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

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

RESPONSE OF xG TECHNOLOGY, LLC TO NOTICE OF INQUIRY

xG Technology, LLC (xGT), by its attorney, hereby submits its response to the Commission's Notice of Inquiry (NOI), issued April 28, 2003 in these proceedings. In the NOI, the Commission is seeking information on a variety of issues related to Broadband over Power Line (BPL) technology. While recognizing the potential benefit of BPL systems in bringing Internet and other high-speed broadband services to rural and underserved areas, the Commission is justifiably concerned that the proliferation of BPL not cause harmful interference to licensed users of the RF spectrum. Accordingly, the Commission has requested public comment on whether and, if so, to what extent its Part 15 regulations need to be modified to facilitate the deployment of this new technology.

INTEREST OF xGT

xGT is a research and development company headquartered in Florida with executive offices in Sarasota and field test facilities in Key West. For the past several years, the company has been engaged in designing and developing a patents pending digital communication system that is called xG™. It consists of a combination of two proprietary technologies. The first is a

narrow band modulation technique; and the second is a data encoding method. Together, they form a system that is capable of transmitting high-speed data over narrow bandwidth RF channels at a rate that constitutes a substantial improvement over the current state of the art. While most of xGT's work to date has been designed to improve the performance and utility of the allocated narrow band channels in the VHF and UHF bands, xG™ is capable of transmitting any binary, data, including digital audio and video, in any portion of the RF spectrum. Accordingly, xG™ is well suited for BPL systems.

In both wired and wireless environments, xG™ is a viable last-mile solution. To date, most last-mile strategies require significant investment in hardware, systems integration, bandwidth and networks. All of these come at considerable cost. Incorporating xG™ is cheap, by comparison. The technology can be encapsulated into relatively inexpensive chipsets. This is particularly significant in the BPL environment where the infrastructures for bringing power lines to both businesses and residences are already in place.

xG™ has been extensively tested. While, at first blush, its performance claims may appear exaggerated, rigorous testing at xGT's facilities in Key West, Florida has shown that the technology is capable of performing up to its design specifications even in the presence of real-world electrical noise and multipath interference. Indeed, the recent development of a mathematical model by a distinguished xGT consultant proves that xG™ is entirely in harmony with basic laws of physics. More information, including specifications and test results may be viewed at http://www.xgtechnology.com.

To date, xGT has been primarily a research and development endeavor. In order to bring xG™ to the marketplace, the company is now exploring strategic partnerships and various market alternatives. This new technology has the potential to significantly increase the value of

present networks as well as creating new opportunities in the telecommunications, cable TV, computing, entertainment, public safety, defense and homeland security industries, as well as BPL. The following are xGT's responses to certain of the Commission's inquiries, as they relate to xG™, and to demonstrate its potential in achieving the Commission's objectives in these proceedings.

DISCUSSION

Frequencies of Operation and Data Speeds

xG™ will work well with both Access and In-House BPL devices that operate from 100 KHz to 30 MHz within the Part 15 rules. These devices are capable of operation in closer proximity in the frequency spectrum to licensed operations without causing harmful interference than conventional devices. This is so because the carrier of an xG™ device utilizes only a very narrow band and appears on the spectrum as an unmodulated carrier. Sideband energy, consisting of integer cycles (single cycles) of RF energy in quite specific spectrum locations relative to the carrier, is not detectable by normal means Data speeds in excess of 14 Mbps are achievable for In-House systems. Speeds closer to 2-3 Mbps are foreseen for Access systems.

Measuring Emissions

Sideband emissions from an xG™ system are virtually undetectable by usual means, regardless of data rate and location in the spectrum, even at very high power levels. Operation outside of Part 15 limitations would only apply to the single carrier frequency if operated at high power levels. Sidebands would not exceed the limitations of Part 15 even with operation of an xG™ device at several watts of transmitter RF output power.

Controlling Interference

While xG™ technology will deliver higher data rates at higher frequency, due to its dependence upon the carrier frequency and the relationship to the integral encoding system, xGT believes that operation on carrier frequencies above 30 MHz should not be necessary unless very high data rates are required. Operating xG™ in an OFDM model will allow the interleaving of multiple signals that can aggregate parallel data streams. By efficiently utilizing spectrum below 30 MHz, unintentional emission can be controlled.

Access BPL Systems (paragraphs 14-15 of the NOI)

The following responses correspond to the first six bullet-point inquiries in paragraph 15:

- While frequencies above 30 MHz will afford higher data rates in an xG™ device, the problem of interference will remain. Systems that utilize conventional modulation techniques will need greater control over emissions. Using xG™ technology, emissions are limited to specific and very narrow band carrier frequencies, rather than the conventional distribution of RF power over a wider spectrum. Therefore, if some coordination of BPL carrier frequencies can be established, operation at frequencies above 30 MHz would be possible without harmful interference. Thus, if some narrow sliver of spectrum (less than 10 KHz) can be found, xG™ would be capable of transporting data at very high rates above the current 30 MHz operational limits.

- xGT believes that spectrum sharing between In-House and Access BPL systems is entirely feasible. A number of methods exist to separate the two systems. The main problem will be in the bypassing of transformers as the frequency increases. While not an unsolvable problem, this can also become one method of system separation

- xG™ systems are designed to be fully symmetrical. They could be designed to be asymmetrical, but that should not be considered a benefit. Speeds are entirely dependent upon two conditions: the highest allocated frequency for the fundamental carrier; and the method of multiplexing upon which standards are built. Using a maximum fundamental frequency of 30 MHz and with no multiplexing, one should expect up to 7.5 Mbps in an xG™ system. Assuming a limited frequency range of 500 KHz to 30 MHz, it would seem quite reasonable to multiplex an xG™ signal every 100-200 KHz. This works out to a data rate of around 100 Mbps. At higher frequencies, the data rate would be proportionally higher.

- xG™ technology consists of very novel and proprietary modulation and encoding techniques. It is based upon the use of single RF cycles (integer cycle modulation) to control the channel bandwidth and the average energy of Bessel function sidebands.

Since higher than conventional data speeds are possible, xGT would recommend a time-sharing system of traffic coordination, similar to Ethernet or 802.11 wireless standards. In fact, 802.3 type standards should be used for In-House systems while 802.11 or 802.16 methods should be used for Access systems. However, many options exist for traffic control. Data encryption also has many options. One may employ encryption at the user device level or at the modulation level. xG™ incorporates a fast, rotating scrambling capability that would serve as a primary security level; and then a user device level encryption (high level) could be used to achieve secondary security.

- As stated above, xGT believes that there is no reason why In-House BPL products should not operate seamlessly with Access services. This is primarily a function of the rules adopted by the Commission.

- xGT has not demonstrated BPL devices at this time. Its primary goals to date have been in the areas of wireless and CATV devices. However, xG™ is easily adaptable to BPL because it was designed initially as a high-speed, low-frequency transmission system.

In-House BPL Systems (paragraphs 16-17 of the NOI)

- xGT's responses are essentially the same as for Access BPL systems.

Interference from BPL Emissions (paragraphs 18-20 of the NOI)

As stated above, xG™ does not generate RF interference beyond the very narrow band carrier frequency. If frequency coordination is applied, no interference is anticipated regardless of the frequency band of operation. One need only assign a narrow band channel (on the order of about 10 KHz) for operation, regardless of the frequency band chosen. Sideband energy is non-detectable, regardless of the width of the channel within the design rules for xG™ systems. As such, other users of the RF spectrum will be unaffected, except for those in very close proximity in frequency to the xG™ carrier frequency, regardless of whether operation is being conducted under Part 15.

The following responses correspond to the 14 bullet-point inquiries in paragraph 20:

- The transformer will, of course, act as a natural barrier to high frequency signals. Filters that are installed to allow the passage of Access BPL signals could be substantially higher or lower than those frequencies used for In-House BPL systems. However, it might also be desirable to not differentiate between the two to allow a more amorphous network. Such configuration could greatly enhance the reliability and redundancy of network

connections throughout the network. Network addressing and security issues need not necessarily be reinvented because those issues have already been resolved by such standards as Ethernet. Those solutions would basically apply to a new system.

- On medium voltage lines, any of the methods mentioned would work. However, xGT believes that applying the signal differentially between two phases of a power line will lead to the lowest interference potential. Injecting the signal between a power line and ground could probably be done at lower cost, however. These emissions issues are mitigated by xG™ since the sidebands are non-detectable.

- There is definitely a need to define frequency bands that must be avoided in order to protect licensed users on the same frequencies as those used by Access BPL systems. Emissions from those systems will clearly affect licensed users in close proximity. However, using extremely narrow band, frequency coordinated systems, such as xG™, will substantially mitigate this potential problem.

- No response.

- xG™ devices will not affect other services co-located on the same utility pole for the reasons stated above. Other services would likely not affect xG™ devices either since such devices designed to be used in that environment would be properly shielded.

- Existing DSL service should have little effect on In-House BPL systems since there is such a disparity in signal strengths between the two. However, DSL might interfere with BPL systems if the method of data delivery is through radiation rather than direct coupling. Considering that most existing BPL modulation methods require relatively wide bandwidth RF channels, and since DSL can operate in essentially the same band, the main source of interference will be poorly filtered AC power supply connections.

- If the Part 15 rules are expanded to accommodate new BPL devices, as anticipated, including possibly increasing emission levels, there is definitely a need for interference mitigation techniques, which may have to include avoiding certain frequency bands or establishing some form of frequency coordination. This will be difficult since conventional modulation methods will increase the amount of spectrum used as data rates increase. Only narrow band systems, such as xG™, can effectively eliminate or at least minimize this potential problem.

- If the noise floor is to be raised, then the potential of harmful interference naturally increases. This is why xG™ was designed so as to transport digital data at high rates without adversely affecting users in the adjoining spectrum.

- No response

- The existing Part 15 rules appear to be adequate if BPL operation is confined below 30 MHz.

- xGT suggests only that power levels be possibly increased for Access BPL systems. The Commission could also specify different frequencies for In-House and Access systems, but not without sacrificing the benefits of a more amorphous system as stated above.

- In a single carrier narrow band system, such as xG™, different users and, in fact, the Access system itself can easily have discrete carrier frequencies. This allows a natural separation of users and a method of self-mitigation of potential interference. Channel switching can then be done by the user or in an automated fashion even "on the fly." This is no different than the method used by modern cordless phones. Another advantage could be achieved if Access and In-House systems were to operate on different frequencies. When data is destined for the broader network outside the In-House system, automatic channel switching would send the data to the Access system on the nearest node or pole.

- It would appear that injected power limits cover the broadest scope and are the easiest specifications to verify. Emitted limits could vary so much from one installation to another that compliance would be tenuous. xGT believes also that a new class of wiring should be designed specifically for In-House installations. This would essentially be "Romex" with appropriate shielding. Such installation could be allowed higher power injection limits and less frequency control.

Equipment Authorization Process (paragraphs 24-26 of the NOI)

The following responses correspond to the three bullet-point inquiries in paragraph 26:

- xGT believes that the new high speed Access and In-House BPL systems, using conventional designs, will pose a higher risk of interference to licensed radio services than the traditional carrier current systems. Increased data rates will generally require increased bandwidth, thereby increasing the likelihood of causing harmful interference to the licensed services. Narrow band technologies, such as xG™, will help to mitigate this potential problem.

- Any components that directly inject RF energy into the power line should be subject to equipment authorization. Likewise, the emissions from any sub-assemblies must meet existing Part 15 rules as unintentional radiators.

- The more stringent *Certification* or *Declaration of Conformity* procedures appear to be justified for new Access and In-House BPL equipment due to its greater potential for causing harmful interference to licensed radio services.

Power Line Carrier Systems (paragraphs 27-28 of the NOI)

The following responses correspond to the five bullet-point inquiries in paragraph 28:

- While xGT has no personal knowledge in this regard, it would appear likely that existing systems employed by utility companies will eventually be replaced with new high-speed BPL equipment given its greater usefulness and the fact that the utilities will be deeply involved in the ownership and operation of the systems.

- No response.

- xGT believes that power line carrier systems using BPL technology should be subject to the coordination process in the current database maintained by UTC. This is justified by the need to monitor and control potential interference.

- These functions can and must be separated. Important power grid control functions must be protected for the safety of the public. This can be accomplished by providing the utility with a dedicated channel that carries no public data. In a narrow band system, such as xG™, this is easy to do.

- These systems should employ automatic security functions, such as channel selection, encryption, etc. to prevent data theft from neighboring users. One way to enhance this system is to place a setting on or in the BPL device that limits the number of in-house devices on the network. For instance, if you have three devices on the network, then a fourth device cannot be communicated with if you set the device limits at three. If a neighboring user attempts to connect to your network with a fourth device, communications will be refused.

CONCLUSION

xGT welcomes the opportunity to participate in these timely proceedings. Although, to our knowledge, neither the technical viability nor the need for BPL has been fully assessed, the Commission recognizes that BPL could potentially play an important role in increasing the choices for broadband services to American consumers. As power lines are ubiquitous nationwide and given the increased potential for BPL to cause harmful interference to the licensed radio services, the Commission is justified in embarking on a path that will lead to the formulation of regulations assuring that BPL will be able to co-exist in the RF environment. Although xGT has not, heretofore, focused on developing products for the BPL market, its xG™ technology is well suited for BPL in overcoming potential interference problems and can easily

be adapted to BPL applications. xGT will be closely following the progress of these proceedings and looks forward to further participation.

Respectfully submitted,

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