IEEE P802.11
Wireless LANs
RF Lighting

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1.0 Abstract

The following paragraphs describe an alternative to the limit on in-band emissions of 20 mV/m @ 3 m for RF lighting devices already proposed by the Part 15 Interests. In an effort to provide the promoters of RF lighting devices with a viable alternative, it is proposed that a 5 MHz portion of the ISM band be reserved for higher powered emissions from RF lighting devices. It is further proposed that this band be located at 2478.5 - 2483.5 MHz. RF Lighting devices shall be restricted to the Part 15 Class A limit of 60 dBuV/m @ 3m in the remainder of the 2.45 GHz ISM band.

As described below, this new proposal represents an attempt to balance the competing interest of the promoters of RF lighting devices, manufacturers and users of WLAN equipment, and users of satellite services in the 2483.5 - 2500 MHz band.

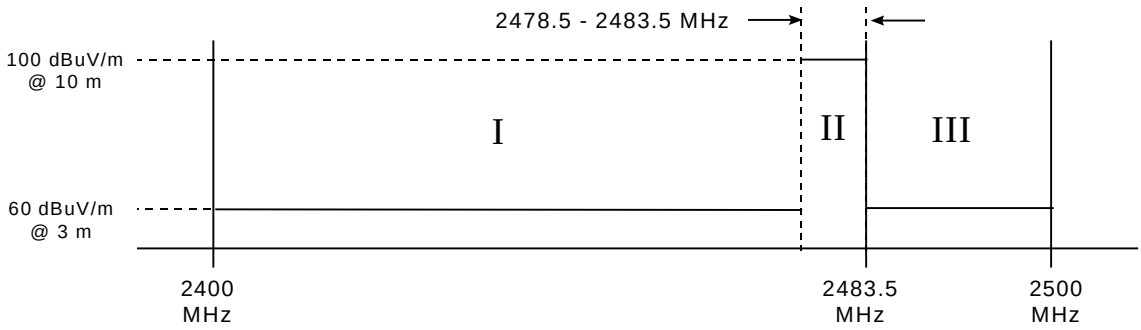
2.0 Proposed RF Lighting PSD

A proposed power spectral mask for RF lighting is shown in Figure 2.0-1 The 2400 - 2500 MHz ISM band is divided into three regions:

Region I: 2400 - 2478.5 MHz. This portion of the band has a limit of 60 dBuV/m @ 3 m, which is consistent with Part 15 Class A limits

Region II: 2478.5 - 2483.5 MHz. RF lighting emission limit in this region should be limited to 100 dBuV/m @ 10 m (equivalent to 330 mV/m @ 3m).

Region III: 2483.5 - 2500 MHz. Emissions limited to same level as Region I.



Region I : 2400 - 2478.5 MHz. RF lighting restricted to Part 15, Class A limit.

Region II : 2478.5 - 2483.5 MHz. RF Light emission limit of 100 dBuV/m @ 10 m (equivalent to 330 mVm @ 3m). Consistent with CISPR15 limits.

Region III : 2483.5 - 2500 MHz. RF lighting restricted to Part 15, Class A limit. This portion of the band includes satellite services.

Figure 2.0-1 Alternative Proposal for In-Band Emissions from RF Lights

3.0 Impact on Interested Parties

The proposed limit is technically feasible, but requires compromise by all interested parties. The magnetron sources used to excite the sulfurous light-emitting compound used in RF lighting devices are inherently ***narrowband*** devices. It is the use of half-wave rectified power supplies (and the associated voltage transients on every cycle of the sinusoidal voltage oscillation of the AC power line) which causes the magnetrons to sweep in frequency and spread interference over a wide portion of the ISM band.

3.1 RF Lighting Promoters

The limit of 100 dBuV/m (equivalent to 330 mV/m @ 3m) is consistent with the CISPR15 limit. This by itself is only of secondary importance. The main issue is that RF lighting interests have already built and sold devices in Europe which comply with this limit (though the CISPR 15 limit is 100 dBuV/m @ 10 m from 2400 - 2500 MHz).

Magnetrons are inherently narrowband devices. Even when loaded, the instantaneous bandwidth is only several hundred kilohertz wide. As described in numerous technical papers on the subject, magnetrons driven by half wave rectified power supplies have a 50% duty cycle and sweep over a considerable portion of the ISM band. Since multiple RF lights can be installed in a given site and could be powered from different phases of the AC power line voltage, these devices could collectively pose a continuous uninterrupted source of broadband interference. Via the use of full-wave rectified power supplies and restricting high powered emissions to a 5 MHz region of the band should effectively address the concerns of both WLAN manufacturers and satellite users.

3.2 Manufacturers of WLAN Equipment

There are two types of radios used in WLANs: Direct Sequence Spread Spectrum (DSSS) and Frequency Hopped Spread Spectrum (FHSS). The implications for each radio type differ slightly, and are described separately below.

3.2.1 DSSS

DSSS based LANs usually operate on three separate non-overlapping channels as shown in Figure 3.2.1-1. By locating a high powered source of RF interference in the 2478.5 - 2483.5 MHz region, DS LAN's may suffer from performance impairment when operating on Channel 11. However, the level of interference will be dependent on the relative location of the RF lighting devices to the WLAN transceivers. Further, DSSS WLAN's operating on Channel 11 in environments where co-location of RF lighting devices and WLAN equipment is essential could reduce the nominal data rate to 7 - 8 Mbps, and use a narrower channel width to provide improved immunity to interference from RF lights operating in the proposed 2478.5 - 2483.5 MHz band.

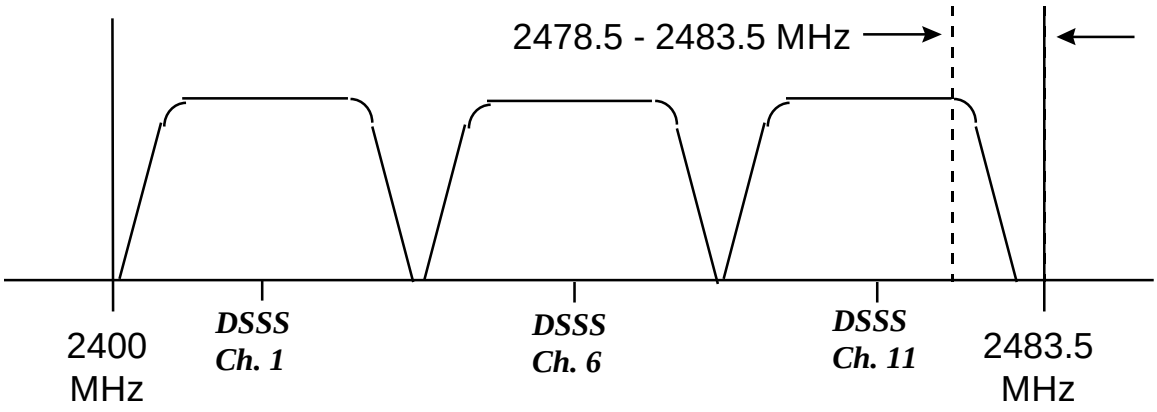


Figure 2.2.1-1 Proposed RF Lighting Band will Overlap DSSS Channel 11

3.2.2 FHSS

FHSS technology is used both for Bluetooth and IEEE 802.11 based WLAN systems. If a high powered source of fixed RF interference were located at the extreme lower edge of the proposed 2478.5 - 2483.5 MHz band, two FHSS channels, 79 and 80 (note that DSSS and FHSS channel definitions are different), would be affected. The degree to which these channels would be affected is dependent upon the relative locations of the RF lighting devices and the WLAN transceivers. However, it must be assumed that in some extreme circumstances, the use of Channels 79 and 80 may be precluded.

This level of interference may be deemed acceptable to manufacturers of FHSS equipment. If not, FCC regulations would permit modification of the hop sequence to eliminate channels 79 and 80. This would result in a system having only 77 separate FH channels, which still exceeds the FCC requirement for at least 75 channels (FCC 15.247).

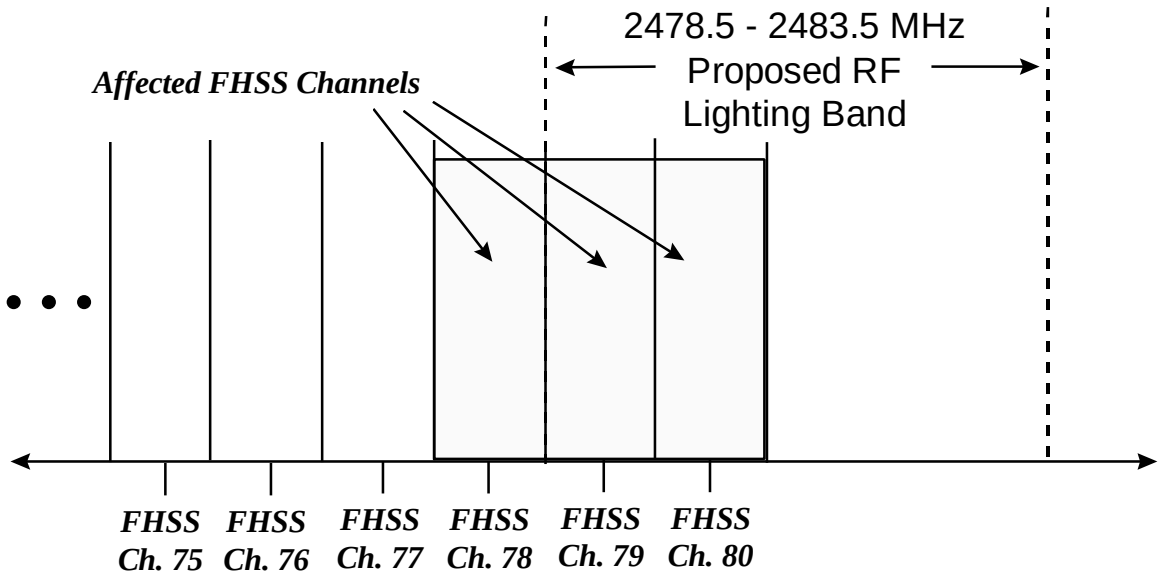


Figure 3.2-1 Proposed RF Lighting Band will Affect FHSS Channels 79 and 80

3.3 Satellite Terminals

The 2483.5 - 2500 MHz region of the ISM band is a restricted band for Part 15 users. This is due to location of satellite services in this spectrum. Nevertheless, the rule change now before the FCC would authorize RF lighting devices to radiate in this portion of the ISM band without limitation. The power spectral mask proposed herein addresses this issue. By locating the RF lightning band (radiation limit of 100 dBuV/m) in the 2478.5 - 2483.5 MHz region, none of the spectrum reserved for satellite services would be affected. The proposed power spectral mask protects the entire 2483.5 - 2500 MHz band by imposition of the Part 15 Class A limit (60 dBuV/m @ 3m).

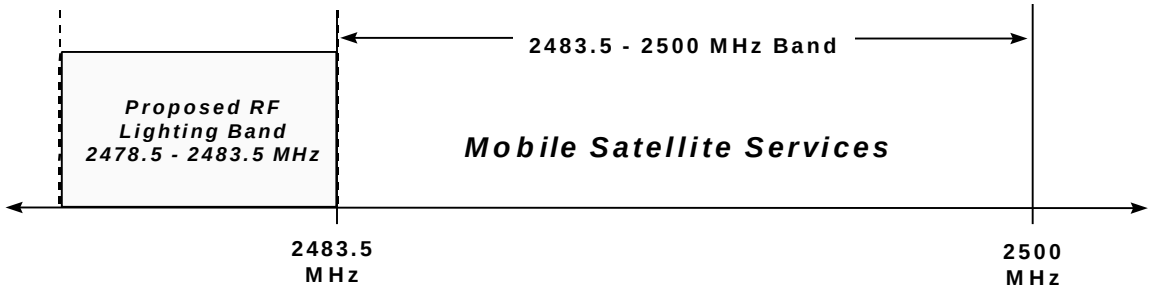


Figure 3.3-1 Proposed RF Light Band Overlaps 2483.5 - 2500 MHz Restricted Band

4.0 Conclusions

The proposed location for the RF lighting band (2478.5 - 2483.5 MHz) and the associated limit of 100 dBuV/m @ 10 m (equivalent to 330 mV/m @ 3m) represents a compromise for all interests. The Part 15 Interests will suffer from increased interference in the ISM band, but if the interference is contained within the proposed 5 MHz band, interference with both FH and DS based equipment would be minimized. At the same time, adoption of the limit will require manufacturers of RF lighting equipment to use full wave rectified power supplies.

This proposal represents a sincere attempt to balance the interests of all parties. We look forward to a response from the promoters of RF lighting devices in this matter and assure them that it will be given our prompt attention.