February 5 , 2014

To:

Federal Communications Commission
Office of Engineering and Technology
445 12TH ST SW
Washington DC 20554

Phone: +1-202-418-2470
Fax: +1-202-418-1944
E-mail: oetinfo@fcc.gov

CC:

Federal Communications Commission
Office of Engineering and Technology Laboratory Division
7435 Oakland Mills Rd
Columbia MD 21046-1609

Phone: +1-301-362-3000
Fax: +1-301-362-3290

Online: www.fcc.gov/labhelp

http://transition.fcc.gov/oet/contact/

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755

Subject: Answers to FCC technical questions for devices operating in the 3650-3700 MHz band

Hello,

The purpose of the document is to answer the required questions as appeared on the FCC guidelines document "552295 D01 CBP Guidance for 3650 3700 Band v02r01", to enable certification of the product 'BreezeCOMPACT1000', for an unrestricted certification under Part90Z (3650-3700 MHz band).

The product is an all in one high capacity base station with 4Tx/4Rx radio and 4G baseband modem . The BreezeCOMPACT1000 is IP services oriented Broadband Wireless Access system.

BreezeCOMPACT1000 is based on WiMAX technology and future upgradable to TD-LTE, the system is TDD system covering 3400MHz up to 3700MHz range. The system contains an all outdoor base station unit.

*WiMax is a designation under the WiMax Forum for certified compliance based upon the harmonized IEEE 802.16/ETSI HiperMAN standard.

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755

The following are the answers & questions according to the FCC guidelines documents:

2 Unrestricted Certification under Part 90Z (3650-3700 Band)

In order to ensure that a device complies with the requirements of unrestricted contention based protocol, the following information should be provided in the application.

2.1. Unrestricted Protocol Description

Address the key requirements for operation using unrestricted contention based protocol. Please note that this requires recognizing other systems (both similar to yours and different from yours) that operate on a co-channel. Indicate the strategy for sharing the spectrum in terms of:

Does the system use spectrum sensing to determine if the other devices are transmitting and then find ways to share the bandwidth, or have some other strategy?

Telrad's BreezeCOMPACT base station implements a channel collision sensing mechanism. The system performs a "listen before transmit" function at system startup (channel availability check) and monitoring the channel during its regular listening periods. The system will detect (both at startup and on normal operation) if another system , using any technology, is transmitting on the same frequency bandwidth, regardless of the type of transmitting protocol, raising a proper alarm and evacuate the channel as long as the channel is occupied, restarting the "listen before talk" mechanism.

Upon alarm, the operator may manually set the base station to a new non-busy channel, always restarting the "listen before talk" mechanism.

Because of radio planning considerations, the system designed not to change automatically the carrier frequency to a new non-busy channel.

2.2. Threshold detection to determine occupancy

2.2.1. Describe how your system determines if another system is using the spectrum. At what detection level – relative to 0 dBi receive antenna gain (busy channel threshold), does the device determine if another system is operating on the spectrum?

The system is using a noise and interference estimation algorithm during the period which its received path is enabled.

As for TDD, the system is scheduled to transmit only on the DL-subframe which its duration is about 3mili-seconds (the total frame length is 5 mili-seconds) and only if no other system was detected for using the spectrum.

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755

On start up or for any case of changing RF frequency or after evacuate the channel from any reason, the system assumes by default that the channel is “busy”, therefore the system will restart the “listen before transmit” mechanism, waiting for the channel to be “clear” before attempting any transmission (e.g. the noise & interference RMS power is below the “clear” channel threshold level).

The system will evacuate the channel, once it will determine that the channel is “occupied” where as the noise & interference level exceed the “busy channel” detect threshold level.

The “busy-channel” detection threshold levels may be configurable by the operator with a valid range of -92dBm to -75dBm, set by default to a level of -87dBm.

The “clear-channel” detection threshold level is set with an offset of 3dB lower than the “busy-channel” threshold, with a valid range of -95dBm to -78dBm,set by default level of -90dBm.

The thresholds levels are actually the measured interference and noise RMS power [dBm] over all the configured bandwidth, as measured on the antenna port, relative to 0 dBi receive antenna gain.

The default thresholds levels are similar for all supported BW configurations.

2.2.2 How long does the system observe to determine if the channel is busy – at the initial time and in between communications?

On initial time and also in between communications the system monitors the channel for a scanning period time of 50 mili-seconds, before deciding if the channel is busy or clear.

2.2.3 What is the bandwidth being monitored versus bandwidth occupied for all modes of operation?

The system is monitoring the entire occupied bandwidth.

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755

2.2.4 How much variability is provided to the system operator to adjust busy channel detection threshold?

The system operator can adjust the busy channel detection threshold between -92dBm to -75dBm. The default busy channel detection threshold level is -87dBm.

The clear channel detection threshold is with an offset of 3dB lower than the busy channel detection threshold with a default level of -95dBm.

2.2.5 What is the operating system threshold (receive threshold) compared to the monitoring threshold (busy channel threshold)?

The operation target level of the received signal power is depends on the selected modulation type, BW and other parameters controlled by the rate adaption and power control mechanisms.
For example, for BW of 10MHz, the sensitivity level of base station varies between -95dBm for MCS of QPSK code rate of 1/2 and -76dBm for 64QAM code rate of 5/6.

The default “clear” threshold is -90dBm (valid configurable range of -78dBm to -95dBm).
The default “busy” threshold is -87dBm (valid configurable range of -75dBm to -92dBm).

2.2.6 What additional checks does the system perform to determine if the spectrum is being used before initiating a transmission?

The system scan the channel over all the used BW and over the scanned period in order to verify that the channel is clear before initiate a transmission. The noise & interference detection mechanism creates an histogram of the noise & interference power levels over the scanned period and verify that the maximum detected noise & interference level is below the required threshold, before initiate any transmission.
Therefore, the existence of any short interference pulse or narrow band interference over the scanned period will be detected by the mechanism.

2.2.7 Does the master and the client perform the threshold detection? If master only performs the detection, how does it determine if the client may interfere with the other system (hidden node detection mechanism)?

Only the base station performs threshold detection.

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755

As the used protocol is a scheduled TDD, the overall interference of the remote clients on the other system is marginal, as explained below.
The remote clients may be scheduled for UL grant only during the UL-subframe duration, which is about 1.5 mili-seconds from the total frame length of 5 mili-seconds.

The UL grants are shared between all the occupied clients, therefore the BS scheduler mechanism, allocates only a fractional of the UL frequency/time resources for each user.

The UL power control mechanism is targeting the clients to be received on the BS with the minimal power achieving lowest noise raise on the site with a stable link.

All the clients are distributed over a large geographical area, lowering the probability for an event which many clients will interfere on the same time/frequency to the foreign system, required those clients to transmit any UL traffic and which its antennas are directed to that foreign system antennas.

2.3.1 What action does your system take when it determines occupancy? Does it vacate the channel or does it have some back-off and retry strategy? What is the impact of traffic on the spectrum sensing or avoidance performance?

When the base station detects that the channel is occupied, it will stop transmitting and raise an alarm to the operator.

It is up to the operator to decide whether to reset the system to a different channel (and again, perform listen-before-talk before starting transmission), or keep the system waiting (without transmitting) till the channel would be cleared.

In any case, the system will not transmit until the channel is cleared.

Traffic has no influence on the spectrum sensing since the noise and interference estimation algorithm can distinguish between energy coming from our own users, and energy coming from external sources.

2.3.2 If you use other means, please describe how the device determines the existence of other systems and what steps it takes to either share the channel or avoid its use.

Not applicable, as the system uses spectrum sensing, as described above.

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755

2.3.3 Describe any mechanism that would limit a transmission from a remote station if only the master detects occupancy (hidden node avoidance mechanism).

As the product uses a scheduled protocol, therefore if the base station stops transmitting, the client will not receive the necessary control information and will also stop transmitting.

Once the spectrum usage is clear to be used, the base station will resume its transmission and only then the clients will re-connect to the base station and may safely receive UL grants.

2.4.1 When describing occupancy profile, clarify any differences between start-up acquisition mode of spectrum and operational modes.

At initial start-up the system assumes the channel is busy and will listen to the channel over the scanning period of 50 mili-seconds in order to determine whether the channel is clear or not before starting transmission.

In case the channel is busy, it will continue to listen to the channel, not enable the transmission till the channel will be cleared.

In operational mode, the system algorithm is similar as on initial start-up, where the channel will be monitored every frame for the existence of another system using the spectrum, reporting about the channel status on the end of the scanning period.

2.4.2 In operational mode, how long does the system transmit before stopping giving others a reasonable time to transmit before continuing?

As the used protocol is TDD, the base station transmit only during the DL-subframe which its duration is about 3 mili-seconds (the total frame length is 5 mili-seconds), allowing other systems a reasonable time to join the channel during the remaining frame time (2mili-seconds). While on receive mode, the system keeps sensing the channel for the existence of any other system, vacating the channel in case of sensing one within up to 50 milli-seconds.

2.4.3 Does the system (master and / or client) listen prior to every transmission? If no, explain.

Yes it is.

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755

2.4.4 Describe how the operational spectrum usage (on air time) is dependent on system load conditions (no load, typical and overload). For example, if a station does not have any information to transmit describe any regular or recurring transmission that may take place?

The BreezeCOMPACT base station is a scheduled system which defines its frame builder, downlink and uplink zones and load according to the traffic needs.

Regarding the DL zone, the base station always transmits a synchronization signals, while as for cases which a maximum downlink traffic load is required, the total transmitted power is increased by extra of ~4dB (relative to a condition where no DL traffic load is required).

Regarding the UL zone, the frequency-time resources are shared by all available CPE on the site. If UL traffic grant is required by a certain client, it shares the available frequency-time domain resources with all other available CPEs (up to 512 users per site).

When no load is required, the CPEs are very rarely transmitting a weak and short synchronization signal on the beginning of the uplink zone (occupying only a fraction of the frequency-time domain). The power-control mechanism of the base-station regulates the CPE's transmission power, in order to maintain the lowest noise raise on the site.

Any traffic load, even on the maximum level, will not influence the channel detection capabilities.

2.4.5 Describe if there are any limitations imposed by the contention protocol on what applications are used (i.e. limitations on Quality of Service).

The system does not impose any QOS limitations for enabling the contention protocol.

2.4.6 Describe how applications or configuration of services can affect spectrum usage. To describe your occupancy sharing capability, you can assume that two systems on a co-channel are the same (your systems being described). How would they share the spectrum?

The standard facilitates spectrum sharing between the same systems by synchronizing timing, frame duration and downlink to uplink ratios across various equipment providers.

In addition, the standard provides the ability to allocate different frequency sub-bands (when the two stations are using the same frequency bandwidth) in designated timeslots, which eliminates co-channel interference.

Telrad Networks Ltd.

1 Bat Sheva Street , LOD 71100, ISRAEL, P.O.Box 228

Reception: 972 -732467474, **R&D:** 972 -732467225, **Fax:** 972-732467755