

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Inquiry Regarding Carrier Current Systems) ET Docket No. 03-104
Including Broadband over Power Line)
Systems)

COMMENTS OF PowerWAN, Inc..

Pursuant to Section 1.415 of the Federal Communications Commission (“FCC”) Rules, POWERWAN, INC. hereby submits comments in response to the *Notice of Inquiry* in the above referenced proceeds. PowerWAN, Inc. applauds the FCC for initiating this NOI and provides the following information in support of Broadband over Power Line (BPL)¹ technology deployment by utility companies and other service providers.

POWERWAN, INC. has been testing BPL since the year 2000 in multiple and single-dwelling residential homes and businesses, as well as in utility company facilities. This has included testing over medium voltage and low voltage power grids, in both overhead and underground networks. PowerWAN, Inc.’s characterization results demonstrated that the power line medium is a feasible media for both access and in-home high-speed data telecommunications.

Section 15 BPL Access Spectrum

POWERWAN, INC believes that Access BPL would use the spectrum from 2-50 MHz. The reason for this choice is that frequency reuse of portions of this spectrum with significant data throughput would be facilitated. This would allow some ability for noise avoidance by not using some frequencies, as well as not using portions of the spectrum where other services are located, such as the amateur radio bands.

POWERWAN, INC. believes that Access BPL and In-house BPL can coexist. If the assumption is made that the 30-50 MHz band can be used by BPL, as well as the 2-30 MHz band, then the argument could be made that certain portions of the available bandwidth could be given preference for Access or In-home use.

- a) A gateway is placed at each residential meter, and this implements a filter isolating the in-home and Access services. This proposal would be costly, but is a possible methodology.

¹ Previously commonly referred to as Power Line Communications (PLC).

- b) Frequency Division/Allocation is implemented in which Access & In-Home do not overlap. Potentially, some sort of a “beacon” carrier can also be generated at the edge of the band if a service is present so that Access or In-Home services can detect whether the other is present. If the other service is not present, the deployed service can utilize the portion of the spectrum allocated to the other service.
- c) The services may overlap, but Access must be compatible with In-Home modulation within the designated In-Home band. In this way, the Access BPL and In-house BPL would share bandwidth in the area of overlap

Data Transmission speeds that Access BPL can achieve are governed by the bandwidth that is allocated to a particular data channel. If the whole band from 2-50 MHz is used, then the speeds should be in the range of 100 Mb/s. On a shared basis, the speeds are governed by the over subscription rate that is used, and the amount of frequency reuse that can be implemented. Greater than 1 Mb/s per user is typically supported. The data rate per user will be largely symmetrical, though this is governed by the relative noise levels at the customer premise and on the power line.

The modulation technique used by POWERWAN, INC is OFDM. Data privacy is ensured by separate encryption of each user’s data stream and service path. Quality of Service is supported on each path also, which allows Access and In-home services to be controlled and separated.

PowerWAN,INC access products work with In-home BPL products and services without additional equipment or adapters.

POWERWAN, INC. expects to be in full deployment of its Access equipment in 2004.

Standards work has not been done domestically or internationally other than ETSI. POWERWAN, INC believes that it is still too early for standards work to be successfully embarked upon, as there are no deployments large enough to provide the real world experience to prove or disprove technologies and techniques.

Section 17 -In-House BPL Systems

There are other in-house BPL systems in Europe that operate in a portion of the same spectrum.

Using next generation OFDM technology, which should be available over the next several months, in-house data speeds should be in the 50-100 Mb/s region. This would be under normal user loading conditions, but would still use approximately 16 MHz to accomplish this. Today, this rate is approximately 6.5 Mb/s at the application layer.

The modulation technique is OFDM. A single encryption key is used today by the HomePlug 1.0 standard. This is a large limitation, as multiple encryption keys are desirable for different uses. Multiple levels of QoS, for contention resolution, would be also be desirable.

Products developed using different standards may or may not work together, as they both may be using the same spectrum, and therefore, there may be contention.

In this country, in-house BPL has been “standardized” by HomePlug.

Section 20-Interference from BPL Emissions

POWERWAN, INC. believes that there is no evidence that the un-bypassed distribution transformer can be relied upon as a natural barrier sufficient enough to guarantee frequency isolation and no impact between in-home and Access technologies. Thus, independent of whether or not the transformer is bypassed, the loss through the transformer is not sufficient enough to provide complete isolation. We don’t believe the transformer can be relied upon as a “natural barrier”.

POWERWAN, INC. uses both capacitive and magnetic couplers for injection and reception of power line signals on medium voltage and low voltage lines. Implications are that lower radiation emissions are seen on lines where they are closely balanced, using a differential method of signal injection.

Definition of frequency bands that must be avoided or have significant signal attenuation would help, especially in particular areas such as the amateur radio bands. Notching out of particular frequency areas in an OFDM signal is routinely done. This would allow continued use of radios in these frequency bands without interference.

POWERWAN, INC. believes that the medium voltage power line should be considered as a class A environment, as there is no chance that the medium voltage will ever enter a home, except under extreme fault conditions.

In trials where the various services have been co-located, there have not been complaints of interference due to BPL.

BPL in-house and DSL services appear to co-locate together well, as they are both used in the home of a POWERWAN, INC. employee. We are also aware of others that use BPL in-house and cable modem access without interference.

Mitigation techniques used by in-home BPL systems mainly are notched filtering at the amateur radio band frequencies, and meeting Part 15 limits in the frequency band.

Access field tests to date have not resulted in any complaints, either from the customer or from the customers’ neighbors. As said previously, continuous use of In-house BPL does not appear to be noticeable by other family members.

POWERWAN, INC. believes that the existing part 15 rules for low speed carrier current systems are adequate for BPL testing, but will pose economic impact on full deployments.

POWERWAN, INC. believes that BPL Access should be treated as a service that provides better usage of existing power company assets to provide data access and other value-added services to customers who would otherwise not be able to obtain these. As such, less regulation, including an upward adjustment of Emission rules for carrier current systems to 100 uV/M at 30 meters, will facilitate lowering the cost of Access BPL by lessening the need for repeaters to provide broadband in urban and especially, rural areas. Moving the Emission limit breakpoint from 30 MHz to 50 MHz will help facilitate higher bandwidth and better frequency reuse schema. It also will allow better planning between Access and In-House BPL. As many of the radio services that were authorized to operate in the 30 to 50 MHz band have moved to higher frequencies, this band has

received lower usage, and could be re-used for the good of the public by higher limits for Access BPL.

To date, Access and In-House BPL has not been shown to be detrimental to radio services. As is seen in many other bands, radio services are migrating to digital technology with forward error correction, with strong benefits to users including higher capacity. As cellphone users know, digital technology produces clearer and higher quality calls. The side benefit is that the available spectrum is better utilized on an information density basis due to higher order modulations that can be used. As the bands from 2-50 MHz are used more by digital technologies such as BPL, better utilization of these important frequencies will result. The radio services in this band will also benefit users by going from analog to digital technologies with modern modulation methodologies.

As there are typically only three wires to a house, and as such this also should be treated as a scarce asset. The one wire that goes to everybody's house that has a refrigerator is the power line. This wire is underutilized today, only carrying a single frequency, and a few harmonics of that frequency. Being able to use its higher frequency transmission capability to bring more people into the information age is a worthwhile endeavor that should be pursued. Being able to utilize this capability has been brought on by the advances in digital silicon technologies, and will only continue to get better, with higher throughputs and longer distances, and lower costs, over time.

Both In-House and Access BPL should use the same radiated emission specifications. POWERWAN, INC. believes a level of 100 uV per meter at 30 meters, would be reasonable for both In-House and Access BPL below 30 MHz, due to the nature of the signal being wideband, rather than single carrier.

POWERWAN, INC. believes that radiated emission limits are adequate to control interference for both high and low speed BPL systems.

Section 23-Radiated Emission Measurements

POWERWAN, INC. believes that a standardized measurement method would be good for the BPL industry. Utilization of a standard antenna for Access BPL, that is easily calibrated and mobile, would be of great assistance. A part of this issue is that each power line installation is somewhat different, and a representative installation would have to be defined or built. Open site testing would be preferred over laboratory testing. The same antenna could also be used for In-House BPL, if physical size permits. The measurement procedures for low-speed carrier current systems should not be used, due the fact that they are characterized for single carrier systems, which occupy very little spectrum.

POWERWAN, INC. has typically used differential injection, though arguments can be made for common mode injection. Again, only radiated emission measurements should be used.

POWERWAN, INC. believes that overhead power line testing for radiated emissions is the proper way to test Access BPL, and that attempting to test on a power line for conducted emissions is a difficult and unnecessary task. As measurements will be taken in the near field at the frequencies of interest, the measurement should be in the form of dBuv/MHz.

Section 24-26-Equipment Authorization Process

POWERWAN, INC. believes that BPL equipment should go through the Verification process, and not the Certification process. As pointed out, existing carrier current equipment has not been a source of harmful interference using the Verification process.

POWERWAN, INC. does not believe that the multicarrier signal imposes a higher risk of interference with existing licensed radio services, as notching, and other techniques can be used to mitigate this issue.

The Access BPL modems should be subject to equipment authorization. As all equipments located outside the house will be installed by trained personnel, these would be covered under the verification program. The only item a consumer would install would be an In-house modem, by plugging it in to an existing power outlet.

Section 28-Power Line Carrier Systems

The question of replacement of existing power line carrier (PLC) systems is not clear at this time. It is POWERWAN, INC.'s experience that power companies would like to see the additional data handling capability of BPL, but they realize that certain issues must be considered. One of the main issues is that PLC systems today do use higher power to provide their signals over long distances. These higher power signals are necessary for long distance signal transmission and would likely cause more radiated emissions in a different frequency band than is presently being utilized. Also, the frequencies presently used by PLC have lower losses per distance than those utilized today by BPL. The different systems, being in different frequency bands, would coexist with few problems. As techniques exist to filter the signal at desired locations, a coordination process would not be necessary. As to whether the PLC systems using BPL technology are subject to the Access BPL requirements would depend on the frequency band being used. If the Access BPL system in the 2-50 MHz band is carrying both broadband and monitoring signals, it would be subject to the rules of Access BPL. POWERWAN, INC.'s equipment separates these signals at higher layers, and provides security for both.

Section 29-Standardized Transport

POWERWAN, INC. uses IP transport between the user and the Internet point of presence, and does not believe that PPP, PPPoE, ATM, or other protocols are necessary.

BPL Enables Cost-Effective Broadband Services, along with Enhanced Utility Customer Service and Operations

POWERWAN, INC.'s interest in BPL is to provide the technology to provide broadband data services and enhanced utility services over the existing medium and low voltage power grid that would be of benefit to both the utility service providers and their customers

The enhanced utility operation functions occur as a result of Access BPL—the presence of BPL signals on the utility medium and low voltage distribution network. Most significantly, the POWERWAN Node and Repeater devices will have the capability of

detecting signal signatures that occur prior to breakdown of electrical grid elements, such as faulty conductors, low voltage transformers, capacitors, fuse devices, etc. As these BPL detection technologies develop and mature, the BPL bandwidth availability can presently be used to extend traditional utility SCADA (Status, Control And Data Acquisition) throughout the utility power grid. Today, there is essentially no data available from the power grid between the substation and the customer. Such a deployment would improve customer service and system reliability and minimize, if not eliminate, customer reliance for outage notification. Existing low-speed power line communication (low speed PLC) technologies do not afford these capabilities. Thus, predictive failure analysis and the potential physical “reach” of BPL are side benefits of BPL deployment that could lead to reliability and service improvements to utility customers. There are numerous other enhanced utility functions² that POWERWAN, INC. included in its technical analysis.

At the BPL in-home level, POWERWAN, INC. and several utilities have jointly identified a number of enhanced customer service applications³ that heretofore have not been economically viable. These, coupled with the enhanced utility operations applications, provide a strong business case for deploying BPL for utility needs. Utility uses generally only consume small bandwidth, leaving a significant bandwidth available for consumer level broadband applications, such as Internet service or Voice Over Internet Protocol (VoIP) telephony. The latter services further bolster the utility’s prospective BPL business case.

POWERWAN, INC. believes the combination of utility applications and potential to provide consumer Internet/Voice services is in the best interests of the utility ratepayers and corporate shareholders. No other technology is available that leverages existing assets (utility distribution facilities) and provides enormous potential for economical customer connectivity in both rural and urban settings.

BPL provides a potential communications infrastructure that promises to be lower cost than other alternatives for serving residential and business customers, including applications such as advanced customer metering, direct load management, and demand response programs. From an operations perspective, BPL’s high speed capacities will allow utilities to improve their infrastructure security, better ensure public safety, and provide more timely responses to customer outages. This is increasingly important due to classification by the United States government of specific public and private infrastructure assets, such as electric utility assets, under MEVA⁴ guidelines. Under MEVA, utilities are responsible to ensure secure infrastructure power for federal facilities, including military bases, and state, city, and local government. BPL is also

² Hawaiian Electric Company identified enhanced utility applications that may include: communications for distribution automation, distributed generation, distribution data acquisition, disaster recovery, system protection, and diagnostic monitoring.

³ Hawaiian Electric Company identified several in-home BPL enhanced customer service applications that may include load control/demand response, Time-of-Use rates, load profiling, outage detection, meter theft monitoring, and remote start/stop.

⁴ MEVA – Mission Essential Voluntary Assets established by Presidential order as part of the Homeland Security policies framework.

envisioned as a boon to economically expand the utility communications infrastructure, enabling applications such as electric facilities' video surveillance to ensure security and public safety.

BPL Promotes Facilities-based Competition and Provides Connectivity for Underserved Communities and Customers

POWERWAN, INC. believes BPL will benefit its served communities by providing another facilities-based medium for last-mile customer connectivity for a variety of high-speed communications services. As is well known, there are many communities in the U.S. where broadband services are unavailable, as the cost models for providing these services using DSL or cable do not provide the necessary revenue to the service provider. The cost of providing the additional infrastructure necessary is too high. BPL can fill this need, as the electrical connections are ubiquitous to essentially all homes and businesses. Using these electrical connections and their associated infrastructure as the communications medium allows the cost to be significantly lower than other infrastructures. The actual content required for these services can be provided in several different ways depending on the utility's business model. The ones that come to mind include a utility having an unregulated subsidiary or third party partner that provides the content and billing, or an open access model, where the utility acts as the landlord. The open access model affords Internet Service Providers (ISPs) and Competitive Local Exchange Carriers (CLECs) that do not have last mile facilities, as well as the Local Exchange Carrier (LEC) and cable company, to use the access facilities for specific needs. In the latter case, for example, the LEC may have areas where DSL service is infeasible, and in those areas BPL may offer a platform for economical DSL-equivalent service. Likewise, the cable company may have commercial buildings where secure conduit space is inaccessible, but where BPL could provide instant-wired connectivity. In summary, BPL is an access medium that has unique qualities that may be attractive to diverse broadband competitors to expand competitive breadth.

From a cost perspective, POWERWAN, INC. estimates that by leveraging existing wired utility assets, BPL potentially offers a lower cost medium that may enable tiered Internet services at price points that dial-up customers will find attractive. Also, with expanded utility uses, such as advanced metering, BPL may provide expand services and links to customers that are currently not attractive or economical for existing broadband services providers. Essentially, every electrical outlet could become part of a home-based, symmetrical Internet network, with no new wiring or re-wiring.

As we go forward, communities that do not have broadband, are going to find that they will not be able to meet the needs of their citizens for communications and specific content. BPL provides a clear answer to this issue, at a cost that is within reach. This is especially critical to schools and other facilities that are tasked with providing the educational needs of our future generations.

BPL Interference is a Low Risk

POWERWAN, INC. believes that BPL does not pose significant risks for unintended high frequency radiations that will interfere with consumer devices, amateur radio

operators, or other forms of commercial communications (television, radio, mobile radio, etc.). This belief is held for several reasons, described as follows:

- *Equipment Vendors will FCC-Verify their access and in-home BPL technologies.* POWERWAN, INC. is working with consultants to verify the PowerWAN access and in-home equipment. In tests to date, the results are promising.
- *BPL In-home Consumer products are FCC Part 15 verified.* HomePlug™ 1.0 compliant bridges, routers, and adapters from Asoka, LinkSys, NetGear, and Siemens have been FCC certified and UL approved.
- *Tests have not revealed any issues.* In POWERWAN, INC.'s first three-month BPL deployment, no public complaints were registered for access or in-home related interference. POWERWAN, INC. has conducted its own in-home testing with a number of consumer devices, such as household appliances, televisions, and radios, and did not observe any radiated emissions interference from BPL signals on the in-home wiring.
- *Extensive safety checks on overhead (aerial) and underground equipment.* POWERWAN, INC. believes the access and in-home BPL technologies can be safely and reliably installed and operated. POWERWAN, INC. has paid special attention to ongoing safety concerns, such as distribution line coupling, pole attachment clearances, powering options, appropriate fusing, etc. This experience supports POWERWAN, INC.'s view that BPL will reliably and safely operate on utility distribution networks.
- *Providing broadband access to many people that would not otherwise be served.* POWERWAN, INC. believes that BPL provides the best means for providing broadband access to customers that would not be served, due to various reasons, by other technologies.
- In summary, POWERWAN, INC. believes that FCC Part 15 radiated compliance rules sufficiently govern both access and in-home BPL technologies. POWERWAN, INC. also supports elimination of conducted limits, as radiated emissions are the true indications of interference potential.

Conclusion

POWERWAN, INC. commends the FCC for its efforts with the subject NOI, and looks forward to an outcome that permits utilities to leverage their assets and provide a new broadband medium that will serve the public good, while further stimulating broadband competition.

POWERWAN, INC. asserts that the existing FCC guidelines are sufficient and that the FCC's encouragement of utility investment and trial deployment, potentially leading to BPL commercialization, is appropriate and justified. POWERWAN, INC. understands the need for FCC to verify equipment before it can be commercially deployed. With these protections, interference issues can be mitigated to ensure that BPL access and in-home equipment operates within existing FCC guidelines.

A “third wire” broadband medium, as highlighted in Chairman Powell’s comments⁵, is in the public’s best interest. For the utility, duality of use is attractive and will lead to benefits for its utility customers, for the public in general, and for potential service providers that can leverage the BPL infrastructure. Presently, the BPL opportunity is leading to increased OFDM⁶ technology innovation, which will help the telecommunications industry and provide more options for broadband deployment worldwide.

BPL vendors, including POWERWAN, INC., have demonstrated sincere efforts to ensure that their technology, provisioned as an unintentional radiator, does not interfere with FCC-regulated radio bands and will indeed meet FCC Part 15 requirements. In addition, FCC Order 97-Section 157 essentially places the burden on BPL opponents to justify why a new entrant or technology that may provide more affordable telecommunications to a broader base of customers, should not be approved. POWERWAN, INC. asserts that heretofore arguments voiced by amateur radio forums do not meet this burden, and remain unsubstantiated and speculative without direct evidence that BPL vendors’ technologies cause interference in excess of approved limitations established by FCC guidelines.

POWERWAN, INC. appreciates the opportunity to provide relevant comments on the BPL NOI.

Respectfully submitted,

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⁵ FCC Chairman Powell’s separate statement in ET Docket 03-100, Page 17, April 28, 2003

⁶ OFDM – Orthogonal Frequency Division Multiplexing