

Ultrawideband: New promises, new problems

Ultrawideband (UWB) technology has caused some debate along its way to making current spectrum more efficient. This article addresses the concerns regarding its feasibility, and the FCC's market approach.

By William Stumpf

Ultrawideband (UWB) is one of the radio frequency device technologies in the news. UWB uses low-power transmission of a high-speed pulsed radio signal to send information through the air over short distances. The pulses are very short or narrow, resulting in a wide transmission bandwidth.

UWB technology may lead to advances in safety and rescue operations, military applications, medical imaging, and enable broadband communications to devices in homes and offices.



Caption

However, the impact of UWB communications on existing communications infrastructure is unknown. For this reason, the FCC has approached the introduction of this technology cautiously, imposing what some believe to be overly stringent regulations on these devices.

The intent is for UWB devices to operate using RF spectrum occupied by existing radio services, without causing harm or interference to these services.

The RF spectrum is getting more scarce today with the proliferation of wireless communication devices, and these UWB devices would allow more efficient utilization of the airwaves since they would be able to share them with current technology.

Within the next year, expect UWB technology to show up in laptop computers and cellular telephones for high-speed data transmission, and in short-range radar imaging devices, among other possibilities. However, this much-celebrated technology has caused some debate along the way. This article addresses some of the concerns about UWB's feasibility, and the Federal Communications Commission's (FCC's) approach to bringing this technology to the market.

Both sides of the fence

One side of the UWB argument claims that the since UWB technology can transmit over all systems, it can also transmit over all frequency bands, including aeronautical frequencies, which could cause damage to existing systems.

Recently, a UWB device was mock tested by NASA in a Boeing 737. The test showed that key cockpit safety devices were knocked out from virtually every seat in the plane. Admittedly, the levels transmitted were higher than the levels permitted by the FCC for consumer devices, but the results were enough to convince United Airlines to order additional testing.

Extensive independent testing was also done to determine the effect of UWB transmissions on global position systems (GPS) receivers, personal communication systems (PCS), amateur radio, and government radio services. Some of the testing showed a potential interference to these services. However, the FCC has concluded from these results that interference from UWB devices to these services is unlikely.

On the other side of the debate is the United States Congress, which feels that the technology could be hindered because the power levels permitted by the FCC are too low. The FCC has stated clearly that it is taking the cautious first step to this technology.

Currently, there is little production UWB equipment available to gain evidence of the impact of these devices to other radio services. The new standards adopted by the FCC are based in large part on the standards that the National Telecommunications Information Administration (NTIA at www.ntia.doc.gov)

believes are necessary to protect against interference to vital federal government operations. The FCC intends to review the standards released to address new issues and the operation of additional types of UWB devices.

The FCC released ET Docket 98-153 in April 2002, which amends Part 15 of

the FCC rules to permit marketing and operation of certain types of UWB technology. It establishes different technical standards and operating restrictions for three types of UWB devices based on their potential to cause interference to existing radio services:

- Imaging systems;
- Vehicular radar systems; and

- Communications and measurement systems.

UWB devices operate in frequency bands allocated to both U.S. government and non-government operations. The FCC regulates non-government operations, while government operations are regulated by the NTIA. The regulations adopted by the FCC for imaging systems are largely based on the standards the NTIA found to be necessary for protection of government operations. Imaging systems are also restricted for use by certain parties.

Imaging systems include:

- *Ground Penetrating Radar Systems (GPRs)*: May only operate when in contact with, or close proximity to, the ground for purposes of detecting or obtaining images of buried objects. GPRs are allowed to operate below 960 MHz, or in the frequency band from 3.1 GHz to 10.6 GHz. The energy from the GPR must be directed down into the ground, and operation is restricted to law enforcement agencies, fire and rescue organizations, scientific research institutions, commercial mining companies, and construction companies.
- *Wall Imaging Systems*: Generally used to detect images within a wall. They can only be operated below 900 MHz or in the frequency band 3.1 GHz to 10.6 GHz. Operation is restricted to law enforcement agencies, fire and rescue organizations, scientific research institutions, commercial mining companies, and construction companies.
- *Through-Wall Imaging Systems*: Used to detect objects or persons on the other side of a wall or structure. They must be operated below 960 MHz or in the frequency band 1.99 GHz to 10.6 GHz. Operation is restricted to law enforcement or fire and rescue organizations.
- *Medical Systems*: Medical imaging systems can be used for health applications to view inside a person or animal. They are allowed to operate in the frequency band 3.1 GHz to 10.6 GHz at the direction of, or under the supervision of, a licensed health care practitioner.
- *Surveillance Systems*: Used to generate a stationary RF perimeter field used to detect the intru-

Frequency Band	Imaging <960 MHz	Imaging Mid Frequency	Imaging High Frequency	Indoor Applications	Hand Held	Vehicular Radar
.009 MHz to 960 MHz	Pt. 15.109	Pt. 15.109	Pt. 15.109	Pt. 15.109	Pt. 15.109	Pt. 15.109
960 MHz to 1610 MHz	-65.3 dBm	-53.3 dBm	-65.3 dBm	-75.3 dBm	-75.3 dBm	-75.3 dBm
1610 MHz to 1990 MHz	-53.3 dBm	-51.3 dBm	-53.3 dBm	-53.3 dBm	-63.3 dBm	-61.3 dBm
1990 MHz- 3100 MHz	-51.3 dBm	-41.3 dBm	-51.3 dBm	-51.3 dBm	-61.3 dBm	-61.3 dBm
3100 MHz to 10600 MHz	-51.3 dBm	-41.3 dBm	-41.3 dBm	-41.3 dBm	-41.3 dBm	-61.3 dBm
10600 MHz to 22000 MHz	-51.3 dBm	-51.3 dBm	-51.3 dBm	-51.3 dBm	-61.3 dBm	-61.3 dBm
22000 MHz to 29000 MHz	-51.3 dBm	-51.3 dBm	-51.3 dBm	-51.3 dBm	-61.3 dBm	-41.3 dBm
Over 29000 MHz	-51.3 dBm	-51.3 dBm	-51.3 dBm	-51.3 dBm	-61.3 dBm	-51.3 dBm

Table 1: Average emission limits EIRP measured with a 1 MHz resolution bandwidth (RBW)

sion of persons or objects within the field. Although these devices are not considered imaging systems, the FCC opted to treat them the same as through-wall imaging systems for regulatory purposes and permits operation in the 1.99 GHz to 10.6 GHz frequency band. Operation is restricted to law enforcement, fire and rescue organizations, public utilities and industrial parties.

Other than imaging systems, the FCC has addressed two other types of UWB devices: vehicular radar systems and communications and measurement systems.

Vehicular radar systems operate in the 24 GHz frequency band. They are used in terrestrial transportation vehicles to detect the location and movement of nearby objects, and use directional antennas. The center frequency and the frequency at which the highest radiated emission occur must be over 24.075 GHz.

Communications and measurement systems include a variety of other UWB devices, such as high-speed networking. The devices must operate in the 3.1 GHz to 10.6 GHz frequency band, and are subject to other frequency and power limitations as defined in Part 15 of the FCC Rules.

Hand-held devices for such activities as peer-to-peer operation and other short-range high-speed data transmission devices are allowed. Otherwise, indoor only operation must be ensured by design. Hand-held

devices can only transmit when in communication with an associated receiver. The transmission must cease within 10 seconds unless it receives acknowledgement from the associated receiver, and the acknowledgement will continue during the transmission at 10-second intervals.

The regulations for UWB devices dictate that they operate at the levels specified in CFR Part 15.209 provided they operate within their permitted frequency bands. The limits for imaging systems operating above 960 MHz vary with the type and frequency range of operation of the device. In addition, some imaging systems can only be operated by parties that are eligible for licensing under the provisions of Part 90 of the FCC rules, while others require government coordination for operation.

FCC Technical Requirements

Each rule section has a table listing the emission limits pertaining to specific UWB applications. The UWB device must comply with all applicable limits for all frequency bands associated with the device. See table 1 for an overview of the limits that apply to different categories of UWB devices.

UWB technologies may become a significant factor in the future of communications in the United States and worldwide.

The FCC has enacted strict regulations for UWB devices, with the understanding that this technology will be used around the globe, and other coun-

tries will impose their own regulations, possibly less stringent.

Comprehending the urgency in releasing this new technology, the FCC will initiate further review with public input within the year. With hope, there will be more information available on the effect of these devices to current communications technologies. And with new information may come more relaxed FCC regulations, which could advance the development of UWB devices.

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