Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules with	)	GN Docket No. 12-354
Regard to Commercial Operation s in the	)	
3550-3650 MHz Band	)	

To: The Commission

RESPONSE OF xG TECHNOLOGY, INC. TO
FURTHER NOTICE OF PROPOSED RULEMAKING

xG Technology, Inc. (xG or the Company), by its representatives, hereby submits its response to the Commission's *Further Notice of Proposed Rulemaking* (*FNPRM)* in these proceedings, which seeks comment on the establishment of rules to govern a new Citizens Broadband Radio Service (CBRS) in the 3550-3650 MHz band (3.5 GHz band). xG first presents the background of its technology. Its comments then examine the Commission's proposal for interference avoidance in the to-be-shared 3.5 GHz band and describe an alternative approach to mitigating interference in shared spectrum, based on advanced cognitive radio technology.

The Company and the Background of its Technology

xG (NASDAQ: XGTI) is a leading developer of innovative communications technologies for wireless networks. Its extensive patented intellectual property portfolio covers a broad range of applications including cognitive radio networks. The Company has commercialized its technologies to create xMax™, the world's first carrier-class cognitive radio network using licensed or unlicensed spectrum. The Company has successfully deployed and operated cognitive cellular mobile radio networks in Fort Lauderdale, Florida and rural Arkansas using the

unlicensed 900 MHz band (902-928 MHz) under Part 15 of the Commission's Rules.

xG's technology features a wide range of spectrum-agnostic, cognitive radio solutions that enable commercial service providers and public safety entities to deliver extensive fixed and mobile wireless services using licensed or unlicensed spectrum.

The xMax technology is capable of operating on any frequency. Antenna selection and radio filters dictate the actual operating frequencies which are controlled by software. A web-accessible controller creates a set of rules that either permit or exclude any portion of the network's frequency range, thereby allowing instant (sampled 33 times per second) changes to the operating frequencies as conditions change.

The proprietary cognitive radio technology incorporates orthogonal frequency division multiplexing (OFDM) and four-by-two multiple input-multiple output (MIMO) features.[1] This permits virtually interference-free operation on any of the selected frequency ranges. A key feature of the cognitive aspect of the system is the ability to detect and avoid potentially interfering radio signals seamlessly. This is part of the cognitive radio strategy pioneered by xG and is, to xG's knowledge, the only such cognitive radio technology that has been proven successful in actual field operating conditions. This feature, known commonly as Dynamic Spectrum Access, or DSA, actively spots interferers and causes the equipment to change frequencies before communications are impacted. In addition, xMax radios utilize a multi-tier interference mitigation technology to actually factor out interference at the receiver. Both short burst interference and long burst interference are removed by parallel digital signal processing

[1] xG incorporates 4X2 MIMO, which uses two antennas for transmit / receive and two more for receive only. A powerful Digital Signal Processing (DSP) system receives four independent signals and mathematically negates interference.

(DSP) engines in real time. Even interferers many times stronger than the xG signal are removed in real time. Problematic interferers are then dealt with by the previously mentioned DSA. Thus, xG equipment operates without interference in high density and shared radio spectrum with near impunity for a virtual dedicated spectrum experience.

Since every component of the network utilizes the xMax cognitive radio technology, no frequency planning or use pattern analysis is necessary prior to system deployment due to its ability to create its own RF plan in real time. This Self Organizing Networking (SON) eliminates the need for complex, error prone and expensive frequency planning. An on-going complication of fixed small-cell networks, including the proposed 3.5 GHz network, is self-interference. The patented SON attributes of xMax fully eliminate this problem, reducing manpower and expense, reducing system engineering and buildout costs dramatically and eliminating self- interference.[2]

General Comments

In the *FNPRM*, the Commission has proposed rules to govern the CBRS, including a system for minimizing interference among multiple users sharing the 3.5 GHz band based largely on the system developed for TV White Spaces. The proposal seeks to implement a plan put forth in a July 2012 report to the President by the President's Council of Advisors on Science and Technology (PCAST). Specifically, the proposed rules would implement a comprehensive, if complex, framework to authorize a variety of small cell and other broadband uses of the 3.5 GHz band on a shared basis with incumbent federal and non-federal users, with oversight and enforcement through a federal Spectrum Access System (SAS).

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2 Further information about the Company may be found at http://www.xgtechnology.com.

The PCAST report was, in effect, a call to action to utilize technology to further the use of and sharing of radio spectrum. However, xG is of the opinion that the widespread use of a centralized planning and management system through SAS databases falls short of the directive. It does not define the state of the art in cognitive radio. By definition, cognitive radios are able to react to local conditions for the achievement of virtually interference-free radio communications. Effective cognitive radios maximize the use of the radio spectrum by avoiding other spectrum users either temporally or through frequency agility. They can anticipate potential interference and utilize their technology to mitigate interference within their own receivers to protect communications.

Cognitive radios do not have to rely on external management to adjust power or to choose a frequency or, for that matter, manage any dozens of operating parameters in order to achieve effective communications. Thus, with certain exceptions, intense management by a central database is unnecessary and should be avoided except perhaps to become aware of exclusion zones, critical incumbent users, or other information that remains reasonably constant. Cognitive radios are capable of reaching a level of spectrum use efficiency and reliability that a database driven, centrally planned network will never achieve. Thus, cognitive radio offers the best and only reliable method for fully utilizing shared radio spectrum.

xG understands that some may consider these statement to be bold and without substance. However, xG's years of effort in developing its xMax cognitive radio technology have resulted in commercially available cognitive radio equipment that meets the goals set forth in the PCAST report without the complications and complexities of database driven systems. Accordingly, xG urges the Commission to consider this different paradigm of spectrum management by setting aside some of the bandwidth, at least 20 megahertz, where cognitive radios are free to operate

and continue to develop without causing interference to federal incumbents.

Other Comments

In regard to the power level proposals in paragraph 74 of the *FNPRM*, xG suggests that the use of peak power as the basis for power measurement instead of the more commonly used root mean square (RMS) power would unfairly limit the effectiveness of both Citizens Broadband Radio Service Devices (CBSDs) and end user devices, thus reducing the commercial incentive to design, develop and manufacture equipment for the 3.5 GHz band. Peak power measurement is ill defined and can treat different technologies unfairly which may unnecessarily result in slowing technical progress. As high efficiency and complex modulation methods are introduced, peak power measurement and overall power output become more complex requiring the Commission to ever more carefully define the testing criteria. A better solution would be to define a reasonable RMS power level and allow innovators to advance the state of the art without being handicapped by methodologies that were better applied to older and simpler technologies.

On the topic of interference, the theme running through the *FNPRM* is the need to protect federal incumbents and receivers from interference. However, little comment is made on the subject of mutual interference among authorized users. The Commission's approach is to control interference by controlling transmitter power and location proximity, as has always been the method in the past. Alternatively, xG has pioneered powerful interference mitigation techniques as part of its cognitive radio initiative. xG defines cognitive radio, not as a slave unit or "drone" controlled by a database driven central planning authority, but rather in terms of a smarter and much more resilient device that is able to communicate with other users of the spectrum fluidly and dynamically by using environmental awareness, tolerance to interference and the ability to, in effect, move away from other users through frequency agility. The advantage of cognitive

radios over remote controlled drone radios is that the network becomes more tolerant to database failure, severed links to the central planning system and instantaneous interference, whatever the cause. xG's commercially available, off-the-shelf equipment can demonstrate powerful interference mitigation characteristics, which simply cannot be achieved with the use of filters, spatial planning, and power reduction. These latter methods just waste system performance and harm commercial viability.

xG suggests, therefore, that where possible, incumbents should be required to retrofit digital receivers with modern interference mitigation techniques. Where not possible, exclusion zones would have to be used. In any event, all new devices, whether microcell, macrocell or end user device, should be required to incorporate modern interference mitigation techniques. Otherwise, the state of the art in interference mitigation will not be advanced.

CONCLUSION

With all due respect to PCAST, its members and its staff, the approach recommended for sharing of the 3.5 GHz band was old technology when it was proposed in July 2012; and it has become even more so now. Thus, the *FNPRM* proposes a 20th Century solution to a 21st Century problem. However, a 21st Century solution is at hand. Cognitive radio, as developed by xG and others, is undeniably the wave of the future in spectrum sharing and interference mitigation. The solution proposed by the Commission is not robust and is prone to failure when there is some accidental or intentional disruption of the link to the central database. Moreover, it fails to achieve full utilization of the spectrum. This is vital when one considers that the *FNPRM*, involving 100 megahertz, is just the next step in PCAST's plan for ultimate utilization of 1,000 megahertz of shared spectrum. If the entire plan is modeled entirely as proposed, with central control ultimately of 1,000 megahertz of critical nationwide infrastructure and devices

that must re-authorize every 60 seconds or at least report position and other data or face automatic de-authorization, the Nation could be only 60 seconds away from disastrous communications collapse. This would be avoided in a cognitive radio environment.

Accordingly, the Commission is urged to set aside at least 20 megahertz of spectrum for cognitive radio use, as proposed herein, to encourage and foster its continued use and development.

Respectfully submitted,

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