WIRELESS VOICE AND DATA FOR MOBILE AND REMOTE MISSION-CRITICAL OPERATIONS

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Drawing a Bead on a Moving Target

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Believe it or not, it has been nearly 15 years since the FCC weighed the seemingly ever-increasing demand for private wireless communications against its ever-dwindling supply of spectrum reserves and decided to lead the industry down a long, sometimes difficult path toward improved spectrum efficiency. At that time, the commission's tentative conclusions were certainly justifiable —private land mobile was experiencing double-digit annual growth with no end in sight and there were limited opportunities on the horizon for new non-public safety spectrum allocations.

Time, technology, and market changes continue to shift the 150 MHz and 450 MHz spectrum-efficiency landscape. Can the FCC keep up?

The only way for the FCC to accommodate the anticipated needs of business, industrial, and land transportation (B/ILT) entities would be to increase the number of users per megahertz through the introduction of new technologies (i.e., trunking systems below 800 MHz), increased reliance on shared-use systems, and more efficient technologies. It was this thought process that led to the initiation of the decade-long refarming proceeding

that, among other things, required equipment manufacturers to narrowband private land mobile equipment from the standard 25-kilohertz channel bandwidth to 12.5 kilohertz and, ultimately, 6.25-kilohertz channel bandwidths.

Of course, things change over the course of 15 years, so it is not surprising that the same forces that led to the narrowbanding decision do not appear to exist today. This is not to say that "creating" new channels through improved spectrum efficiency is no longer an admirable goal, but the days of double-digit licensing growth are behind us. While the lack of available spectrum, or at least that perception, may have scared away a portion of the market, it also is true that commercial carriers are in a much better position today to provide a viable communications solution for many business and industrial users.

Many credit Nextel with the near-eradication of the small private wireless user — the so-called "base-and-10" user whose only requirement is a single base station serving 10 mobile units. And, Nextel and other wireless carriers have not limited their focus but extended services to more sophisticated enterprise and public safety organizations that require fleet-sized communications solutions over large geographical areas.

In short, the profile of today's private land mobile market has shifted away from the base-and-10 user to the larger enterprise and critical infrastructure industry user with more sophisticated communications needs. In addition to improved voice clarity, reliability, and robustness for mission-critical communications, such users increasingly demand more data throughput and IP connectivity to fulfill core objectives.

With this fact in mind, one might think that users' communications needs are inconsistent with the federal government's priority to shrink operational private land mobile bandwidths to squeeze in more narrowband voice systems. Put another way, is there another radio service being asked to reduce operational bandwidth in this brave new digital world? We may be witnessing our own version of the digital divide.

Narrowbanding, Take Two

First, let's summarize, from a regulatory perspective, the status of mandated narrowbanding for private systems. Things have changed in the past few months from what the FCC originally adopted in the refarming proceeding. Originally, the FCC developed an approach to encourage a graceful migration to 12.5-kilohertz and 6.25-kilohertz operation in the 150 MHz and 450 MHz frequency bands. The commission required equipment manufacturers to improve, over time, the spectrum efficiency of the product designs they submitted for FCC approval.

Under that framework, manufacturers were required to include a 12.5-kilohertz operation mode for all new products submitted after Jan. 1, 1997, and a 6.25-kilohertz mode for all new product designs submitted after Jan. 1, 2005. Multimode equipment enabling backward compatibility with legacy 25-kilohertz systems was specifically allowed and manufacturers could meet the narrowband requirements with wider bandwidth modes that satisfied an "equivalent efficiency" design standard. The most important aspect of this approach, however, was that users were not *required* to change out their existing equipment, but to gradually retire 25-kilohertz devices as more narrowband-capable equipment infiltrated their inventories.

It did not take long for the FCC to see that narrowbanding in the refarming bands would not proceed as swiftly as hoped. As a result, the commission proposed to amend the approach by implementing a date-certain for users to migrate to 12.5-kilohertz efficient operations. Perhaps surprisingly, most industry associations agreed that users would only witness the benefits of narrowbanding if the switch was mandated, so they generally supported the commission's intent, if not the specific proposals. After several rounds of comments and revisions, the FCC settled on the following course of action in late 2004:

- By Jan. 1, 2013, all licensees (business, industrial, and public safety) must move to 12.5-kilohertz technology or one that achieves the narrowband equivalent of one channel per 12.5 kilohertz of bandwidth (voice) or 4800 bits per second per 6.25 kilohertz (data) if the bandwidth is greater than 12.5 kilohertz.
- Applications for new or modified or expanded operations on 25-kilohertz channels will continue to be accepted until Jan. 1, 2011. After that date, applications specifying bandwidths greater than 12.5 kilohertz will be accepted only for equivalent-efficiency designs.
- Non-equivalent-efficiency equipment operating on channel bandwidths up to 25 kilohertz can continue to be manufactured and imported until Jan. 1, 2011. After that date, the manufacture and importation of such equipment operating on channel bandwidths greater than 12.5 kilohertz will be limited to equivalent-efficiency designs.

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• Applications for certification of 25 kilohertz-bandwidth equipment received on or after Jan. 1, 2005, will be permitted if the equipment meets the spectrum efficiency standard of one channel per 6.25 kilohertz of bandwidth (voice) or 4800 bits per second per 6.25 kilohertz (data). As discussed below, this decision was held in abeyance — or stayed — pending the outcome of another notice of proposed rulemaking.
• Part 90 paging-only frequencies would continue to be exempted from the narrowbanding requirements.

While one would hope that this would end the regulatory proceedings affecting the narrowbanding of the 150 MHz and 450 MHz bands, further work remains as the commission continues to consider whether it should also impose a second date-certain for the transition to 6.25 kilohertz technologies. At press time, the 12.5-kilohertz decisions remain subject to potential petitions for reconsideration that, if successful, could once again alter the adopted timelines.

The commission also has imposed a narrowbanding requirement applicable only to the 700 MHz public safety band. In WT Docket No. 96-86, the FCC decided that 12.5-kilohertz equipment capable of operating on the 700 MHz general-use channels (i.e., those channels not reserved for interoperable communications) cannot be marketed, manufactured, or imported after Dec. 14, 2014. After Dec. 31, 2016, all 25-kilohertz legacy use on those general-use channels must be converted to 6.25-kilohertz or equivalent-efficiency technologies. This decision also remains subject to further petitions for reconsideration and further regulatory proceedings, so stay tuned.

The bottom line of all these regulatory actions is that the FCC has established the new baseline for efficient channel use in private land mobile services at 12.5 kilohertz with a further reduction likely to occur during the next decade. How are manufacturers responding to these FCC-imposed technical standards? Until very recently, there has been little, if any, emphasis by the manufacturers on the development of technologies designed to operate within 6.25-kilohertz bandwidths.

Splitting the Difference

Rather than creating these new technologies, manufacturers have strenuously urged the FCC to preserve its policy of permitting equivalent-efficiency technologies to meet the ultimate goal of 6.25 kilohertz per voice path. Otherwise, according to Motorola, M/A-COM, EFJohnson, and Kenwood, the FCC would undo years of work to develop standards for 6.25-kilohertz equivalent efficiency technologies within the TIA-led Project 25, Phase 2 process. When completed, these standards will define a two-slot TDMA technology operating in a 12.5-kilohertz bandwidth while maintaining backward compatibility with Project 25, Phase 1 systems operating within 25-kilohertz and 12.5-kilohertz bandwidths.

While the Project 25 standards process is principally designed for public safety applications, it is probably the single greatest driver for the development of private land mobile equipment today. Thus, it is likely that the basic air-interface technology developed for the Project 25 standard will eventually result in equipment designed for broader-based enterprise markets.

That raises certain implementation issues, however. More sophisticated equipment on the congested 450 MHz and 150 MHz business and industrial channels may require some new thinking about co-channel protection, as impediments posed by a shared-spectrum environment may undermine any spectrum efficiency gains created by the technology. Today, only trunked VHF and UHF systems can obtain channel exclusivity within a specific service area; non-trunked TDMA-based systems may require similar protection.

Finally, at the 2005 IWCE conference in April, Icom and Kenwood demonstrated a new very narrowband digital communications technology that would run contrary to industry trends by operating within a 12.5-kilohertz channel bandwidth. Utilizing an FDMA, four-level FSK modulation method, the manufacturers claim the technology would achieve the FCC's minimum required data rate of 4800 bits per second. It is my understanding that FCC approval for this equipment has not yet been obtained so its

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introduction into the marketplace is uncertain. If the technology provides good voice quality at a decent price, however, a true 6.25 kilohertz product for the VHF and UHF bands could prove to be an attractive alternative for a variety of business and industrial applications.

As time goes on, it's possible that larger users with more critical needs will vacate the UHF and VHF private land mobile bands and migrate to newer allocations offering greater opportunity for broadband deployment. Even so, it is important for the industry and the FCC to ensure that the narrowbanding regulations make sense, so that the 150 MHz and 450 MHz bands can continue to serve as the workhorse bands for private land mobile users. ■

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