

## Practical Advice for Meeting the DFS Testing Requirements of the FCC

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**Author's Note:** The intent of this article is to share some practical advice on how to achieve compliance with the FCC's new dynamic frequency selection (DFS) requirements. However, in order to provide some general background information on this subject, the article begins with an excerpt from the article "Dynamic Frequency Selection and the 5 GHz Band," written by our colleague Mark Briggs and originally published in Conformity in December 2005.

The advent of the 802.11a wireless market and the constant push to open up new spectrum for unlicensed use created a requirement for dynamic frequency selection (DFS), a mechanism to allow unlicensed devices to share spectrum with existing radar systems. The regulatory requirements for DFS, along with requirements for transmit power control (TPC) and uniform channel loading have been adopted in the United States, Europe and Japan and are being considered by many other regulatory domains looking at adopting the 5GHz bands for unlicensed (and possibly licensed) devices.

### Some Background on DFS Requirements in the United States

The Federal Communications Commission (FCC) had already opened up the 5150 – 5350 MHz band when it adopted the UNII rules into Part 15. The FCC opened up the 5470 – 5725 MHz band by working with industry and the Department of Defense through the U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA), and released its Report and Order FCC 03-287 [3]. To release the 5470 – 5725 MHz, a requirement for DFS was proposed to cover the new band and the existing 5250 – 5350 MHz band. The timing and threshold requirements were identical to those of EN 301 893 v1.2.3, but the signal parameters were different and included a frequency hopping radar.

Signal	PRF	Pulse Width	Burst Length	Hopping Rate
Radar Signal #1	700 Hz	1 $\mu$ s	26ms (18 pulses)	n/a
Radar Signal #2	1800 Hz	1 $\mu$ s	5ms (10 pulses)	n/a
Radar Signal #3	3000 Hz	1 $\mu$ s	100ms (300 pulses)	1kHz

Table 1: FCC-03-287 Radar Parameters

The original time line for these bands would have required any devices using the 5250 – 5350 MHz band that would be certified after January 2005 to have DFS capability. Issues with the implementation of a test procedure (such as detection success rates) and the radar parameters caused the postponement of this date first to January 2006 and ultimately to July 2006. The main concern from the government's side was that the detection algorithms implemented might only look for signals with the specific parameters listed, and industry was concerned that detection rates might not be achievable in the proposed, high-traffic (50% channel utilization) environment.

Additional trials with real radars were the next step, and these results and further discussions between industry and government finalized the formal test procedures and pass/fail criteria. Once these issues were resolved,

any products that required certification of DFS capability had to be certified by the FCC. At the same time, the FCC also performed surveillance audits on many devices until DFS capabilities had been proven.

As the 5GHz bands are opened up in other geographic areas, it can be expected that DFS requirements will be included in each country’s spectrum allocation. Now that the U.S. has ironed out the prevailing issues with its DFS requirements, it is hoped that the concordance reached between the various industry and governmental parties will assist in making regulations that match the requirements of existing spectrum users and new wireless technologies in other markets.

**Practical Advice for Meeting the FCC’s DFS Requirements**

On June 30, 2006 when the FCC issued its Report & Order mandating official DFS certification requirements for devices operating in the 5 GHz band, wireless device manufacturers faced a new set of compliance challenges that they did not have to contend with in the past. Since those requirements went into effect, we have assisted numerous companies in achieving their DFS certification requirements and have learned some very valuable lessons along the way. With the July 2007 compliance deadline now upon us (for products that were already on the market when the requirements went into effect in July 2006), we thought this would be a particularly timely opportunity to share some of our initial findings on the DFS testing and certification process.

***Don’t Assume that your Product Will Meet the DFS Requirements the First Time it is Tested***

In today’s highly competitive electronic manufacturing marketplace, most companies operate as close as possible to the speed of light in order to beat their competitors to market. This generally means squeezing every single unnecessary delay out of the product development process, and often results in commitment, to product release deadlines that can be challenging (if not impossible) to meet.

We have found that many of the products we have tested failed to meet their DFS requirements on the first pass. Although many of our clients have come to us with the expectation that they would be able to complete their DFS testing in just a few days, more often than not, once the DFS test set-up are in place and the initial measurements begin, we quickly find problems with devices in meeting the radar detection requirements, the channel move time requirements, the channel availability check requirements, or all of the above. Many of our clients have had a particularly difficult time meeting the detection requirements when subjected to the bin 5 waveform, specifically with regard to the timing of the bursts.

	Pulse Width (µs)	Pulse repetition interval (µs)	Pulses per burst	Pulse Modulation	Hopping Rate
Bin 1	1	1428	18	None	n/a
Bin 2	1-5	150-230	23-29	None	n/a
Bin 3	5-10	250-500	16-18	None	n/a
Bin 4	10-20	250-500	12-16	None	n/a
Bin 5	50-100	1000-5000	1-3	5-20 MHz linear chirp	n/a
Frequency Hopping	1	333	9 pulses per hop, 100 hops per burst	333 Hz	

Note: The bin 5 waveform is to be made of between 8 and 20 bursts over a 12 second period. Each burst contains one, two or three pulses. Each pulse within a burst has the same modulation and width but the repetition interval (for the three-pulse burst) can be different between the first and second, and second and third pulses). The parameters for the pulses in different bursts are not identical.

**Table 2: FCC Radar Waveforms**

When these failures occur, the formal testing process comes to a halt while the manufacturer addresses the source of the DFS-related problems. This can take anywhere from a few days to a few weeks of concentrated troubleshooting and debugging effort, and the testing process is essentially stalled during this time. So our first words of advice to manufacturers of products affected by the DFS requirements are plan accordingly and allow sufficient time to address your DFS testing needs.

***DFS is Primarily a Software Issue – Get the Software Developers Involved as Early as Possible!***

Another common misunderstanding that takes place in the DFS certification process is the belief that the testing requirements can be handled solely by the manufacturer’s hardware engineering team or compliance management team. It is important to understand that DFS is primarily a software (or firmware) issue so, when problems arise, the software developers often need to get involved to assist with resolution. It is ideal to have a member of the software team present during the testing process to address problems as they arise, and to help keep the testing program on track.

Furthermore, simply preparing a product to begin a formal DFS testing program can sometimes be a challenging task in itself. Many manufacturers going through the process for the first time fail to understand all of the specific modes of operation that a product must be able to demonstrate during the testing process. For example, any product being tested for DFS compliance must be able to operate in “passive scan mode” while using any of the DFS frequencies (the 5250-5350 and 5470-5725 MHz bands). But, manufacturers sometimes show up for testing with their devices unable to meet this requirement, and often require support from their software team to modify the device for testing purposes.

As the software team may rarely (if ever) get involved in matters related to product compliance, this process can sometimes be a time-consuming challenge. In addition, various other software-related issues may arise during the testing process and that is why our second piece of practical advice is *get the software developers involved in the DFS testing process as early as possible*.

***Don’t Underestimate the FCC Turn-Around Times for DFS Grant Approvals***

This is a critically important factor for manufacturers of products affected by the DFS requirements to understand, as it will have a direct impact on their ability to meet their product release deadlines. Currently, the FCC will not allow Telecommunication Certification Bodies (TCBs) to certify grants for any DFS “Master” devices or for DFS “Client” devices that have ad hoc radar detection capabilities.

TCBs essentially exist to expedite the FCC grant approval process for electronic product manufacturers, and many of those manufacturers have grown accustomed to the relatively quick turn-around times that TCBs can provide in the grant approval process. However, since the DFS requirements are still fairly new, and since they deal with matters of critical importance (i.e. military radar system interference), the FCC is currently conducting testing in its own lab on all devices submitted for DFS approval. Furthermore, a representative of the National Telecommunications and Information Administration (NTIA) must be present to witness the testing as it takes place. The only exception to this rule is for devices with no radar detection capability, which are the only type of DFS grant applications that TCBs can currently process.

It has been our experience that the approval process typically takes about 2-3 months from the point when the DFS grant application and product samples are submitted to the FCC. However, in cases where the device is particularly difficult to set up for DFS testing, or where the device has difficulty demonstrating compliance with the DFS requirements, this process can take much longer.

Furthermore, since the majority of the products currently affected by the DFS standards are 802.11a products (access points, routers, PCMCIA cards, etc), the testing requirements assume that the device will be compatible with the Microsoft Windows operating system, and be able to stream an approved MPEG file during the testing process. While many products affected by the DFS requirements can meet these criteria, there are others which cannot.

If a product manufacturer is unable to meet these requirements, they must seek approval from the FCC for the use of an alternate test method. While the alternate test method will likely employ a simple alternative process designed to create at least 40% traffic on the access point that is part of the DFS test set-up, it may take the FCC several weeks to several months in order to provide a definitive response to the manufacturer on this issue. Naturally, the testing and certification process is essentially at a standstill during this time. For these reasons and others, our next piece of advice is *don't underestimate the FCC turn-around time for DFS grant approvals*.

### ***Stay Informed and Be Ready for Additional Changes to DFS Testing Requirements***

In July 2006, the FCC's DFS requirements went into effect for all new products operating in the affected frequency bands. On July 1, 2007 the second deadline will go into effect, which will require that all products (even those that were on the market prior to June 2006) meet the DFS requirements. It appears that most manufacturers have been preparing for this deadline, as a flurry of Class 2 permissive changes have already been filed in the first half of 2007. Once July 1, 2007 passes, there will no longer be exemptions for any devices that operate in the frequencies affected by the DFS standards.

Manufacturers whose products were approved to use the 5250-5250 band prior to July 2006 but which have not applied for DFS approval are required to apply for removal of this band by July 2007. Furthermore, changes have recently been made to the DFS testing requirements. Specifically, the FCC now requires full testing of all bandwidths. These changes, and other changes that may follow, will pose additional challenges to manufacturers of devices affected by the new DFS standards. That is why our final words of advice are to *remain informed and be prepared for additional changes to the FCC's DFS testing requirements*.

### **Conclusion**

In closing, we hope that the information and advice we have provided here is useful in helping wireless device manufacturers meet the challenges posed by the FCC's new DFS requirements. We have found that manufacturers who prepare themselves properly and allow sufficient time for this process generally have little or no problem meeting the DFS requirements without significant impact on their product release process. However, manufacturers who fail to prepare properly, or who come into the process with unrealistic expectations about the time requirements and challenges associated with the DFS testing and certification process are generally disappointed in the end. We urge all manufacturers affected by these requirements to take the time to educate themselves and prepare accordingly. Like it or not, DFS is here to stay.

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