Comments of the

Ultra Wide Band (UWB) Alliance

to the

Federal Communications Commission

on

The Second Further Notice of Proposed Rulemaking: Unlicensed Use of the 6 GHz Band; and Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz

ET Docket No. 13–115 and RM–11341

About the UWB Alliance

The Ultra Wide Band (UWB) Alliance is a global not-for-profit organization that works to collectively establish ultra-wideband (UWB) technology as an open-standards industry. A coalition made up of vendors that either design, manufacture, or sell products that use ultra-wideband technology, the UWB Alliance aims to promote and protect the current allocation of bandwidth as well as promote the continuing globalization of the technology. As part of our mission, we advocate UWB technology and use cases to promote verticals showing the value of UWB for IoT and Industry 4.0 and to build a global ecosystem across the complete UWB value chain, from the silicon to the service. In addition, the Alliance is promoting and assuring interoperability through its work with Standards Development Organizations such as the IEEE and ETSI and then working with members to define upper layers and testing to assure compliance. For more information, please visit us at www.UWBAlliance.org.

Introduction and Background

We thank the Commission for providing the opportunity to comment on the second Further Notice of Proposed Rulemaking[1].

UWB is a rapidly growing industry that is providing spectrum-efficient solutions in applications with high economic and social value. UWB is inherently a sharing technology, with no demonstrated impact to other services. UWB is expanding the use of available spectrum without a requirement for repackaging or repurposing of licensed or other unlicensed frequency bands. UWB is proven to be compatible with many other uses and users of the RF spectrum. In fact, UWB is a complement to other technologies, increasing capability and capacity without increasing the need for new spectrum allocations. It has been operating on an unlicensed basis in the 6 GHz band for over two decades, successfully sharing with many other technologies, both licensed and unlicensed. The UWB industries' perspective on unlicensed use of the 6 GHz band is informed by decades of experience and is relevant to the future optimization of the band.

The UWB market is undergoing significant growth. The global UWB market is considered to be in the range of $1-2 billion USD as of 2024, with a CAGR (Compound Annual Growth Rate) of 17%, reaching up to $4 billion USD by 2029. Key market drivers for UWB include:

- **Consumer Electronics.** Increasing adoption of UWB in smartphones is facilitating features like secure sharing, precision location tracking for AR/VR experiences, and improved connectivity between devices**.**
- **Automotive:** UWB is used by vehicle access control systems to provide keyless entry and enhanced security. Additionally, UWB is being used to detect when a child is left unattended in a vehicle to prevent accidental heat strokes.
- **Healthcare:** UWB is used for tracking life-saving equipment in hospitals such as infusion pumps, mobile X-ray machines, and defibrillators. UWB is also being used to monitor patient vitals, track the location of staff and patients, and monitor environmental factors in sensitive areas that require precise temperature, humidity, and air quality.
- **Manufacturing:** UWB is used for real-time location tracking of materials, tools, and finished products on factory floors. It is also used for streamlining operations and improving worker safety.
- **Retail:** UWB improves inventory management and customer experience through targeted advertisements and product information based on customer location relative to products.

[1] Unlicensed Use of the 6 GHz Band; and Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz. A Proposed Rule by the Federal Communications Commission on 02/26/2024 https://www.federalregister.gov/documents/2024/02/26/2023-28620/unlicensed-use-of-the-6-ghz-band-and-expanding-flexible-use-in-mid-band-spectrum-between-37-and-24

UWB adoption is expected to accelerate as UWB technology awareness among consumers increases, as the cost of UWB chipsets decreases, and as universally standardized protocols for UWB are developed[2].

It should be noted that UWB has been operating in the frequency range of 3.1 GHz to 10.6 GHz on an unlicensed basis for over 20 years. Beginning with the adoption of FCC Part 15 Subpart F in 2002. In 2005, the FCC adopted rules for Wideband devices operating in the 6 GHz band via Part 15.250 with transmit power limits equivalent to Subpart F. It is often misstated that the 2020 revision of Subpart E "opened the 6 GHz band for unlicensed operation" when in fact the band had been in use on an unlicensed basis for two decades at that time. The revision to Subpart E allowed substantially higher power unlicensed operation in the band. In two decades of operation under Subpart F UWB and 15.250 Wideband rules there has been no case reported of interference with other services. The characteristics of UWB such as ultra-low transmit power are proven effective in sharing spectrum without negative impacts.

Overview

In summary:

- UWBA supports operation of VLP U-NII devices in U-NII-6 and U-NII-8 with no more than the power levels specified for U-NII-5 and U-NII-7 (−5 dBm/MHz); UWBA supports in general allowing client to client operation
- UWBA opposes increasing VLP power above current levels
- UWBA suggests expanding requirements for Transmit Power Control
- UWBA has concerns regarding proposed geofencing and requests clarification

We note that the FNPRM proposes to further expand unlicensed use of the 6 GHz band under Part 15, Subpart E U-NII rules, which currently allow unlicensed at higher power levels than defined in Subpart C and Subpart F. We note that wideband and UWB have operated in the 6 GHz band on an unlicensed basis under Subpart C (15.250) and Subpart F since 2005 and 2002, respectively. Use of the band under all these rule parts is valuable and growing. To achieve maximum value, in considering expanded use it is critical to consider potential impacts on existing uses.

All unlicensed users operate under the condition that they do not cause interference and that they are not provided regulatory protection from interference. Use of spectrum on an unlicensed basis has proven to provide great flexibility, promote innovation, and expand spectrum value. We note that these benefits derive directly from the ability to use the same band for multiple uses. Practically, reducing the interference impact of a given use or user will increase efficient use of the band. For this reason,

[2] For example, see current work amending IEEE Std 802.15.4 https://www.ieee802.org/15/pub/TG4ab.html

coexistence of unlicensed uses, among similar and different technologies, is growing in importance. To gain full value from the available spectrum now and in the future, positive coexistence among and between a diversity of uses, users and systems is essential.

The UWBA supports rulemaking that favors positive coexistence, which expands use in ways that can be compatible with existing use, and policies that reward innovation, especially policies that contribute to more positive coexistence and greater diversity of use.

VLP operation in U-NII-6 and U-NII-7

UWBA supports the Commission's proposal to allow VLP devices that operate without a geofencing system in the U–NII–6 (6.425–6.525 GHz) and U–NII–8 (6.875–7.125 GHz) bands in addition to the U–NII–5 and U–NII–7 bands where the Second Report and Order permits them to operate.

Client to client communications

UWBA supports allowing direct client to client communication between VLP in the U-NII-5 through U-NII-8 bands. There are several benefits to client-to-client including:

- Ability to use reduced transmit power to reach a client directly in many scenarios
- Reduce the overall traffic by reducing repetition of going through an AP
- Reduce overall traffic in some scenarios by reducing retransmissions

We recommend that client-to-client power limits be at or below current VLP power limits. The ability to use less power is a key advantage. We recommend considering lower power for client-to-client, as well as expanding requirements for Transmit Power Control (TPC).

Peer to peer network topologies can be an effective and efficient use of spectrum. In most typical use cases client devices will be closer to the peer device than to an AP, thereby yielding more favorable propagation characteristics. This allows the use of reduced transmit power which in turn increases the capacity of the channel by reducing the impact area of each device, thus increasing spatial reuse. It also reduces effect on other users of the spectrum, both licensed and unlicensed. When combined with TPC and link adaptation, this can bring significant improvements.

We support enabling more flexible network topologies by providing flexibility in what constitutes an enabling signal, and considering conditions in which an enabling signal is not required. The goals stated by the commission for protecting licensed incumbent services can be achieved with alternate means such as lower power limits for operation without an enabling signal, or using other means to assure that each transmitter has an associated receiver.

Greater flexibility in network topologies meets the goal of expanding usefulness of the band under Subpart E U-NII rules. Providing a flexible definition of the enabling signal will enable greater opportunities for innovative uses.

When operating outside when AFC is required, use of an enabling signal is a straightforward way to assure client devices do not use channels or power levels that the AFC system determines are harmful. We suggest retaining this requirement as in the current regulations.

When operating at VLP power levels, the commission was determined in the second Report and Order that VLP power limits provide equivalent protection[3], indoor and outdoor. We support the use of low power as an alternative to the enabling signal.

For maximum flexibility and to promote innovative use of the band, we request the commission include conditions that would allow client-to-client to operate without an enabling signal from and associated AP.

Increasing VLP power is not recommended or required

The Commission should not allow VLP devices to operate with up to 1 dBm EIRP PSD. UWBA opposes increasing VLP power limits above what is currently defined. We note that the benefits of "very low power" are lost when using higher power. Very Low transmit Power reduces potential for interference to both licensed services and other unlicensed users by reducing the area of impact. Using higher power increases the area of impact of the radio, reduces the ability to support a high density of devices and users, and reduces overall the capacity of the band.

Use of higher power encourages inefficient solutions over innovative approaches. As one example, a rationale used for needing more power is based on the limitations of existing implementations and uninspired receiver performance assumptions[4]. Even if we consider "only" one use, (e.g. IEEE Std 802.11ax), higher power is negative in many of the typical usage scenarios. The increased impact area reduces the number of users supported within a given area. This leads to a need for (ever) more channels (spectrum allocations).

We urge the commission to enable and encourage innovation that can achieve more capacity with less power. In contrast to the above assumptions, UWB products demonstrate that useful things can be

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[3] We can cite the rational given in the R&O (??)

[4] For example, in comments by Apple Inc. Broadcom Inc. Facebook, Inc. Google LLC [3/18/2020, https://www.fcc.gov/ecfs/search/search-filings/filing/10319674707867] justifying such high power for "very low power", link analysis assumes receiver sensitivity specifications from IEEE Std 802.11ax that have not been supported by sound analysis, rather extrapolate from earlier versions of the standards, and which are far less performant than what can be and that are orders of magnitude short of state of the possible in modern implementations. Implementations that far exceed these expectations are realistic, with many examples in real products (Wi-FI and others) today.

achieved with orders of magnitude less power than what is currently allowed for VLP. UWB designers use quite different assumptions with respect to receiver performance to achieve necessary link margin, successfully[5]. As an example, UWB is being used for low latency communication[6] in human interface devices and in high-definition audio at much lower power than U-NII limits. This illustrates both the possibility as well as the value in applying a combination of technologies in constructive collaboration. This sort of synergy achieves more efficient use of the spectrum.

Even considering only conventional technologies such as IEEE Std 802.11ax (Wi-Fi 6E), there are many applications that can thrive under the current VLP limits. Innovations that improve receiver performance can enable even more applications without compromising coexistence.

We believe that the current limits are not overly conservative, and insufficient experience is record to justify the need for higher power levels.

Geofencing

While the concept of geofencing is potentially valuable for protecting licensed services, however there are concerns regarding how geofencing will work. Assuring geofencing systems operate with accurate and up to date information is one concern. The other observation is that geofencing will have no positive impact on coexistence among and between various unlicensed users, which is a critical concern. Higher power can have a negative impact on coexistence. While unlicensed users expect no protection, the overall value of spectrum is increased when many users and many uses can coexist.

The UWBA requests clarity and more detail regarding the commission's vision for how geofencing will operate so that we can determine the potential impact on unlicensed services.

Transmit Power Control

UWBA supports adoption of TPC requirements for VLP and believes the commission should expand upon TPC requirements beyond the 6 dB authority currently specified and proposed. The ability to set power below the currently mandated 8 dBm EIRP would benefit all spectrum users (including 802.11ax/WiFi 6E).

There are many benefits to reducing transmit power, some noted in the 2nd FNPRM such as more efficient energy usage. Additionally, reducing the impact area of a transmission improves positive

[6] It should be noted that there are vastly different definitions of "low-latency" commonly used; For example, game developers often use 5ms, while some wireless vendors use 20ms for gaming. For Human Interface Devices, sub 1ms latency is desired, while for low-latency audio the target is usually 2ms or less.

coexistence, supports increased device density and diversity of uses, and increases the overall capacity of the band. There are many benefits to using only the power required for a given link at a given time.

As already noted, the ability to use much lower transmit power in many situations is a key advantage of Client-to-Client communication. Even with the pessimistic assumptions of receiver performance used to justify the 14 dBm EIRP, 8 dBm may be much greater TX power than needed to close the link. Adaptive TPC is an extremely valuable method to expand capacity. It reduces the impact area of a transmission, thereby allowing more devices to operate simultaneously.

TPC should be mandated for all VLP devices. The often-cited use cases for VLP in AR/VR and gaming, for example, require many devices operating in the same physical area, often with devices near and in line of sight. Use of TPC to scale power to only that needed for a given link at a given time increase the number of devices per unit area can be supported.

We further encourage the commission to consider technical requirements for the use of TPC that will encourage innovation in intelligent TPC as part of link adaptation schemes. This could be coupled with specific technical requirements to reduce impact footprint such as more capable antennas. For example, some of the cited use cases such as body worn devices suggest the need for higher to overcome through-body loss. This approach seriously impacts all nearby devices, for which the higher power signal is not attenuated by through body loss. Alternative methods are practical which achieve the link margin at lower than current VLP limits through the use of different antenna design that maximizes “around body” propagation over through-body “brute force with power” approaches[7].

If any increase in power is considered, the minimum requirement for TPC should mandate the ability to reduce power to at or below the current limit, (e.g., 8 dBm EIRP).

Encouraging use of only as much power as needed for a given communication link benefits all users without compromising any.

[7] https://antennaware.co.uk/product/bodywave/uwb-antenna