

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
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Amendment of Part 15 of the Commission’s Rules for Unlicensed Operation in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, and)	ET Docket No. 14-165
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Amendment of Part 74 of the Commission’s Rules for Low Power Auxiliary Station in the Repurposed 600 MHz Band and 600 MHz Duplex Gap)	
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)	
Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions)	GN Docket No. 12-268
)	

To: The Commission

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

xG Technology, Inc. (xG or the Company), by its representatives, hereby submits its response to the Commission’s *Notice of Proposed Rulemaking (NPRM)* in these proceedings, which seeks comment on the establishment of rules to govern unlicensed operation in the frequency bands that are now and will continue to be allocated and assigned to broadcast television services (“TV Bands”), including fixed and personal/portable white space devices and unlicensed wireless microphones. The Commission’s goal is to allow for more robust service and efficient spectral use without increasing the risk of harmful interference to authorized users. xG first presents the background of its technology. Its comments then examine the Commission’s proposal for interference avoidance in the to-be-shared TV Bands 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 xMax™ cognitive radio system is a breakthrough technological advancement in the radio art that has been proven to work as designed and developed by xG in Fort Lauderdale, Florida. Systems have been successfully deployed in both urban and rural settings, as well as in tests conducted by the U.S. Army.

The xMax™ system has a fast and easy setup when deployed. It eliminates frequency planning issues that arise in other traditional (non-cognitive) wireless networks that cause delays and consume valuable manpower. 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 that 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 (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 DSA feature. 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 TV Bands/600 MHz, 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

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.

eliminating self- interference.²

Another of its most important and unique advantages is that it is the only system to xG's knowledge that can use commercial off-the-shelf (COTS) devices from any cellular network that have either Wi-Fi, USB, or Ethernet connections, and still allow these devices to work on their original networks when either returned to service or when otherwise required.

Experience has shown that conventional technologies typically require extensive frequency planning, allow only the use of devices specifically designed to be used with the particular system and do nothing to mitigate electrical interference issues. In short, they are not flexible or adaptable enough as the circumstances change to perform adequately.

xMax™ is an all IP and VoIP system that has the advantages of light weight, portability, low power consumption, frequency versatility and interference avoidance and mitigation. It can also be used in conventional telecommunications systems to maximize frequency utilization.

General Comments

The *NPRM* proposes that operators of Part 74 devices register the times and locations of their operation in the TV Bands databases to obtain interference protection from TV white spaces ("TVWS") devices. xG submits that such databases are, alone, insufficient to achieve interference protection for both licensed and unlicensed users. Instead, xG proposes that the Commission consider current, commercially-available RF interference mitigation technology as a solution that actively resolves interference in real time for all spectrum users – licensed and unlicensed.

Licensed operators, such as users of Part 74 wireless microphones, may register the times and locations of their operation in the TV Bands databases to obtain interference protection from

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

TVWS devices. Unlicensed users must not cause interference, and additionally must accept interference encountered in the subject spectrum, as they obtain no interference protection from the databases. Alternative interference mitigation tools, therefore, will be critical for unlicensed users to facilitate delivery of quality service - in addition to providing active and real-time interference mitigation for licensed users, beyond the administrative protection of databases.

Furthermore, the Commission has stated that it would consider modifying the requirement for power restrictions on both licensed and unlicensed devices operating on adjacent channels “if parties develop options that would permit operations on first adjacent channels that would not increase the potential for interference to television service.” xG submits the xMax™ cognitive radio system, described above, for the Commission’s consideration in addressing a broad range of interference issues. In addition to delivering high-performance frequency agility in the form of DSA technology, the xMax™ system incorporates sophisticated interference mitigation (IM) algorithms that to date have defeated military jamming systems operating at over twenty times the xMax™ system’s power.

xMax™ is a cognitive MIMO radio with advanced interference mitigation capabilities that allows for significantly increased network density or base stations and/or user terminals. The radio system incorporates a cognitive engine that receives information on the relative performance of different receiver algorithms. This information is used to decide how best to use the antenna system and available DSP resources to maximize capacity, throughput or other network performance measures.

The xMax™ cognitive radio design and system architecture is inherently flexible, employing a “modular” RF interface; the xMax™ processor can be coupled with a radio module

to operate on frequencies, in its present configuration, from 300 MHz to 3.2 GHz. Modification of current xMax™ commercial products to accommodate operation in the TV Bands/600 MHz frequency spectrum can be accomplished by relatively simple and cost-efficient modification of the xMax™ software-defined radio platform.

If a database solution is employed as a means of interference mitigation for licensed TVWS device users, xG can support a software interface within its radio platform to access and utilize such a database, thereby providing a platform for both preventing and resolving potential interference issues that incorporates administrative controls and active, sophisticated IM in real time, available to both licensed and unlicensed device users.

Responses to Specific Proposals

Having described the xMax™ system and its capabilities, we are providing below our comments with reference to specific proposals by paragraph number of the *NPRM*:

Paragraph 25 – We agree with the proposal to end the prohibition of TVWS devices on the first two vacant channels above and below channel 37.

Paragraph 26 – We agree that at least one channel should be reserved for TVWS devices in each and every market.

Paragraphs 27 & 28 – We agree that operation on TV channels 3 and 4 by fixed TVWS devices should not be prohibited where such channels are vacant and further suggest that such prohibition to mobile devices is not warranted as well, for the reasons set forth by the Commission.

Paragraphs 30 & 31 – We agree that portable/personal TVWS devices can and should be used on channels 14-20.

Paragraph 32 - We further agree that there is no reason to prohibit personal/portable TVWS device operation on channels 7-13.

Paragraph 37 – We agree that fixed TVWS devices should continue to operate with four watts EIRP where at least two contiguous channels exist, provided such devices comply with all fixed white space requirements with respect to the six megahertz band in which they operate.

Paragraph 43 – We submit that the cost and complexity of TVWS devices could be reduced if the device simply reports its geographic coordinates to the database and the database then responds with the list of available channels and power limits.

Paragraph 44 – We agree that especially in rural areas, the maximum antenna height and power should be increased to allow for better service to underserved rural customers.

Paragraph.48 – We submit that the four-watt EIRP limit is too limited to make service for rural customers cost effective. We believe a power increase of at least 6 dB should be allowed where the interference profile makes sense.

Paragraph 50 – We agree that the higher power levels would help rationalize offering wide area service to rural customers but that even 10 watts EIRP is insufficient in many rural areas. We believe large areas of geography can be easily identified where a 16-watt limit would be justified. We accordingly suggest a 6 dB power increase should be made to the conducted power limits, setting the upper limit to 16 watts EIRP with variable intermediate power levels set by geographic sensitivity to the interference profile. Thus, a real opportunity would be created to finally serve underserved rural areas by creating economic incentives.

Paragraphs 55 & 56 – We agree that channel bonding is good practice and elimination of the 6 MHz out-of-band limits with respect to contiguous use of adjacent channels is appropriate. We would however object to channel bonding that occupies all of the available channels, leaving no spectrum for diverse users.

Paragraph 188 – We disagree with the re-check / re-authorization paradigm currently in use with reference to TVWS devices. In order for these devices to be commercially viable, a reliable service must be offered through them. Critical communications may in the future take place through these devices and their networks. Thus, if the Commission requires all devices to essentially go dark soon after loss of communications with the database, vast amounts of critical communications could conceivably be lost.

It is possible that connection to the databases could be interrupted, potentially for a lengthy time period by acts of God, terrorist attack or simple human error. Given that these TVWS devices, systems and networks will have a built in self shutdown due possibly to an event hundreds or thousands of miles away, commercial, government, public safety and other customers who expect high reliability might not subscribe to the service thus damaging the prospects and development of the industry before it starts.

Because interference profiles don't change much over the short term, there is no reason to

arbitrarily choose such a short shutdown period. We submit that there is no harm in allowing the devices to continue to operate for up to 30 days in the event of a database failure, allowing time for the database access to be restored. Wireless microphone operations would be protected because without connection to the database, TVWS device would be unable to change frequency. The entirety of the TVWS inventory would be frozen into the last set of authorizations until database connection is restored. We believe the Commission is failing to consider the ramifications of database failure solely in the effort to protect wireless microphones.

Conclusion

xG applauds the obvious intense effort of the Commission's staff as reflected by the thoughtful proposals in these proceedings to make operation of unlicensed TVWS devices more capable and effective in terms of providing higher power, longer range, more channel capacity and higher effective throughput. These actions will help to accelerate development of such devices and systems. The public necessity of more choices for wireless broadband data is increasingly apparent and, if adopted, many of these proposals will greatly serve the public interest. We especially urge the Commission to reconsider the very short re-authorization schedules to which these devices are subject in order to maintain local, regional and national network viability in the event of loss of database access. We believe a 30-day grace period should be allowed whenever access to the database is lost. This small change will ensure critical infrastructure to remain viable for at least some time following a catastrophic Internet interruption.

Respectfully submitted,

xG TECHNOLOGY, INC.

/s/ Harold Mordkofsky

By: Harold Mordkofsky
Its Attorney
Blooston, Mordkofsky, Dickens,
Duffy & Prendergast, LLP
2120 L Street, NW
Washington, DC 20037
Email: halmor at bloostonlaw.com
Tel. (202) 828-5520

By: George F. Schmitt, Chairman
xG Technology, Inc.
7771 West Oakland Park Boulevard
Sunrise (Ft. Lauderdale), FL 33351
Tel. (954) 572-0395

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