FCC Considerations for Spread Spectrum Systems

-- By Jim Pearce, Director, Pegasus Technologies

Oftentimes, potential clients call me with a great idea for a spread spectrum system. It fills a market need, it's feasible from a technical standpoint, and it's just plain sexy. On further discussion, though, it becomes evident that the system as contemplated (or in some cases, as already designed and ready to go into production) will not pass FCC Part 15 certification. While FCC experimental rules will permit the initial design and prototyping of many of these systems, any systems that are to be manufactured for sale must be certified under FCC Rules.

47 CFR Part 15 deals with unlicensed RF devices. "Unintentional or intentional radiators" (i.e., radios, computers, or other emittors) that are to be manufactured for sale must either meet the requirements for this part, or must meet Part 2 requirements and their operation must be licensed. Part 15 is aimed at ensuring that unlicensed operation does not result in interference with other RF systems, and this means keeping transmitter power low. For this reason, external, stand-alone amplifiers of any kind are not permitted under Part 15. (You can download FCC's Part 15 rules directly from our FCC Rules page, or you can go straight to the FCC itself.)

Section 15.247 allows up to 1 watt of transmitter power for spread spectrum systems that operate in the 900 MHz, 2.4GHz, and 5.8GHz unlicensed bands. One watt is quite a bit of power, and this makes certification under this section an attractive target for new products that need up to a mile of range. In order to be certified under this section, however, a system must meet certain listed requirements, including a specification for processing gain for direct sequence spread spectrum data links.

A key point here: ***Both the transmitter and the receiver must exhibit processing gain to qualify as a spread spectrum system under section 15.247.***

The FCC has issued several interpretations that touch on the necessity of a receiver to exhibit processing gain. It should be noted that these interpretations often do not have the original question included with them, just the FCC's response. Because of this, you must try to piece together the original question from the text of the FCC's answer quoted below (All added emphasis is my own):

> This is to confirm our telecon of April 27 regarding the wireless personal locating system described in the referenced fax. Based on the information provided, it appears that your system fails to comply with the requirements

of Section 15.247 of our Rules. As explained in your fax, the normal measurement process performed by your system consists of three basic steps:

- Step 1: The system "RDF" units transmit a standard direct sequence signal (with ASK-modulated enabling message) to the 'BT' units. It does not appear that the 'BTs' correlate the received spread spectrum signal and, therefore, they do not demonstrate processing gain as required by Section 15.247(e). Since we view a spread spectrum system as a transmitter and the associated receiver with which it is communicating, the 'BT' receivers must display the required processing gain.

- Step 2: Operating under the provisions of Section 15.249, the desired 'BT' shifts the frequency of the incoming 'RDF' signal and transmits it back to the 'RDFs' with an ASK-modulated acknowledgement message. This is acceptable operation under 15.249.

- Step 3: The 'RDFs' transmit a spread spectrum signal to the 'BTs' for 130 ms. The 'RDF' receivers despread the signal returning from the desired 'BT' and determine ranging information by calculating the time delay between the outgoing and returning PN sequences in the spread spectrum signal. This aspect of system operation fails to comply with the definition of a spread spectrum system contained in Part 2 of our Rules. Under this definition, only 'a portion of the information being conveyed by the system may be contained in the spreading function.' As described, all of the information being conveyed in this step of the location process is contained in the spreading function. Based on the above, your system is not acceptable for authorization under Part 15 of our Rules.

The FCC seems pretty firm on this issue, and even though they are charged with supporting innovation they do not use this mandate as a method to get around the Section 15.247 requirements. They want systems to meet both the letter and the spirit of the regulations, as discussed in the following interpretation:

This is in response to the referenced fax regarding [petitioner's] gas and electric meter modules. You indicate that these transmitter modules are currently authorized under Section 15.231, and inquire about the possibility of approving them as spread spectrum devices under Section 15.247. We have examined the technical information you provided to support your request, and find that there is insufficient justification for authorizing the referenced equipment under 15.247. Although the subject modules demonstrate frequency agility by successively transmitting redundant meter data on a series of 8 frequencies, they fail to comply with the requirement of

> Section 15.247(a)(1)(i) which mandates a minimum of 50 hopping channels. Additionally, the associated system receivers do not comply with the synchronized hopping requirement of 15.247(a)(1). In place of synchronized frequency shifting receivers, the ... system utilizes a bank of 48 fixed-tuned receivers to cover the operating frequency band. In your fax, you acknowledge that an individual module does not comply with the r equirements of Section 15.247, but that when viewed as a system consisting of thousands of devices, the "spirit" of the law is met. Unfortunately, our rules do not provide latitude for approaching authorization of these modules from this perspective.

From this it is evident that any system where the receiver does not exhibit processing gain will have a difficult time overcoming the FCC part 15.247 certification hurdle. Another FCC interpretation that addresses this point is the following discussion on spread spectrum repeaters:

> An application for a repeater that consisted of a RX front-end, down-converter, up-converter, amp and antenna (port), retransmitting at spread spectrum power levels was denied.
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> While such devices may be authorized under licensed Rules Parts (formerly Type Acceptance), they cannot be authorized under Part 15. As a part of a licensed system, they would only receive signals licensed to operate on certain specific frequencies. A Part 15 repeated such as this one, however, could receive, amplify and retransmit ANY incoming signal (the [Xxx] device, operated in the 2.45 GHz band, so it could, in theory, have received and retransmitted emissions from a microwave oven).
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> We have authorized repeaters under Part 15 where they demodulated the incoming signal in order to determine if it was 'valid', I.e., it came from a specific device with which the repeater was designed to operate. In these cases, we list the FCC ID of the transmitter with which the repeater operates on the Grant.
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> In the [XXX] case, the difference is that it does not demodulate the incoming signal in order to identify its source. This cannot be allowed under Part 15. The actual Rule Part for the denial was 15.247(e), which requires that a direct sequence receiver realize at least 10 dB processing gain. The receiver portion of the [Xxx] repeater realizes no Gp, as it does not correlate or demod. If the device had been designed to operate with a hopper, Section 15.247(a)(1) would have been cited, which requires that a frequency hopping receiver have an input bandwidth matching the transmitter bandwidth, and have the ability to hop in sequence with the transmitted signal.

> We will only grant a spread spectrum repeater (or any Part 15 repeater) if it has the ability to determine the source and validity of the incoming signal, and only retransmits signals from a specific transmitter, which is listed on its grant.

I have had occasion to discuss this issue with an FCC representative in the Office of Engineering and Technology. Without identifying the client or the actual application, I explained the basic operation of a client's proposed system and asked him to comment on it from a certification point of view.

The fellow said that there would be no problem certifying the system as long as it demodulates the signal and then retransmits the digital stream. I asked if operation without the demodulation would be certifiable. He confirmed that since it would not exhibit processing gain it would not meet the requirements of 15.247(e) and would not be certified.

If a system can't be certified under section 15.247, there are some other options to consider. These include:

- Designing the system so that both the transmitter and the receiver exhibit the required processing gain;
- Designing the system so that it will meet FCC part 15.249 (with its power limitation of approximately 1 mW);
- abandoning the 2.4 GHz band in favor of a band that allows more leeway for innovative concepts, such as the 5 GHz NII bands;
- Petitioning for an exception (although these are hardly ever granted); or
- petitioning for a rule change - but don't hold your breath while waiting for this to happen.

As you can see from the discussion above, it is very important to consider FCC issues at the very start of a design project. These issues can have a very major impact on the entire concept of the design, and early consideration is vital to avoid wasted time and money designing a system that can't be certified for sale.