Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

REPLY COMMENTS OF
GARY W. BOX
To Comments of
MAIN.NET COMMUNICATIONS
Dated 7 July 2003

These are Reply Comments of Gary W. Box to comments filed by Main.net Communications, referred to as Main.net.

The writer received a BSEE and MSEE from UCLA, 1977 and has been employed as a electrical engineer involved in the power electronics and industrial electronics industries for 29 years, mainly in product development. This experience includes numerous encounters with FCC emission requirements including designing, building and testing equipment for compliance. The writer has also been issued 9 patents and currently holds the call sign N0JCG as a member of the Amateur Radio Service.

These replies take the form of excerpts from the Main.net original comment, noted as "Comment," followed by reply remarks, noted as "Reply". A number annotates each Comment and Reply. Replies commence immediately below.

1. COMMENT
Although there is some theoretical concern regarding interference to Amateur Radio operations below 30 MHz, Main.net's experience, including operation in the homes of active Amateur Radio licensees, has been that there is no interference. Part of the reason for this in likely that Amateurs typically install their antenna outside.

REPLY
Main.net claims that their products have been installed in the homes of active amateurs. The Commission should follow this up by asking Main.net for details on those users installation conditions and experiences. Main.net refers to the typical amateur antenna being an outside installation, which leads me to believe the active amateurs had in-home BPL only installed. As a matter of fact, the Amateur Service is not restricted to using outside antennas and is free to experiment with antenna configurations of all types. I have personally communicated to both Massachusetts and California using a small inside antenna and 5 watts on 18.157MHz.

2. COMMENT
In the currently installed equipment (which is based on spread spectrum modulation) under the experimental license as well as in Main.net's next generation technology (which is based on OFDM modulation), notches can be defined remotely, so that the system will not transmit in any frequencies where there is as official request regarding interference. This notching is controlled by software and can be done remotely.

REPLY

Recent tests by the American Radio Relay League (ARRL) using a conventional mobile amateur radio configuration documented substantial harmful interference from several BPL systems. Main.net has described their BPL system as a wide band system using spread spectrum modulation to avoid frequencies in the amateur bands. Let's assume that a spectrum analysis of the BPL signal shows no BPL carriers in the amateur bands. How then did the sensitive narrow bandwidth amateur receiver pick up the out of band BPL signal? If we examine the characteristics of the received noise, we see that most of the interference is a series of random 'pops', which one party described as sounding like a 'Geiger counter'. They were very short, but very often, impulse noise transients. The spread spectrum carriers suddenly appear, transmit their bit streams, which form the packet, and then are extinguished. If the leading and trailing edges of these carriers are fast, the edge of each packet will look like an impulse excitation to the power line. The spectrum of an impulse is spread infinitely across the spectrum. The power line obediently reacts to this excitation as the distributed, unbalanced, resonate wire structure it is and an impulse of energy is radiated all across the HF spectrum. The phenomena would occur at every edge of every packet.

In the Amateur Radio Service this effect has been known for 80 years as "key click". A CW (Morse code) transmitter operates by turning the carrier on and off as the key is opened and closed. In much the same way that the BPL spread spectrum carrier turns on and off at the beginning and end of the packet, although at a considerably slower rate. In CW, 'key click' is fixed by controlling the rise and fall times of the RF envelope, effectively passing the RF envelope through a low pass filter.

Unfortunately for BPL, passing the signal through a low pass filter will slow the baud rate substantially. Spread spectrum works great in a band where all users are using the same modulation scheme because spread spectrum itself has good immunity to this effect. This is why there should be no conflict between access and in-home BPL. However, on the HF band, where the development emphasis over the last 100 years has been on raising signal to noise performance and sensitivity by designing ever-sharper filters and highly bandwidth conserving modulation schemes, a mode that continually generates impulse noise is incompatible.

In addition, if Main.net avoids transmitting in just the amateur, short-wave broadcast and utility portions of the band, which would leave little spectrum for their operation and throughput will suffer accordingly.

3. COMMENT

Security in Main.net PLUS BPL is primarily performed at the MAC (Media Access Control) layer. The system is built using several levels so it can protect the network from internal hacking as well as secure the in-home device and the end-user's PC using standard DES56 encryption as well as other mechanisms. The end-user's privacy and security are ensured using different mechanisms. As the traffic is going to the Internet, we recommend that both the end user and the service provider add application layer security (as is any other broadband technology).

REPLY

In order to operate, the BPL receivers must have an operating bandwidth extending from 1.7MHz to over 30MHz. Such a receiver will be highly sensitive to local transmitters anywhere within the passband. To a first order, a strong signal will cause the receiver AGC to reduce the RF gain, driving the BPL carriers into the noise floor. With a stronger RF signal, the receiver front end will act as diodes and clamp the input to the receiver altogether, forcing a delay as the receiver recovers when the carrier is removed. With a still stronger RF signal, the receiver front end will act as a fuse and simply fail. None of the BPL proponents address the immunity of BPL equipment in the presence of a strong RF field from a local transmitter. With the vulnerability of the nations electrical distribution recently demonstrated by the power failure in the Northeast, I can't imagine the utilities trusting critical command and control functions to a system that is even more vulnerable. BPL is a wide open door for an ILLEGAL, local transmitter to lock up the whole BPL system and thus affect an electrical grid running SCADA through it. All the software security will be worthless with the BPL system inoperable. It would be far more secure for the utility to invest in fiber or microwave links.

4. COMMENT
Main.net's technology works in such a way that, even if hundreds of units are installed, only one unit is transmitting on any frequency at any given time in an area. Therefore, the measured emission of one unit is equivalent to that of the entire system.

REPLY
In order for BPL to work at all, RF energy must be conducted along the entire path from the transmitting device to the receiving device. All parties to the NOI, including Main.net, admit that the power line is an unbalanced system relative to RF. RF energy fed into an unbalanced system of conductors is precisely the definition of an antenna, thus the entire line will radiate. The intensity of the radiation will fall off as the signal passes from line segment to line segment because a good deal of the energy is radiated. Main.net is right that only one device on a given segment will transmit on a given frequency at a time, however, an antenna with RF injected alternately at either end is still an antenna. Main.net and other BPL proponents have made it clear they intend to increase the conducted RF energy until the radiated emissions hi the limits imposed by Part 15. They clearly then intend to emit this maximum RF level continuously. All BPL proponents, Main.net included, are under the mistaken notion that the Part 15 emission limits are a sort of digital threshold, below which there is no interference and above which there is. Harmful interference is defined as any repeated interruption of a licensed service, regardless of the RF field level from the offending device. As noted in #2 and as evidenced by the ARRL tests, BPL technology does produce enough RF energy in the passband of a narrow band HF receiver to cause harmful interference. Analysis by the ARRL at Part 15 emission levels, indicate 30dB or higher levels within 100 feet of a BPL injected power line. A large part of American population lives less than 100 feet from a power line, so Amateur Radio, short-wave broadcasting, National Bureau of Standards Time Signals, and any other HF service would all be effectively "jammed" for anyone within the BPL service area.

BPL should not proceed because the opportunity cost of injecting RF onto the power line is too high and it is not necessary.

Respectfully Submitted;

Gary W. Box