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Broadband Internet through Home Electric Power Cable and Network of Electronic Equipments

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Abstract

High-speed data service is important to our national communications infrastructure, and we are pleased to introduce this leading-edge technology in maximizing the utilization of our existing high-capacity hybrid fiber/coax wire, we will be able to provide high-speed Internet access and on-line services efficiently and economically. Electric Power Corporation is a government-owned enterprise established to promote electric power resource development, to run the electric power business with efficiency and to contribute to stable growth of the national economy by ensuring a stable and economical supply of electric power. It seems equivalent to standard cable service and a little faster than standard DSL but the speed is not asynchronous, meaning we get the same speed upstream and downstream. Imagine this, we plug our modem into any power socket at home and we're instantly connected to a high speed broadband ISP. Electric power cable line or transmission lines used for communication purposes along with transmitting electrical energy. Because the power grid is already in place, the electric power cable has the obvious advantage of reducing communication infrastructure cost. However, the power grid designed optimally for power delivery (not the data). We're great on technology, but not so good on working out the rules of the road; nearly all of the industrialized nations have national plans for broadband. This comprehensive strategy can give easy internet access in urban and rural areas.

Keywords: *DSL, ADSL, Handheld Devices, Internet Access Communication,WAP, EDGE/GPRS*

1. Introduction

Electrical power cable grid is an interconnected network of wires and other components, delivering power from the point of generation to the end user. Major operations concerned with the aforementioned are: Power generation, Power transmission, Power distribution, Power control. The appearance of data transmission through home electric wire enables access to the Internet through the conventional power lines, could become a serious alternative to the current broadband technologies. This standards electricity companies must fulfill if they want to start deployment. The electric Internet can be taking off in some rural cities where electricity is available. But the question now is whether this system is in fact accomplishing the optimistic expectations of the electricity companies that might be defined the service as Internet at the speed of light. The technology offers a competitive and cost-effective alternative for Internet access and LAN applications.

On the one hand, the installation of electric wire internet technology is faster and more economical than cable as it uses an already existing structure which is the conventional electrical power lines and a simple plug. Furthermore, the wide-ranging deployment of the electric power system enables easily reach outlying rural areas. Thirdly, it offers a speed of transmission comparable to ADSL. Lastly, it allows the simultaneous

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transmission of voice and data, which means that one can make telephone calls while using the Internet.

2. A Profitable Business Model

A home based electric wire internet to become an alternative to broadband is simply that the technology works. Although it seems that the Internet over the electric power lines is now reliable, there are still quite a few people who might complain about interference. On the other hand, the suppliers of these services must be convinced that a profitable business model exists. One of the most important assets the electricity companies have is the infrastructure they have deployed, which drastically reduces the investment to be made. However, the electricity companies will have to make sure that they do not have to renew installations worn down with the passing of the years. Lastly, unless an unlikely increase in broadband services shoots up demand, the local transmission of information will not only have to split itself among more players, but also have to face a reduction in prices due to greater competition. Therefore, in the areas that have three alternative accesses to the Internet (cable, home electric wire and telephone line), operators can reach among a broad range of people.

2.1. The Need to Complement each other

The tests undertaken so far with home electric wire technology, which enables Internet connection through the electricity supply, have demonstrated its technical feasibility and, short of watching how it behaves with large masses of users, it can be taken that we are looking at a serious alternative offering broadband Internet in competition with other existing networks on the market such as ADSL [4]. The key to this technology becoming a real option is in the definition of sustainable business models in which the operators, who can offer Internet technology and communications, and the content and services suppliers profitably, complement each other in a regulated environment where natural competitive barriers can be overcome. One possible successful approach could be to offer this broadband service to people in certain geographic areas or segments where the deployment of other technologies like cable is not profitable [4, 7].

2.2. Home Plug av 4-port Desktop Ethernet Bridge Application

The home wire AV 4-Port Ethernet Bridge operates on the Home wire power line AV Specification standard, providing up to 200Mbps bandwidth over home AC wiring. Since the home power lines are the most pervasive medium in households with multiple outlets in every room, the AV 4-Port Ethernet Bridge allows multiple home desktops and notebooks to be networked, to share Internet connections, printers, files, and play games without any additional wiring. The 4-Port Ethernet Bridge provides four 10/100Mbps ports to be used for multiple network connections, perfect for our entertainment centers where we can plug in a gaming console, DVR, IP STB, or any other Ethernet based multimedia devices. For security, the devices are equipped with 128-bit AES encryption. The private home power grid plus encryption makes significantly more secure than competing technologies. The Ethernet Bridge [9] is the best solution for No-New-Wires home networking. With easy Plug and Play installation, there is no need for new wires.

Figure 1. Home plug Ethernet Bridge Features

– Stand-Alone Unit Attaches Directly to Broadband Device[10] and Home Power line [9] Network for seamless Integration
– Up to 200Mbps Data Rate on Power line
– Co-exists with 14/85mbps electric wire
– Security push button for software free configuration
– Power Packet Utility provides unsophisticated way to graphically manage their network

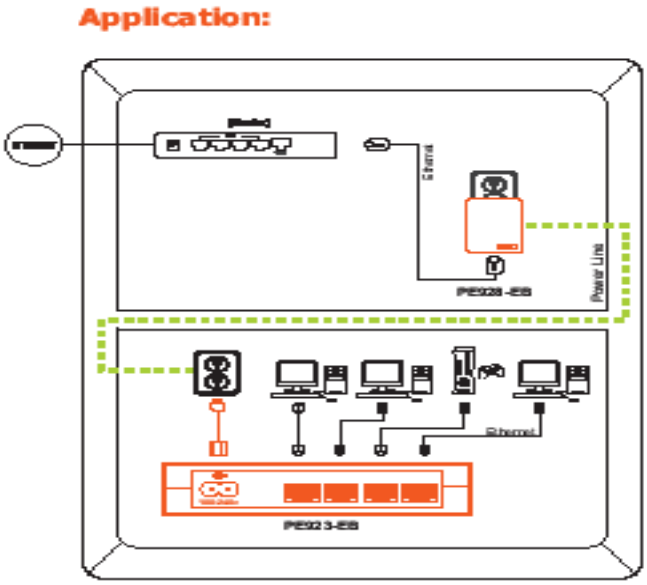

Figure 2. Application with Home Wire Internet Systems

2.3. Measurements of Electric Wire Internet along the Energized Power Line

Measurements of electric wire emissions along the energized power line were made using a variety of antennas. The first measurements were taken along a fairly straight segment of power line having both a repeater and an extractor. Four measurement frequencies were chosen to represent the frequency bands used by this system (downstream injector-to-repeater, upstream repeater-to-injector, downstream repeater-to extractor, and upstream extractor-to-repeater). Three mutually orthogonal components of the field were measured and plotted as three separate curves per graph for the frequencies 4.303, 8.125, 22.957 and 28.298 MHz. [7, 8] Note that in these and all other figures depicting home electric wire [9] signal power vs. distance, lines connecting data points are connected to show possible trends but should not be interpreted to provide expected, interpolated values.

2.4. Plugging into the Net, through the Humble Wall Outlet

Electric wire is the ultimate in plug-and-play. Users plug a small power line modem into any wall outlet and then connect the modem to a computer with a U.S.B. or Ethernet cable, or through a wireless Wi-Fi connection. The appeal of broadband power line [9] is that most of the wiring for the network is in place. Although data must be carefully routed over the electric grid [10] to prevent interference and signal degradation, there is no need to dig up streets or rewire homes.

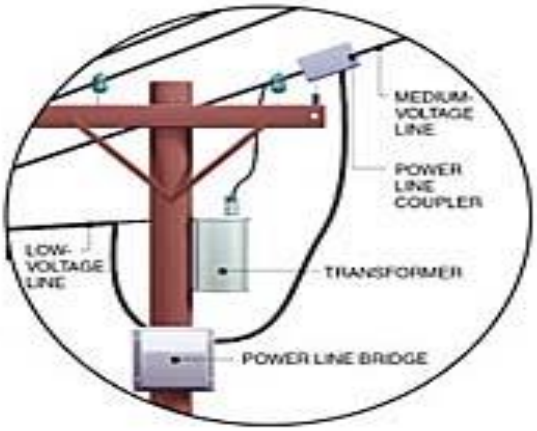

Figure 3. Plugging into the INTERNET

3. Benefits of a smart Grid

The impetus to install home wire power cable is not a desire by the power utilities to compete with ISP's. Rather, offering Internet service is an associated benefit of the power companies moving to "smart grids" [10] that include components such as sensors and interactive controls. He pointed out that today a power company doesn't know that a transformer has failed until a customer calls to complain about the lights being out, but with a smart grid, faster responses and proactive maintenance would be possible. Thereafter, offering retail Internet service is icing on the cake.

The benefits of a smart grid include smaller power outages [11] and less loss of energy in transmission. Every day in Bangladesh an average of 500,000 people experience a power failure of at least two hours, But a smart grid ought to be able to cut those outages by 80%, he estimated. About 7% of power is lost in transmission, and smart grids should cut that loss by 10%. Meanwhile, power customers could have smart electric meters that automatically report usage, eliminating the need for meter readers. The smart meters would allow additional features, such as discounts for those who cut their usage during peak hours, sources agreed.

3.1. The Pros

Aside from the fact that nearly every home in the country is connected to the power grid, this exciting new technology offers several other advantages over current broadband Internet service connections [10, 11].

First is the fact that no professional installation or additional wiring would be needed in your home. True 'plug-and-play' technology.

Another interesting aspect of home electric power wire internet is that every electric device is connected to the electric distribution network. That means that it could let chips in every electric device talk to each other. Much simpler and more cost effective than putting a wireless chip in every appliance.

Imagine the possibilities if your alarm clock, light switch, water heater and coffee maker could talk each other! Or how about this scenario: You unpack and plug in your brand new flat-panel TV and it automatically connects to the cable box, DVD player, your Home Theater system and the Internet.

Even more than the communications aspects, electric utilities are interested in of home electric power wire internet because it could give them an intelligent electric grid that is both more secure and more reliable. That in turn could lead to less pollution and lower electric power costs.

3.2. The Cons

The above-ground utility wires that carry of home electric power wire internet signals can also act as antennas and cause radio frequency interfere with airplane radios, emergency, military and police radios, HAM radios and short-wave broadcasts. This possible interference is central to the debate over whether or not the FCC should allow of home electric power wire[11] internet to exist.

4. How Broadband over Power Lines Works

There are two different technologies under development: Access of home electric power wire internet and In-house home electric power wire internet.

4.1. Access of Home Electric Power Wire Internet

Access of home electric power wire internet combines the technological principles of radio, wireless networking, and modems. It uses medium voltage power lines[11] carrying about 7,200 volts (the ones that you see at the top of electric utility poles) to carry broadband Internet traffic. It can send data over power lines and into homes at speeds between 500 kilobits and 3 megabits per second which is currently comparable to cable and DSL modem speeds. But turning the power grid into a stable, high-speed system of data transmission is tricky.

Those medium voltage power lines are just one component of a power grid. In addition there are generators, high voltage lines, substations and transformers that help carry electricity from the power plant all the way to your plug. And all of them interfere with data transmission.

So first of home electric power wire internet bypasses high-voltage power lines using either fiber-optic or telephone lines to inject the data into the medium-voltage power grid downstream. However the data can only travel so far before it begins to degrade. So special devices (called repeaters) are installed on the lines to take in the data and amplify it for the next leg of the journey.

There is also no way to run a clean data signal through a transformer. To overcome this, one of home electric power wire internet model uses two other devices, a coupler and a bridge to distribute Internet traffic. These are attached at the power pole and allow the data to bypass the transformer and enter the low voltage lines attached to your home. There are also wireless systems that bypass the low voltage lines altogether.

From there Access of home electric power wire internet uses a special modem that is about the size of a common AC adapter. It simply plugs into a 110 volt wall socket and has an Ethernet cable that connects to your computer (wireless versions are also available) of home electric power wire internet modems use silicon chips specifically designed to send signals over medium voltage power lines and separate data from 110 volt electric current. These are available right now and several electric utility companies in over 26 states are quietly doing pilot programs.

4.2. In-house Home Electric Power Wire Internet

In-house home electric power wire internet networks machines within your home or office. In-house BROADBAND ELECTRIC LINE products can easily comply with the radiated emissions limits listed in Part 15 of the FCC's Rules, because they connect directly with the low voltage electric lines inside your home or office. This technology has little to do with actually connecting to the Internet and is available in stores right now.

The radio interference issue is serious enough that at least one utility company was forced to terminate its pilot program prematurely. The concept has enough merits and profit potential that of home electric power wire internet developers and investors alike refuse to give up. Let's hope it's for the upcoming events.

5. Issues, Challenges, Uncertainties and Drawbacks

Because of enormous variations in the physical characteristics of the electricity network and virtual absence of international standards make the provisioning of service far from being standard and a repeatable process. besides, the amount of bandwidth that a broadband electric linesystem [12] can provide compared to cable and wireless is in question. the issues being faced by broadband electric line is that power lines are inherently very noisy due to high energy that they carry. thus, turning on or off every time of any electrical device introduces a click into the linen and this becomes quite predominant in case of energy saving devices [13] which introduce quite noisy harmonics into the line. the system has thus to be designed to effectively deal with these natural signaling disruptions.

Another major issue is signal strength and operating frequency. the system is expected to use frequencies of 10 to 30 mhz. since power lines [14] are unshielded and act as antennas for the signals they carry, they have to interfere with short wave radio frequencies over which broadband electric line operates. and this interference becomes quite perceptible in cases where the antennas are physically close to the power lines. however, this interference considerably diminishes and is barely perceptible where the antennas are moderately separated from the power network.

It is not yet clear completely that the deployment of operational broadband electric line systems will not cause other problems like:

(i) compatibility problems with other users of the radio spectrum,
(ii) rfi related issues with other users of the spectrum,
(iii) signal attenuation,
(iv) signal boosting and repeater design,
(v) coordination among telecom & power service providers,
(vi) security issues in adoption of internet services
(vii) lv transformers act as a low-pass filter, allowing electricity through it with low losses at low frequencies but not higher frequencies *etc*.

6. Literature Review

The basic principle of electric power line communications is to use the existing electrical power line networks for supplying electricity purposes. Over the years, power line networks have served as a medium of transmission and distribution of electricity signals. Until recently, communication over power lines was restricted to low-speed functions such as remote metering and operations management that serve the needs of power supply utilities. This limited scope of power line functions changed recently, on account of the tremendous demand for high-speed broadband multimedia communications. Research shows that the main losses present in high-voltage lines are the heat loss caused by the resistance of the power line material and leakage losses. Heat

losses can be minimized by increasing the nominal voltage. However, increasing the voltage results in an increase of the leakage losses. A strong communication system provides reliable and efficient platform. Data and power transmission between user and power line proving vital communication for existence power line. Communication in power line is not only responsible for notifications or reminders but also includes software based transmission, control, re-routing algorithms, fault recognition and self healing. By designing data and power transmission architecture [14], one can choose from currently available communication technologies; among wireless, wired/cable, cellular, or power line itself. Each has different advantages and disadvantages even hybrid combination of them could be used.

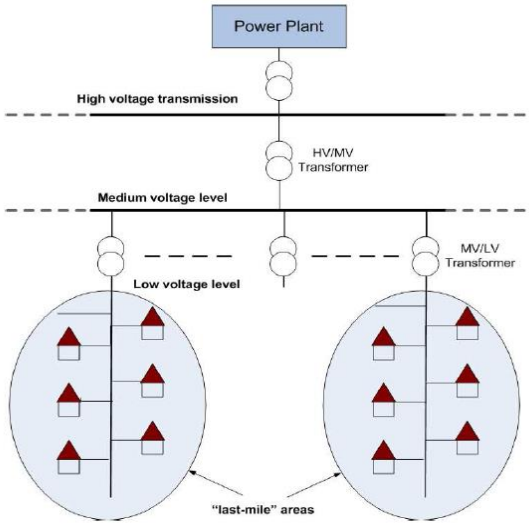

Figure 4. Simplified Structure of ELECTRIC NETWORK

7. Conclusion and Recommendations

In a developing country broad band penetration is extremely low and the costs of laying down copper cable or providing short haul satellite for providing broad band for its final leg of journey is very high, providing broad band over power lines holds a great promise, provided issues relating to interference etc are sorted out. even in advanced countries like usa, europe *etc.*, the larger issues of interference remain unaddressed because of absence of stringent regulatory measures. Even in the absence of these regulatory measures, broadband electric line is gaining ground in these countries despite strong protests from those agencies which are vulnerable to interference because of broadband electric line.

The country where serious financial constraints exist in terms of heavy investments to be made for laying copper or installing satellite as a mode of final broad band transmission, giving serious consideration and priority to broadband electric line would be worthwhile, while addressing other pertinent issues. another great potential that broadband electric line holds in future is that it can be used as a backhaul for wireless communications, for instance by hanging wi-fi access points or cell phone base stations on poles, thus allowing end users within a certain range to connect with the equipment they already have. besides, low maintenance costs and lesser installation time make broadband electric line a worth technology for increasing broad band penetration. the broad band over power line communication network technologies are new for indian telecom network and will grow extensively in near future for higher capacity applications

e.g., triple play services (telephony, data and tv *etc.*,). also broadband electric line is a better option with less cost for network operators.

Broadband electric line is already on the scene with commercial products readily available. green energy technologies like solar, wind *etc.*, may be used as power line solutions. combination of broadband electric line with fttx, dsl, pon *etc.*, may be economic solution for access networks in future.

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