a more of a niche that has an upside that has to be developed," he says.

He sums up the competitive issues with just one question: "Do you think you can successfully compete against an AT&T?"

Greene explains that competition from the AT&Ts and Bell Atlantics of the world is one reason no company is willing to make promises about PLT. Of course, on the surface, telecoms don't seem to be worried either.

"We welcome electric utilities into the telecom space," says a spokesman for Bell Atlantic, adding that his company would welcome the competition.

PLT Regulation: Too Much Risk?

Lawrence J. Spiwak, president and chairman of the board of editorial advisors at the Phoenix Center for Advanced Legal and Economic Public Policy Studies, explains some of the regulatory reasons for utilities' reluctance to make public their PLT work. "Understand there is a wide variety of constituencies [such as] incumbents in the telephone industry arguing against utility entry into telecom," he says. Spiwak outlines some of those arguments.

"The first is the competitive advantage myth that utilities have a better brand name. Second, there is the cross-subsidization myth--that utilities will supposedly take [a] dominant position and leverage it into the telecommunications market [by] pricing below cost, driving the incumbents out and recouping by charging super-competitive pricing; Spiwak says.

But he jokes, "I don't think Bell Atlantic is going anywhere anytime soon."

Furthermore, Spiwak argues that price gouging would be difficult considering that utilities are regulated at both the state and federal levels.

He adds that the utilities' uncertainty over what will become of their transmission and distribution assets as a result of electric deregulation also has played a factor in their withdrawal from PLT technology or

secrecy about their involvement.

"Given Federal Energy Regulatory Commission Order 2000, [utilities] don't know if they are going to own the assets or not," he says. "[Furthermore], you don't know if they are going to control their local distribution. Will FERC make them unbundle?"

Spiwak explains that the Federal Communications Commission has established regulations forcing incumbent telephone companies to unbundle the high-frequency portion of the copper loop. Would utilities have to unbundle the high-frequency portion of the powerline?

Another reason Spiwak names for the utilities' lack of interest in PLT technology is that they have been caught up in dealing with electric deregulation. In addition, utility investment in transmission is down 50 percent.

"If they are not going to invest in transmission, why the hell would you want to invest in powerline technology?"

Moreover, the debate over whether captive ratepayers or utility shareholders own the assets likely will be a big issue among state regulators with regard to PLT, he predicts. In fact, a source at the National Association of Regulatory Utility Commissioners reveals the current regulatory thinking on PLT technology.

"Let's say that the technology works, and a distribution utility decides that it wants to offer Internet service and decides to charge $10 a month. [I] would imagine that they need to seek approval from the public service commission for at least the rate that is charged.

"For example, say that the dism'bution charge is two cents, and they are going to offer $10-a-month Internet service. The commission would want to see two cents per kilowatt-hour flowing back to the utility as that portion to that rate base," he says.

"They would not allow [utilities] to use a rate base to supply a competitive service without the competitive service having to flow some money back to the ratepayers that paid for the wires," he adds.

Furthermore, the NARUC source says if another company wanted to provide Internet service on powerlines, in a deregulated state, the utility would have to provide its lines to the competitor at the same rate it charged itself.

"The rate that they charge themselves would have to be equal to the two cents per kilowatt-hour that is the tariff rate," adds the regulator.

Utilities might refute this scheme, he notes, because Internet access speeds with PLT technology, as with cable modems, slow with the addition of more users.

"The utilities may claim higher rates because of lack of capacity or upgrades to improve capacity," he concludes.

Competitive Analysis: Wall Street Gives Green Light

Analysts at investment bank Morgan Stanley Dean Witter believe PLT not only could be a commercial reality soon, but they expect investor skepticism of PLT to diminish during the next six months. In fact,

Siemens AG, which is working to develop PLT technology, forecasts that 10 percent of all Internet connections will be served via powerline communications by 2002.

But although Morgan Stanley's analysts seem to embrace the technology wholeheartedly in research reports on utility equity, they note that regulatory, standardization, and technical issues must be overcome before the technology is viable.

"[Nevertheless], we consider the market for [PLT] to be substantial and extremely broad in its potential applications. The market is twofold: to-thehome, or `last mile' access; and in-the-home, or `last inch' access," according to one of the reports.

Morgan Stanley says powerline communications are superior to other last-inch access technologies (cable, wireless) because powerlines are ubiquitous-multiple sockets in each room provide considerable and dispersed capacity. Best of all, no new wiring is necessary. For example, the inhome solution would allow networking of computers using the powerlines, as well as new devices such as smart appliances that adapt their energy consumption according to prevailing market prices.

Philip Hunt, vice president of the HomePlug Powerline Alliance and senior manager at Cisco Systems, imagines a day when a homeowner can buy rights to music on the Internet and stream the audio directly to his speakers. Or, he suggests, the user may have a smart alarm clock networked to a news feed that knows not to wake him to take the kids to school when school has been cancelled due to a snow storm.

Cisco is part of the HomePlug Powerline Alliance, created to set a technology specification for home powerline networking and promote its wide acceptance in the market. Other technology companies in the Alliance include Compaq, Intel, Motorola, Panasonic, and Texas Instruments. Consolidated Edison became the first utility to join the group in June.

Alberto Mantovani, president of HomePlug and division director, strategic programs, Conexant Systems Inc., explains the effort: "We are targeting several type of requirements. We are looking at PC networking, Internet sharing, consumer electronics applications, voice telephony."

Mantovani says there is more need for home networking in the United States than internationally, but the development of powerline opens greater opportunity overseas. For home networking, he says, access continues to be a problem.

The current model for last-inch service is to network the home using PLT technology, and then connect to telephone lines from the home until such time as the grid powerline connection standards and technology becomes a reality, he explains.

"The market reality is that there are already established mechanisms to get [Internet access from the home]. We need to be able with [in-home] powerline to serve the xDSL and cable [customers] in the short term."

"In the medium to long-term, we are going to bring the HomePlug expertise and technology to the table of these international group, and try to figure out with them what could be the best way to be able to support access when it is done over powerlines;' Mantovani says.

For last-mile access, Morgan Stanley agrees that the industry will face competition from cable, xDSL, and wireless. But analysts at the investment bank say there is no clear winner in this respect, according to the report.

It adds, "Deployment of some competing technologies will require substantial infrastructure build-out and major capital investment (in some cases, amounting to billions of dollars):'

In addition, if PLT were proven, it appears that Internet downloading speeds with the technology would be competitive with the xDSL, cable, and wireless technologies. (See table, "Competing PLC Technologies and Data Transmission Speeds," for comparison.)

Judith Warrick, senior advisor at Morgan Stanley Dean Witter's electric utility equity research division, says utilities have much to gain and little to lose from the aggressive development and deployment of PLT Furthermore, Warrick says, several competing business models are possible for last-- inch access.

"One model certainly does not have to include utilities. But [utilities] do have the customer and do have their trust" Warrick concludes that prospects for utilities could be

great. "[Utilities] could own the equipment that conditions the wires for [PLT], owning, and installing the gateway. [Utilities] could maintain the equipment, sell Internet and phone services, provide a network administration and control function."

Richard Stavros is senior editor at Public Utilities Fortnightly.

[Sidebar]
New Players: Will the Latest Hope for PLT Success Pan OUt?

[Sidebar]
Three things distinguish technology company Enikia from its counterparts working on powerline telecom

[Sidebar]
munications technology for utilities.
A CUSTOMER THAT DOES NOT MIND GOING PUBLIC. The New Jersey-based company has a strategic alliance with ONELINE AG, a PLT company affiliated with German utilities PreussenElektra AG and VEBA AG, to develop end-to-end broadband services via electric wires.
PROVEN PRODUCTS. Enikia has developed an information appliance network technology that allows broadband communications networking throughout a building via existing power cabling. Enikia's first-generation powerline home networking chipsets support 10 megabits per second capacity over an in-home local area network.
A FOUNDING MEMBER OF THE HOMEPLUG POWERLINE ALLIANCE.

[Sidebar]
In its partnerships with U.S. and European utilities, Enikia hopes to develop the technology that will allow utilities to offer voice, Internet, and data via the powerlines to homes and on the distribution network. Field trials were to begin this summer in the United States and Europe, according to company officials.
A challenge that remains for the company in developing in-home powerline networks is the need for technology for the distribution networks.

[Sidebar]
"What we are looking to do is bring our technology and our expertise to the access environment and take our initial ideas of access technology and create a product [far the distribution network]," says Jarek Chylinski, Enikia's vice president of global marketing. He says Enikia would be the only company to offer the end-to-end product.
David Healey, vice president of Enikia, adds, "At their current stage, ONELINE AG [has] some very raw technology developed in the powerline access stage. We have a very defined home-networking product. There would be some shared intellectual property." Healey says the company expects to deliver commercial chipsets in the first quarter of next year.
Chylinski explains chipsets technology by comparison to an interface card in a PC.
"In the motherboard of a PC or in a PC itself you may have a network interFace card. Do you have a laptop? You have a card that gives you phone and land connectivity. If you open it up you will see a collection of chips," he explains.
"Chipsets is a grouping of chips that serve a specific function. Tomorrow, I want that card to be a powerline connection that will plug into a wall outlet rather than a structured wire connection. Chipsets is what sits on that card to enable that level of functionality and run a level of drivers and other software code to enable communication," Chylinski explains.

[Sidebar]
"The same principle is applied to the [distribution network outside the home]," he says. For example, "ADSL modem and cable chipsets are devices that control the communication."

ENIKIA SEES PLT AS A FUTURE AID TO HOMEOWNERS.

[Sidebar]
"Today electricity is a given when you flip the switch. Tomorrow, electricity and intelligence should travel the same way," he says.
Healey says the company already has overcome problems associated with noise and the economic differences posed by having different numbers of customers per transformer in Europe and the United States. He says the system is tailored to the requirements of the region in which it will be used.
"We connect the telecom to the power architecture at a different point to inject the signal. In the U.S., we can connect the telecoms network within the medium-voltage system so, in effect, we can see lots of [low-voltage] transformers. That makes the economics much better," he says.
Enikia also has developed methods for avoiding noise created in the home by appliances. That will allow applications such as Internet and telephony for the outside-- distribution network, Healey says.
"Although we will be using the same type architecture, the capacity that we think we can generate off the

[Sidebar]
network will probably much higher. Our noise-avoidance methods within our existing technology will allow us to be much more efficient in terms of bandwidth," Healey explains.
"[To be competitive], the access speeds would have to be compatible with cable modems and wireless. It will have to be somewhere between 10 and 20 megabits to compete," he says.
In addition, Healey believes that his technology avoids altogether the issue of increased radiation levels exhibited when using powerline technology: "We have developed technology to get around the problems of noise and problems of irradiation. I think we understand those issues better than anybody else.
"Noise avoidance is how we get around it. We have always worked to comply with FCC part 15. The outside is an unknown quantity. We are talking to the FCC. Powerline technology is very similar in design to ADSL technologies."
Healey adds, "Irradiation is more difficult in twisted pairs than it is in power networks because the properties of the cable. The FCC has had to deal with the problems of irradiation with DSL. I think we have much better techniques that are going to make sure that irradiation levels are kept to a minimum." -R.S.

[Sidebar]
Media Fusion: Real Science or Science Fiction? Co-founder and chief scientist Stewart answers his critcs.

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Dallas-based startup Media Fusion in the last year has generated much enthusiasm in the utilities industry with its claims of having solved the technological hurdles to making powerline telecommunications a reality.

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But that was before last November, when Media Fusion was issued U.S. Patent No. 5,982,276, say analysts.
Enthusiasm since has been replaced with uncertainty, doubt, or plain skepticism of the new technology, according to some industry engineers and experts at the Federal Communications Commission. Although those experts will not go so far as saying Media Fusion's proposed technology is unworkable, they express deep reservations about some assumptions in the patent that they say defy the laws of physics. They add that Media Fusion's technology is an extreme departure from other developments in PLT technology.
The technology behind Media Fusion's patent centers on naturally occurring magnetic waves surrounding electrical powerlines, according to press materials from the company. The company claims it uses those magnetic waves to solve problems with line noise, electrical load imbalances, and transformer interference that have hindered past efforts in powerline communications.
Is Media Fusion's development nothing more than bunk aimed at enticing utilities to invest millions in the company, or is the technology so far ahead of its time that few if any outside Media Fusion understand it?
To set the record straight, William "Luke" Stewart, Media Fusion's co-founder, chairman, and chief scientist, answers his critics in an interview with the Fortnightly.

[Sidebar]
Who are your strategic partners?

[Sidebar]
I can't really go into the names. I can say this: They are

[Sidebar]
large computing companies that do a great deal of special-effects work and have very, very good sophistication in unique processing environments. These companies are well-renowned. They are basically the foundation of many of the advanced technology studies that are done by the government and by various agencies. They are very strong in the computing and software industry. ...
What are your computer specifications?

[Sidebar]
We a needed servers that could handle about two-and

[Sidebar]
a-half trillion bits per second through their bus speed in order to clock our microwave emitter If you can't gate and shutter the microwave emitter through the q switches, then we really don't know how much signal strength or attenuation happens over the line or how much amplification we needed to palm. We needed basic clocking and emission power ratios before we could do actual power factor correction on the overall emissions. ...
With these companies we have working with us, we have also got a large research institute and Department of Energy labs that [are] helping us with some of the ground-breaking prototyping so that we can integrate these systems.

[Sidebar]
How do you respond to engineers who say magnetic fields can not become "wave guides," as published in your patent?

[Sidebar]
Magnetic fields are not that well-understood by gen

[Sidebar]
era) engineers. When you talk about a magnetic field, they generally look at the simple diagrams that they studied where it shows electron flow in one axis and magnetic field in a second axis. In other words, if you looked at a sine wave, you might see the sine wave through the XY coordinate, and you might see the magnetic field acting in the Z coordinate. Well, the bottom line is that nobody at this time has worked on a device that was very sensitive to magnetic anomalies.
But guess who has worked on devices like that: Medical doctors use magnetic resonance imaging machines all the time to look at the variations of movement of electrons and magnetic fluctuations to detect bone fracture or the presence of cancer A person that is not familiar with that type of atomic engineering would not understand that process.
So magnetic fields can become "wave guides"'?

[Sidebar]
No, what I am saying that magnetic fields can be

[Sidebar]
manipulated, and if they can be manipulated or anyway oscillated, then that, in fact, can cause disturbances in

[Sidebar]
other types of energy around. Like the patent says, ... when the magnetic field rises and falls in a [continuum], you may propagate other kinds of energy like electrons. That is how we generate electricity ... The magnetic field allows you to manipulate other types of energy so that the magnetic field could be considered as a wave guide or could be considered as the exciter to a propagation of energy like alternating current or DC or any other type of electrical energy.
What about engineers who say there are no such things as frequency levels?

[Sidebar]
Well, if there weren't such thing as frequency levels,

[Sidebar]
there would be no spectrum auctions.
Relative to your technology?

[Sidebar]
Absolutely.

[Sidebar]
What about engineers who refute your patent's claim that there are no atomic transitions within magnetic fields?

[Sidebar]
If there is a scientist that can prove that, I will take

[Sidebar]
my hat off to them. Even the guys who won Nobel prizes, in the last 100 years, 80 percent were awarded by new discoveries regarding magnetics. We are in the process of reducing our patent to practice. What that means is that we are actually developing the components and devices that have to be integrated so that our system can be operated and we can detect all the things that happen in physics and all of the energy that is created and all of the energy that travels up and down the wires so that we can actually put a signal on top of it like a cable signal or a computer signal, telephone signal, or Internet signal.
When will you unveil your final product?

[Sidebar]

We believe if we keep our current process under

[Sidebar]
way, we will have our prototype operational in the next six months.

[Sidebar]
Does that mean you've raised the $65 million you said you needed to develop the technology?
We have bank guarantees and we have a number of term sheets that range far larger than that.

[Sidebar]
In your press materials, you say powerlines are a lot faster because they lack switches, routers, and gateways. But won't you need those things?

[Sidebar]
Let me ask you a question. When you are working on

[Sidebar]
a spreadsheet and type in a number in one cell, how long does it take you to move that number to the other cell? If you use your point and click and copy, it takes a number of steps. But if I have a macro that takes one number that when you plug in one cell immediately feeds another cell, it happens at the same instant that the two memory slots are filled. ...
So the point is that we don't have to worry about routing because all the plugs will act like little macro cells and as one acts, the other ones will recognize that. They don't have a route; it is all dynamic memory. Everybody is on the same basic huge computing platform where the wires are tying it all together like in your computer Wires are tying all your processors together: We are actually duplicating that, except we are using electric wire rather than your tiny wires in your computer:

[Sidebar]
An engineer noted that your technology is like a broadcast signal, and he doesn't understand how you can incorporate Internet and all the other things you claim using a broadcast signal.

[Sidebar]
Again, it is just that he doesn't understand the tech

[Sidebar]
nology. As I described it to you, we can put any type of signal on the microwave carrier in the same way that telephone companies currently use microwaves to carry Internet. It is not a problem. He is just not familiar with the technology. -R.S.
