Will Narrowbanding Cost Me Radio System Coverage? *By Sean O'Hara*

The Engineer in Me

I have a confession to make; I am an engineer. As such, I have this burning desire to dive into the bowels of technical detail until I have driven everyone around me into a type of numb stupor – leaving nothing but glazed eyes in my wake. Hence, I find myself in a quandary. How do I handle the highly technical topics of narrowbanding and radio coverage? Further, how do I do so at a high enough level that system owners and operators can actually understand the impacts of narrowbanding well enough to make the best choice for themselves?

How we will handle this is fairly simple. I will leave most of the technical detail out of this summary, and provide it on the NPSTC website in the near future. This will satisfy my editors (glazed eyes), as well as my dearest engineering comrades.

The Narrowbanding Mandate

With the May 13 release of the 4th Memorandum Opinion and Order (MO&O) on Narrowbanding (FCC Docket 97-87), the FCC has, to a large extent, clarified the timelines for a transition to narrowband technologies. These timelines will affect all 150-174 MHz and 421-512 MHz Private Land Mobile Radio (PLMR) licensees and system operators, many of whom have already started the long and expensive process of replacing and/or updating their radio equipment to meet this mandate.

In the MO&O only a single firm date was set by the Commission. Here, a date of 2013 was solidified as the deadline for a transition to 12.5 kHz technologies, or technologies that offered functional equivalence to 12.5 kHz technologies. However, this was clearly seen to be an interim step to the second date, a yet to-be-determined date where licensees must meet a more stringent efficiency of 6.25 kHz technologies, or technologies that offered functional equivalence to 6.25 kHz.

The FCC made it clear in this MO&O that they understood that full 6.25 kHz-equivalent technology exists now, and that Project 25 Phase II technologies are on a development path for availability in the near future. Given this, all public safety licensees should give consideration to their eventual transition to 6.25 kHz technologies – especially given the long and fixed budget cycles that typically constrain public safety system deployments.

A Discussion on Coverage

The discussion here focuses on a subject near and dear to our hearts—the topic of radio coverage. There has been much discussion in the community lately regarding the impact that the narrowband transition will have on radio system coverage. This is a serious topic, since radio coverage is what connects our first responders, both in daily operations as well as times of crisis. Unfortunately, radio coverage is one of the most hard to define topics there is, and one that I have found is much more often misunderstood than understood. It is an area where users live, while engineers count their dBs (decibels). There are few topics that are more important. To discuss changes in coverage, I have decided to utilize what we engineers call technical jargon. Hence I will use the following coverage definitions for changes to coverage:

Little Impact: Little if any coverage loss experienced. No additional radio sites required to maintain coverage reliability.

Some Coverage Loss: Some coverage loss experienced. Some additional radio sites required to maintain coverage reliability in areas where coverage has dropped significantly.

Significant Coverage Loss: Significant coverage loss may be experienced. Many additional radio sites may be required to maintain coverage reliability in areas where coverage has dropped significantly.

Sounds simple, doesn't it? Well, it isn't; it is just simplified (perhaps oversimplified).

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In reality "coverage" is still complicated, and the definitions above must be taken in the proper context. You (or your trusty engineer) should always look at your system at some point and count the dBs. Flat areas and rugged areas react differently to changes in technology, and most of the impacts are system specific. Furthermore, one concept that is not specifically addressed here is the users' perception of coverage when going from analog to digital systems. Suffice it to say that if you talk to enough users you will get the impression that the "beauty of digital is in the ear of the beholder."

Where Does Technology Fit In?

From the previous discussions it should be clear that at some point this article will talk about radio technologies, i.e. where do they fit into the big picture? The answer is simple; operations at the various stages of the narrowband transition are supported by different types of technologies. For purposes of this discussion, I will only focus on two technology tracks – analog Frequency Modulation (FM) and digital Project 25. The reader should be aware that many more radio technologies do exist, but we cannot examine them all here. It is important to note that analog FM and digital Project 25 are very different. One difference that will become apparent is that the audio quality of the FM signal is more directly tied to its bandwidth.

The type of technology deployed follows a rough deployment timeline. Currently, most systems operate on 25 kHz technologies. For this discussion we will note that these are primarily analog FM technologies. Operations on these technologies will need to transition to more efficient 12.5 kHz technologies by the year 2013. At present there are also many systems operating on 12.5 kHz technologies. These systems mainly consist of either analog FM or Project 25 Phase I radio technologies. Operations on these technologies do already meet the 2013 transition date, but will still need to eventually transition to 6.25 kHz operations. Outside of 700/800 MHz bands, there are very few technologies in use today that meet the 6.25 kHz narrowband restrictions. Analog FM can meet this spectrum efficiency, as will Project 25 Phase II once it is available for deployments.

Where Do I Stand?

Table 1 (see page 7) lists the most common technology transitions that occur during the narrowbanding process. As can be seen, these coverage transitions are from analog to digital systems as well as digital to digital systems. Further, the table also covers technology transitions that occur as direct cutovers from 25 kHz to 6.25 kHz technologies, as well as interim transitions from 25 kHz to 12.5 kHz to 6.25 kHz.

From the table it is seen that coverage loss is primarily experienced along technology tracks that attempt to maintain analog FM operations. Although this is arguably the least expensive track to take, the coverage decreases slightly at first, then rather dramatically down the road. The impact of this type of planned transition is that it may end up costing more than expected – as more sites will likely be required to maintain system coverage levels without degradation.

The digital technologies hold up well, due to their ability to add error correction and efficient voice compression, an ability that analog FM lacks. Further, Phase II Project 25 is being developed specifically such that coverage losses do not result when the increase in spectrum efficiency is obtained. However, as previously noted, there are often changes in the users' perception of coverage due to the more abrupt transition from "coverage" to "no-coverage" that is exhibited by digital technologies.

Summary

This discussion is intended to provide a high-level understanding of the types of coverage impacts that system owners and operators will face when managing their technology transitions in response to the FCC narrowbanding mandates. Although the discussion was necessarily limited to analog FM and Project 25 technologies, it is still useful to see that the coverage losses experienced are far worse when attempting to maintain analog FM operations throughout the narrowband transition. In the near future, a more technical brief will be provided at the www.NPSTC.org.

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