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Federal Communications Commission

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RE: FCC ID: YETCELFI-RS240WU
Form 731 Confirmation #: EA272711
Correspondence Reference Number: 40891

Attention: Jyun-Cheng Chen

Please find our response to your questions on this application below in blue:

1. The application form is still incomplete as of today. Please check your requested frequency range listing. The device is certainly operating in more than the 5150-5250 MHz band requested on the Form 731. In addition, please confirm the two changes I made for you: Part 27 Emission Designator (per your request) and the related FCC ID on the Part 15 application form (Equip. Specs. 2). The latter had mistakenly listed itself as a related FCC ID, causing the system to show error message whenever trying to save the application. Let me know if both changes are acceptable to you.

   You are correct. A second line entry with a frequency range of 5268-5303 MHz with output power of 0.054W and Part 15E should have been included on the form. The change to the Part 27 Emissions Designator and the related FCC ID on the Part 15 application are acceptable.

2. The e-mail from NTIA is acceptable.

   Noted

3. Please check Page 2 of the MPE calculation. It clearly states that the MPE calculations are based on only 1 WCDMA channel instead of 3. In addition, please clarify if the UNII band transmission does include the payload (i.e., the 4 WCDMA channels) plus the two OFDM control channels. The MPE report seems to indicate only 1 OFDM channel is used in the MPE calculations. A total of 6 channels are carried on the WU-to-CU link according to the Theory of Operation.

   The listed power values for the calculation includes the 3 WCDMA “sub” channels, so the calculated MPE values are correct. For the OFDM link, the listed power includes the 6 “sub” channels. We listed it as one channel that included all sub channels. A revised MPE calculation exhibit has been uploaded with an explanation of this.

4. Page 35 of FCC 06-96 states that "For master devices, indicate how the master provides, on aggregate, uniform channel loading of the spectrum across all channels." Therefore, it is the loading/usage that needs to be uniform in order to "avoid dense clusters of devices operating on the same channel" (Page 2 of FCC 06-96). The description in the Theory of Operation appears to indicate that while

the initial channel selection is random, the selected channel would be occupied until power cycle or a radar signal is detected. For a cellular network access device, power cycle is a rare event. Please justify the current design meets the above uniform channel spreading rule.

The operation in Cel-Fi is as follows:

a) Each Cel-Fi at power up performs random (with uniform distribution) selection of channels to operate on. On the two selected channels CAC is performed. If they are radar-clear channels, the channels are selected for operation. If one or both are not radar –free, then random selection is repeated until two radar-clear channels are found. During operation ISM is done continuously on them. If radar is detected, the channel is vacated and once again a new channel is picked randomly (with uniform distribution over the remaining channels). This is also true if the units are power cycled. Coming out of a power cycle – channel selection is once again random
b) It is true that this procedure can result in a channel being occupied for long durations. However, this behavior is no different that DFS/ Radar compliant 802.11n devices. These devices, as Cel-Fi, adhere to the spirit of the standard and select their channels randomly with a uniform distribution. Once selected, any one access point stays on the same channel for a prolonged time.
c) However, that said, the intent of FCC 06-96 is indeed valid and is fully met in letter and in spirit by Cel-Fi. If 100 Cel-Fis are powered on – each does the channel selection procedure independently and randomly (over a uniform distribution over available channels) and over the ensemble (of Cel-Fis) the channels occupied would be uniformly spread and there would not be dense-clustering onto any one given channel. This pattern of behavior and uniform loading over the ensemble will continue as the normal asynchronous time events (such as power cycling) occur over time.
d) Again – the way 802.11n AP meet this specification is identical – i.e. over an ensemble the distribution of occupied channels is uniform while any given AP stays on its channel for significant durations

5. The objective of the network closed loop power control is actually to balance signals received from various UEs separated by the orthogonal spreading codes. Therefore, the power level is not necessary the minimum required to maintain the link quality. The design seems to provide a fixed repeater gain and thus basically follow the network power control. This is not truly the ATPC required by 27.50(d)(4). Could the applicant elaborate further on its claim of compliance?

Two issues are worth clarifying:

a) The first is that since Cel-Fi is a bi-directional repeater. It provides fixed gain in either direction that enhances coverage while staying unconditionally stable. The gain in both directions is the same – so that Cel-Fi does not interfere with the macro Network’s link balancing etc. As such, Cel-Fi is not involved in the power control on the cellular link.
b) That said, however, the cellular networks power control does indeed control the power of each user to the minimum power necessary. The comment above

is indeed correct as applied to the uplink of the cellular link. However, the power control algorithm in WCDMA serves two purposes

i. Equalizing received power at the NodeB input (as mentioned above). This mitigates near-far problems and makes sure all users can close their links regardless of distance from the NodeB so long as the UE have power to do so
ii. Keeping the NodeB Rise-Over-Thermal (RoT) to the lowest given these set of users. The second is not a link-level issue. Rather it is a NodeB capacity management issue. When RoT at the NodeB reaches a certain threshold, the system hits “pole capacity” and the system cannot admit any more users due to uplink interference limitation. Thus, to maximize network capacity, the NodeB also makes sure that not only are all UEs received at the same level, but rather they are received at the same, minimum power level that is adequate to maintain the link. Hence the inner-loop is constantly monitoring if the BLER target is being met with too much margin and, if it is, pushes the UE towards lower power
iii. As an example – consider a NodeB with integrated noise of -104dBm/5MHz. Consider the case when 10 UEs are each being received at -115dBm and that this level is adequate to maintain the link (processing gain pushes the SNR to positive numbers). In this case, the integrated power at the NodeB is -101.5dBm and RoT is 2.5dB (-101.5 – (-104)). If only equal power is the NodeB desire, then it should not matter if all UE are received instead at -110dBm. Again each can close its link. However, in this case total integrated power is -98.5dBm. In this case the RoT is 5.5dB. Although these 10 users may be well served, the ability of the network to admit more users is much higher when the RoT is 2.5dB than when it is 5.5dB.
iv. Hence power control not only manages near-far issues, it also manages capacity issues
v. For similar downlink capacity (and NodeB power) reasons, the power allocated to each user in the downlink is brought down to the minimum needed to maintain the link.
vi. So, although the presence of Cel-Fi is transparent in the cellular power control loop, the loop indeed brings power down to the minimum needed. This way near-far problems are avoided while network capacity is maximized.

6. PAPR data acceptable. However, test procedure and parameters (how are data arrived) should be described in addition to test result.

   a) The units are tuned to transmit 3 contiguous UMTS channels at f_c, f_c + 5, fc-5 MHz.
   b) The transmit power is set to maximum per channel and hence in aggregate
   c) The transmitted waveform is TM1 (Test waveform with highest PAPR)
   d) The transmitted waveform is connected to a spectrum analyzer in a conducted fashion

e) The spectrum analyzer is set to power measurement mode with the following parameters
   a. Tuned to f_c (CU is set to 2147.5MHz) (WU is set to 1747.5MHz)
   b. Span of 30MHz
   c. Power measurement bandwidth set to 15MHz around f_c
   d. RBW set to 270kHz
   e. VBW set to 2.7MHz (>> RBW => no video averaging)
   f. Sweep time set to 10s (so dwell time on each of the 601 points is adequate)
   g. Average power measurement is done with RMS detector
   h. Peak power measurement is done with Peak detector

f) The PAPR is the difference between the peak and average power measurements

7. Explanation in the revised Theory of Operation is acceptable.

   Noted

Regards,

David W. Bare
Chief Engineer

DWB/dmg