IEEE P802.18
Radio Regulatory Technical Advisory Group (RR-TAG)

Proposed Response to MIIT of China Consultation on "Ultra-Wideband (UWB) Equipment Radio Management Regulations"

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This document drafts a response to MIIT of China consultation on new UWB regulations, especially new spectrum limits. Consultation is introduced in contribution IEEE 15-23-0023-02-04ab (link).

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Re: Consultation on the "900MHz Frequency Band Radio Frequency Identification (RFID) Equipment Radio Management Regulations (Draft for Comments)" and "Ultra Wideband (UWB) Equipment Radio Management Regulations (Draft for Comments)"

Dear MIIT,

IEEE 802 LAN/MAN Standards Committee (LMSC) thanks Ministry of Industry and Information Technology (MIIT) for issuing the consultation on the "Ultra Wideband (UWB) Equipment Radio Management Regulations (Draft for Comments)" and for the opportunity to provide feedback on this topic.

IEEE 802 LMSC is a leading consensus-based industry standards body, producing standards for wireless networking devices, including wireless local area networks ("WLANs"), wireless specialty networks ("WSNs"), wireless metropolitan area networks ("Wireless MANs"), and wireless regional area networks ("WRANs"). We also produce standards for wired Ethernet networks, and technologies produced by implementers of our standards are critical for all networked applications today.

IEEE 802 LMSC is a committee of the IEEE Standards Association and Technical Activities, two of the Major Organizational Units of the Institute of Electrical and Electronics Engineers (IEEE). IEEE has about 400,000 members in over 160 countries. IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity. In submitting this document, IEEE 802 LMSC acknowledges and respects that other components of IEEE Organizational Units may have perspectives that differ from, or compete with, those of IEEE 802 LMSC. Therefore, this submission should not be construed as representing the views of IEEE as a whole[1].

Please find below the responses of IEEE 802 LMSC to the "Ultra Wideband (UWB) Equipment Radio Management Regulations (Draft for Comments)".

IEEE 802.15-based UWB devices

IEEE 802.15 standards specify Ultra-Wideband technology operation, which is finding adoption for numerous short-range sensing and ranging applications. IEEE Std 802.15.4-2020 [1] and IEEE Std 802.15.4z-2020 [2] are standards for precision ranging that are already capable of using both the 6 GHz and 7 GHz frequency bands and are increasingly used in many high value applications. The capability of IEEE Std 802.15.4z-2020 to support secure ranging has led to a renewed interest in UWB from both industry and regulators. The automotive industry was the driving force behind IEEE Std 802.15.4z-2020 and also the first to include UWB in consumer products. Mobile handset makers have followed closely. This is generating significant economic and social value, attracting further interest which is demonstrated by the participation in the IEEE 802.15.4ab task group in IEEE 802 LMSC that is developing future UWB standards.

The fact that UWB is now in consumer products has led many regulators to review the existing regulations [3]. Many countries that previously did not have UWB regulations are now introducing

[1] This document solely represents the views of IEEE 802 LMSC and does not necessarily represent a position of either the IEEE or the IEEE Standards Association.

them, while other regulatory bodies such as CEPT have added capabilities in response to industry demand, e.g., by introducing fixed outdoor transmissions, which were not permitted in Europe, and allowing an extra power of 10 dB for indoor operation.

Concern on the reduction of spectrum available to UWB

IEEE 802 LMSC appreciates MIIT's review of its UWB regulations and suggests that the outcome should not reduce the amount of spectrum available to UWB. There have not been any reports of low power UWB systems causing interference to other systems anywhere in the world, so this reduction of spectrum does not seem necessary to protect other spectrum users.

Throughout the world, license-exempt spectrum allocation between 6 GHz and 7 GHz has provided significant value. Both UWB and RLAN based on IEEE 802 wireless standards are examples of such applications. Restricting UWB to frequencies above 7125 MHz will prohibit access to a very popular IEEE HRP UWB PHY channel, channel 5. IEEE 802 LMSC would therefore suggest to MIIT to consider keeping the existing 6 GHz to 9 GHz allocation.

Comments on the proposed power spectrum density mark

IEEE 802 LMSC suggests MIIT consider aligning the proposed requirements on the power spectral density mask with those in IEEE Std 802.15.4-2020 [1]. Alignment with the spectral masks in the standard would give benefit in terms of availability of products, time to market, and international harmonization.

The proposed band cut-off frequencies come close to those required for IEEE HRP UWB PHY channels 8, 9, and 10, but extra spectrum is required to take into account the roll-off for 500 MHz width transmissions. Section 15.4.5 of IEEE Std 802.15.4-2020 [1] specifies that

> *The transmitted spectrum shall be less than –10 dB relative to the maximum spectral density of the signal for* $0.65/T_p < |f - f_c| < 0.8/T_p$ *and –18 dB for* $|f - f_c| > 0.8/T_p$.

For IEEE HRP UWB PHY channels 8, 9 and 10, T_p equals 1/499.2 MHz. The center frequencies, f_c, defined in [1] are shown in Table 1 for reference:

Chan-nel	Lower -18 dB point [MHz]	Lower -10 dB point [MHz]	Center fre-quency [MHz]	Upper -10 dB point [MHz]	Upper -18 dB point [MHz]
8	7088.64	7163.52	7448.0	7812.48	7887.36
9	7587.84	7662.72	7987.2	8311.68	8386.56
10	8087.04	8161.92	8486.4	8810.88	8885.76

Table 1: Power spectral density limits defined in clause 15 of IEEE Std 802.15.4-2020 [1]

Figure 1 shows the power spectral density masks between the proposed regulation and those defined in [1] for IEEE HRP UWB PHY channels 8 and 10. Note that Channel 9 is left out intentionally to improve the clarity of the figure.

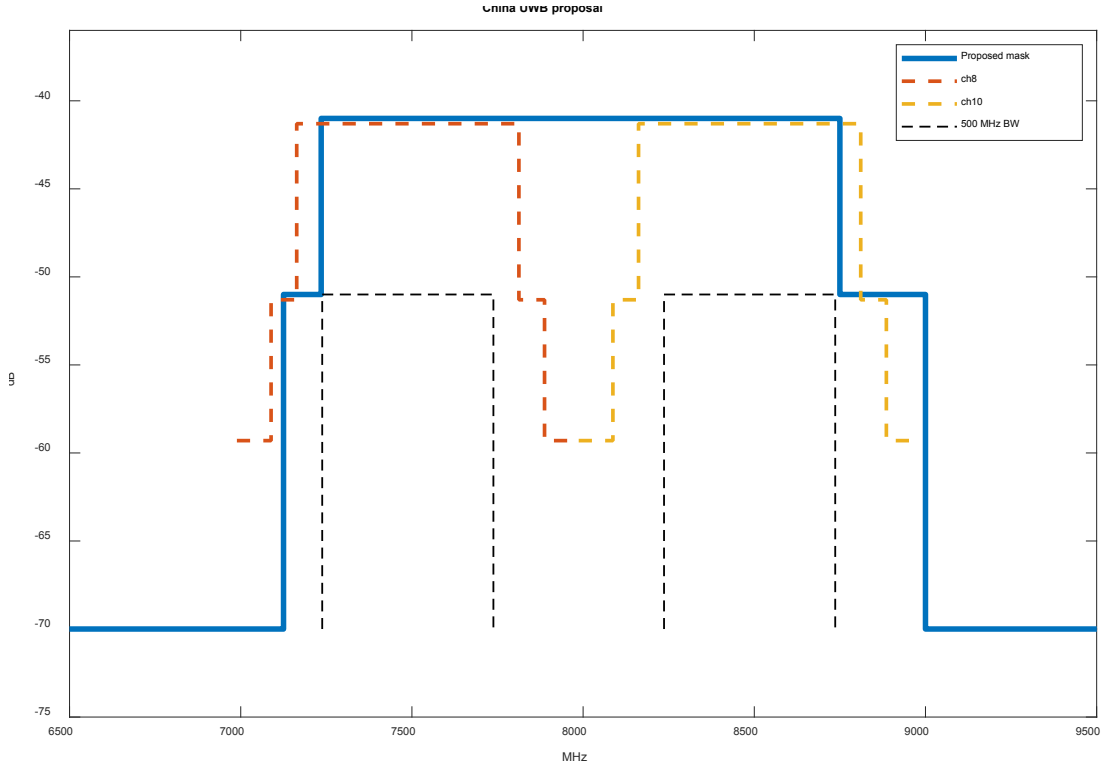

Figure 1: Comparison of the power spectrum density mask between the proposed regulation of China MIIT (i.e., "Proposed mask") and the requirements defined in IEEE Std 802.15.4-2020 [1] for IEEE HRP UWB PHY channels 8 and 10 (i.e., "ch8" and "ch10").

Figure 1 illustrates two issues with the proposed power spectrum density mask with respect to the IEEE Std 802.15.4-2020. First, the power spectrum density mask defined in IEEE Std 802.15.4-2020 does not fit inside the proposed limits. Secondly, the -10 dB minimum bandwidth is defined to be 500 MHz without any extra spectrum to take into account the roll-off. The figure shows that meeting the minimum bandwidth requirement (staying above the dotted black line of "500 MHz BW") and, at the same time, staying within the proposed emission limits (under blue line of "Proposed mask") using the UWB channels defined by [1], is impossible with a practical implementation.

For comparison, Figure 2 shows the power spectral density mask of channel 5 and the existing European regulatory emission limits [4] at band edge. This could be used as a reference for possible limits. The European limit at 6 GHz is not very relaxed by any means, but it does allow a feasible implementation. The 500 MHz minimum bandwidth limit is presented in the figure for reference, but it is not a requirement in Europe.

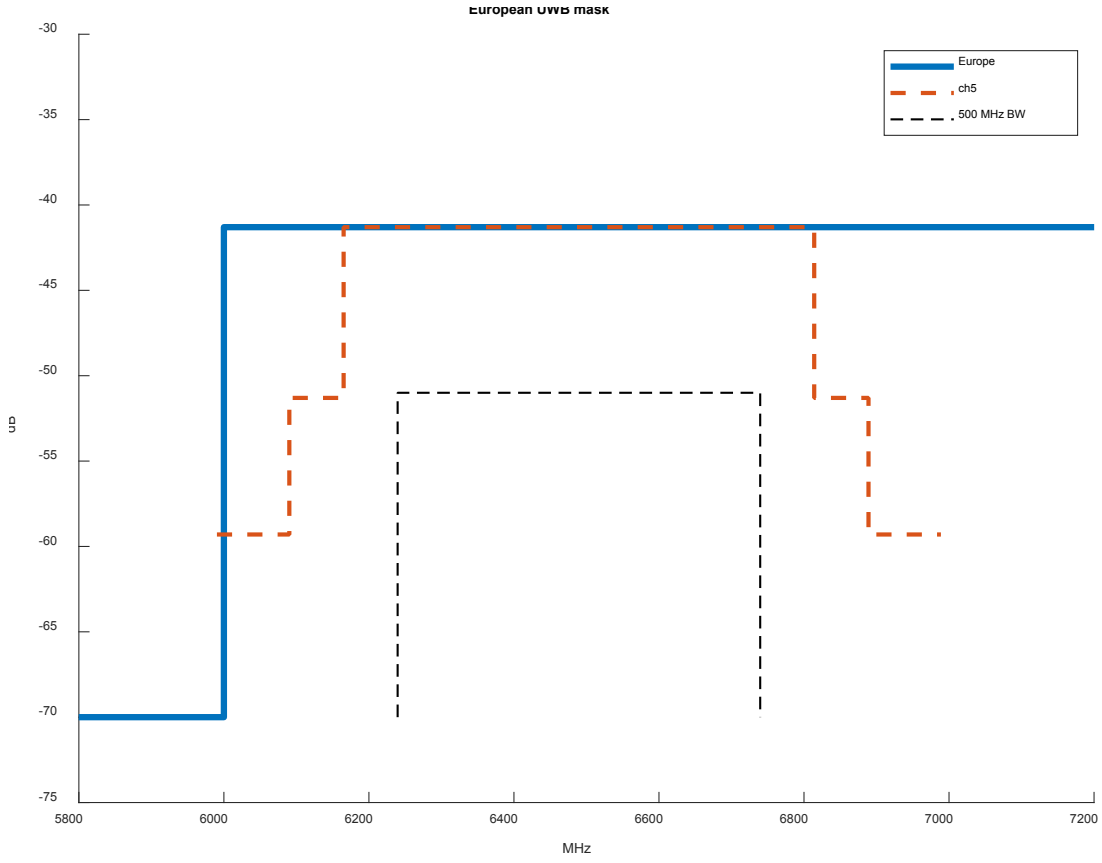

Figure 2: Power spectrum density of the IEEE HRP UWB PHY channel 5 with center frequency of 6489.6 MHz (i.e., "ch5") and the European band edge limits at 6 GHz (i.e., "Europe")

Given the center frequency of the IEEE HRP UWB PHY channel 5 is equal to 6489.6 MHz, the European rules define a frequency separation of 489.6 MHz from the center frequency to the band edge with -70 dBm/MHz limit. In order to enable use of the IEEE HRP UWB PHY channel 8 with the center frequency of 7488 MHz in China, the corresponding separation for channel 8 would require the lower -70 dBm/MHz band edge not to be higher than 6998 MHz. It is worth noticing that the -51 dBm/MHz limit does not exist in [4]. If it is considered necessary, it should not be stricter than the spectrum mask defined in the IEEE Std 802.15.4-2020, which would set the -51 dBm/MHz limit at 7163 MHz or below.

Similar expansion of the available band would be needed for the upper UWB band limit to enable IEEE HRP UWB PHY channel 10 with the center frequency of 8486.4 MHz, where a -70 dBm/MHz limit would be set to 8976 MHz or above, and the possible -51 dB/MHz limit at or above 8810 MHz.

Table 2 summarizes the IEEE 802 LMSC's proposed emission limits that allow the use of IEEE HRP UWB PHY channels 8, 9, and 10 in China.

Frequency range	EIRP limit
Below 6998 MHz	-70 dBm/MHz
6998 MHz – 7163 MHz	-51 dBm/MHz
7163 MHz – 8810 MHz	-41 dBm/MHz
8810 MHz – 8976 MHz	-51 dBm/MHz
Above 8976 MHz	-70 dBm/MHz

Table 2: Emission limits that would allow the use of IEEE HRP UWB PHY channels 8, 9, and 10 in China

Conclusion

IEEE 802 LMSC thanks MIIT for the opportunity to provide this submission and kindly requests MIIT to take into account our responses in its decision towards the UWB regulation.

Respectfully submitted

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References:

[1] "IEEE Standard for Low-Rate Wireless Networks," in *IEEE Std 802.15.4-2020* (Revision of IEEE Std 802.15.4-2015), vol., no., pp.1-800, 23 July 2020, doi: 10.1109/IEEESTD.2020.9144691.

[2] "IEEE Standard for Low-Rate Wireless Networks--Amendment 1: Enhanced Ultra Wideband (UWB) Physical Layers (PHYs) and Associated Ranging Techniques," in *IEEE Std 802.15.4z-2020* (Amendment to IEEE Std 802.15.4-2020), vol., no., pp.1-174, 25 Aug. 2020, doi: 10.1109/IEEESTD.2020.9179124.

[3] FiRa Consortium: Unleashing the Potential of UWB: Regulatory considerations, August 2022. Available online [accessed: 23 January 2023]

[4] Decision (EU) 2019/785, 14 May 2019. Available online [accessed: 23 January 2023]