3 GHz / 7/GHz Ultra Wideband Deployment
Working Paper

October 21, 2024

The Ultra Wide Band (UWB) Alliance is pleased to submit its report providing commercial wireless industry input to the National Telecommunications and Information Administration's (NTIA) National Spectrum Strategy (NSS) Multi-Stakeholder Group (MSG) as part of the preparation work for the 3 GHz and 7/8 GHz band study planned to begin in the Fall of 2024.

The contributors to this document welcome NTIA's full use and incorporation of any information deemed helpful in producing NTIA's input documents to the study process.

This contribution provides information on Ultra Widenand (UWB) technology as presently deployed as well as providing information on emerging applications. UWB adoption is rapidly growing and has become a significant and valuable user of the spectrum in the bands subject to study.

This paper augments the joint submission from FiRa, CCC, and UWB Alliance which provides specific technical for consideration in the band studies. This paper adds information on the broad range of UWB uses beyond the specific focus of that paper for background.

We thank the NSS MSG for the opportunity to add input into the implementation planning process.

In summary, The UWB Alliance recommends studies to be performed in the NSS implementation plan includes UWB technologies. Although operating in the unlicensed band, its unique capabilities, financial value, and the safety it provides warrant its inclusion in studies to determine future band allocation.

Section 1: Commercial Spectrum Needs

UWB systems presently deployed under FCC Part 15 Subpart F may utilize the band from 3.1 GHz to 10.6 GHz. High volume consumer applications are concentrated primarily in the part of the band above 6 GHz. Many UWB products are based on IEEE Std 802.15.4. The most prevalent channel characteristics used by standard-based products utilize a nominal channel width of 500 MHz with multiple channels defined in the subject bands.

As noted in the joint contribution, the band from 7.775 GHz to 8.4 GHz is used by consumer devices such as smartphones and accessories for features such as secure sharing, accessory tracking, and improved connectivity between devices. The introduction of new significantly higher powered systems in this range would be expected to be extremely disruptive.

Additionally, existing and emerging uses occupy other parts of the band available for UWB. Some of these use cases include non-standardized proprietary technology. For example, industrial and commercial wall imaging systems use portions in and below 6 GHz, which may overlap the 3.1-3.45 GHz range being studied. New products such as high-performance audio and human interface devices demanding extremely low latency communications have emerged as a growing sector, typically using the full range of frequencies from 7.125-8.4 GHz. Additional examples include sports tracking applications such as those used by the NFL to track trajectory of the ball in play and player movement on the field. These operate in the 7.125-7.900 GHz range. It may be noted that some of these utilize wider channel bandwidths than 500 MHz.

Analysis should include impacts on UWB systems that result from any band reallocation that introduces new uses, especially those operating at significantly higher power than provided for in Part 15, Subpart F. UWB implementations are designed to work in the presence of other technologies sharing its frequency bands, but there are limits to its ability to reject interference.

We further note that introducing high power commercial services that would disrupt UWB in the 7.725 – 8.4 GHz range are also highly likely to interfere with existing government services. Some of these services may be supplied by satellites that cannot be moved to other frequencies. Many of these satellites have sensitive downlinks that provide critical safety services to the American public.

The primary spectrum need for UWB is to preserve the usability of the bands for extremely low power operation such as UWB. As would be shown from studies, spectrum sharing with other low power services should not require additional mitigations.

Section 2: Commercial Network Characteristics

We endorse the technical characteristics suggested for simulation band studies proposed in the FiRa Consortium/Car Connectivity Consortium/UWB Alliance (FiRa, et al.) submission. These characteristics cover many of the current uses of standard-based UWB. We request that these scenarios and parameters be incorporated into the studies of the bands.

As noted in submission, analysis should include impacts on UWB systems that result from any band reallocation that introduces new uses, especially those operating at significantly higher power than provided for in Part 15, Subpart F.

In addition to the application use cases characterized in the above referenced submission, several application areas are currently in use and/or are emerging as potentially high growth, high value applications. Spectrum sensing (RF channel characterization) is emerging as the optimal technology for use such as presence detection of humans and animals, for example detecting a child or pet left in a vehicle. UWB can achieve high precision at extremely low power. High resolution, low latency audio is another emerging application of UWB. Current systems are capable of higher performance and lower latency than other technologies, again at a small fraction of the power of other technologies. In the current IEEE P802.15.4ab project draft, additional channel plans in support of these uses have been introduced that cover the full span of 7.125 to 8.4 GHz. The presence of UWB across the entire range should be considered in studies conducted in this band.

The technical parameters in the FiRa, CCC, and UWB Alliance document are suitable for characterizing these use cases also, with the additional consideration of the entire band.

Currently there are UWB systems that operate in the lower part of the 3.1 to 6 GHz region, covered in the 3 GHz band identified in the NSS implementation plan. Examples include industrial Real Time Location Services (RTLS) and through-wall imaging systems, which operate under Part 15, Subpart F. These systems have been proven not to cause interference to existing users, but like some government systems in this band, may be subjected to disruption if services are introduced at power levels higher than currently authorized. The technical criteria are substantially similar to those enumerated for the 7 to 8 GHz band. We encourage the NTIA NSS MSG to consider these existing UWB systems when evaluating this band as well.

Section 3: Commercial EIRP

UWB is authorized under 47 CFR Part 15 Subpart F, Ultra-Wideband Operation. The subpart defines several types of UWB devices for communication and imaging applications.
While imaging as covered by § 15.509 through § 15.513 are important uses of UWB, these are very specialized with use restricted to specific professional and/or government users and with coordination requirements. The majority of consumer and industry users of UWB systems

operate under the provisions of § 15.517, § 15.519 as well as the general provisions of Subpart F that apply to all UWB devices.

Some commercial imaging systems in use and in development operate similarly to through-wall imaging and utilize spectrum below 3.1 GHz. The FCC has approved devices under waiver with specified operating conditions and volume restrictions. Consumer applications as described above operating under § 15.517 and § 15.519 are authorized in the frequency range of 3.1 GHz to 10.6 GHz. The currently authorized UWB emissions limits within this band are given as follows:

		Power Spectral Density	*Peak within a 50 MHz BW*
15.517	Indoor UWB Systems	-41.3 dBm/MHz	0 dBm
15.519	Handheld UWB systems	-41.3 dBm/MHz	0 dBm

For both indoor and handheld, out of band emissions are lower a specific "notch" in the GPS bands of 1164-1240 MHz and 1559-1610 of -85.3 dBm. Additional restrictions given in § 15.521 include operation onboard an aircraft, ship, or satellite.

Section 4: Mitigations Towards the Federal Incumbents

Currently operating in the subject bands with no discernable impact to other services, UWB is fundamentally qualified as a sharing technology. UWB systems have been operating in these bands for over 20 years with no incidents of interference reported to the FCC from consumer users. Even as the diversity of uses for UWB has expanded there has been no need for repackaging or repurposing of government systems, providing further evidence of the existing compatibility between UWB with government and commercial users.

The primary interference mitigation technique is extremely low transmit power. The power spectral density limits that are at or below unintentional, spurious, and out of band emissions limits of other technologies.

In addition to the extremely low transmission power, many of the noted UWB applications perform with very low activity factors. For indoor use, the additional loss from building exit further reduces the transmitted power to undetectable levels.

Recent technical exploration has shown that additional mitigations such as dynamic measurement of the channel and channel diversity can be used to improve coexistence of UWB with other services.

UWB has been proven to operate without impact on government systems in the subject band.

Section 5: Geographic Density and Deployment

UWB systems can be deployed in many different scenarios, environments, and densities. The extremely low power emissions, low spectral density, low activity factors, and high spatial reuse support high devices densities. In high volume consumer users, devices are portable and thus not operated at a fixed geographic location. Indoor systems may be at a fixed location. Operating on an unlicensed basis, the geographic location of UWB systems is not easily determined.

Section 6: Additional Background Information

UWB is a significant and rapidly growing industry that is providing spectrum-efficient solutions in a diverse set of applications that provide high economic and social value. Since 2018, UWB use has expanded greatly and continues to grow rapidly following its introduction into consumer products such as smartphones and personal accessory devices. Ranging and tracking are common examples of UWB implementations, buts its applicability reaches beyond this set of uses. These other applications include but are not limited to examples such as wall scanners, heart monitoring devices, and High-Definition audio.

The global UWB market is estimated at $1-2 billion USD as of 2024, with a Compound Annual Growth Rate (CAGR) of 17%. Key market drivers for UWB include:

- **Consumer Electronics.** Increasing adoption of UWB in smartphones is facilitating features like secure sharing, accessory tracking, and improved connectivity between devices**.** UWB headphone and loudspeaker product sales were launched in 2024 and are creating significant excitement. High performance human interface devices for demanding uses such as gaming is another area poised for growth.
- **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 heat-related accidents.
- **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, as well as 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.

UWB audio products have been demonstrated at numerous conventions, including the Munich High End Audio Show, CES, and the Audio Engineering Society convention. The products have received much attention and garner extremely positive reviews due to excellent audio quality combined with exceedingly low latency. In addition, high-quality wall and floor scanners are in

use by consumers to safely make modifications to their homes and apartments without cutting pipes or electrical wiring.

UWB adoption is expected to continue to accelerate as consumers awareness of the technology increases, as the cost of UWB chipsets decreases, and as universally standardized protocols for UWB are developed[1].

Many UWB products are based on IEEE Std 802.15.4. The first IEEE standard for UWB published was IEEE Std 802.15.4a-2007, which was expanded and enhanced in IEEE Std 802.15.4z-2020. This revision led to the rapid expansion in deployments that the technology has experienced. A current project, IEEE P802.15.4ab, is underway to further increase the capabilities of standardized UWB. It is presently at draft 1.0 available from IEEE. Note that amendment IEEE Std 802.15.4z has been incorporated into the currently approved revision of IEEE Std 802.15.4 that is in the process of IEEE publication.

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