



TECHNICAL COLUMNS

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SOME THOUGHTS ON LTE INTERFACE

By RON HRANAC

There's a new kid on the block — the interference block, that is. That new kid is Long Term Evolution (LTE), a moniker for the next generation of mobile wireless broadband technology. What are known as LTE bands 12, 13, 14 and 17 are in a frequency range that overlaps frequencies used in many cable networks, specifically in the roughly 700 MHz to 800 MHz bands. A number of years ago, the upper end of the old North American UHF TV band — channels 70-83 or 806 MHz-890 MHz — was reallocated to such other services as 800 MHz trunked two-way radio and some cellular telephony.

More recently, UHF channels 52-69 (698 MHz-806 MHz [the so-called 700 MHz band]) were reallocated to such new services as LTE. Why is this a concern? After all, cable networks have been operating in the presence of a variety of over-the-air signals for decades. Keep the plant tight, and ingress and leakage shouldn't be major issues. In theory, that's absolutely correct. In practice, the industry is seeing some issues in those higher frequency ranges. Some of you experienced interference to digital video when a cellphone was placed on or near a set-top box. The culprit likely was ingress in the drop cabling, direct pickup in the set-top itself or a combination of the two. Regarding direct pickup by a set-top or cable modem, the enclosure's seams, ventilation holes and so forth make effective slot antennas that work reasonably well at very high frequencies where the wavelengths are fairly short. The shielding effectiveness of the enclosure can play a role, as can common mode current susceptibility on the power leads and other connections.

In the last few months, I've become aware of some situations in which downstream signal leakage from cable networks has been identified as the source of interference to LTE service. I also know of at least one operator in a major metropolitan area that has abandoned cable channels 116 and 117 because of ingress interference from LTE.

Verizon's Test Results

Verizon is among the companies with nationwide LTE allocations in the 700 MHz band (the 746 MHz-756 MHz and 776 MHz-786 MHz LTE bands, collectively known as LTE band 13, are assigned to Verizon; other carriers operate on different bands in the 698 MHz-806 MHz range), and some of its field engineers have been conducting routine signal and interference surveys in markets where it's deploying LTE service. In a number of instances, Verizon's engineers have found leakage from cable networks in the vicinity of 750 MHz at sometimes rather high field strengths, and the leaking signals have been QAM signals!

In one case, a leak on the order of 1,000 microvolts per meter ($\mu\text{V}/\text{m}$) was found, despite the fact that leakage in the VHF aeronautical band was well-below the FCC's 20 $\mu\text{V}/\text{m}$ limit. The problem was a defective tap. A replacement tap took care of the leakage, but follow-up lab testing of the defective tap showed it had about 40 dB less shielding effectiveness at 750 MHz than it did at 133 MHz because of a flaky faceplate gasket. That correlated well with the approximately 1,000 $\mu\text{V}/\text{m}$ leakage field strength at 750 MHz versus the approximately 10 $\mu\text{V}/\text{m}$ leakage field strength at 133 MHz, also a 40 dB difference. What this says is that, under the right conditions, leakage can be pretty nasty at 750 MHz, even though leakage in the VHF aeronautical band is within spec! One cannot assume that just because leakage is ok in the midband, it's also ok at much higher frequencies.



Old-Fashioned Methods

One way to perform signal leakage measurements at 750 MHz involves doing it the old-fashioned way, with a suitable antenna, preamp, bandpass filter and spectrum analyzer. In many plants, a CW carrier or analog TV channel is placed at the top of the spectrum for amplifier alignment and reference purposes, and that signal could be used for high-frequency leakage measurements. For example, a CW carrier at the upper end of a 750 MHz network's spectrum would be ideal for this purpose.

Several manufacturers make suitable UHF-only TV antennas that cover channels 14-69 (470 MHz-806 MHz). RadioShack and Winegard are among the companies that have relatively inexpensive consumer-grade antennas with between 9 dB and 12 dB of gain, depending on the model, and that sell for less than \$100. Commercial manufacturers like Sitco Antennas and Wade Antennas have heavy-duty CATV versions with similar gain.

A bandpass filter that covers the 698 MHz-806 MHz spectrum (to encompass all of the 700 MHz LTE allocations) probably would have to be custom-built. Perhaps Arcom, Eagle ComTronics, PPC and similar trap/filter companies could do this.

Some spectrum analyzers have built-in preamps, so that's an alternative to using an external one. I'm not sure who makes a suitable external, low-noise preamp that covers the desired frequency range, although there are consumer-grade UHF-TV versions available that might work. When measuring leakage at much higher frequencies, it's important to be aware of the roughly 15 dB antenna factor difference between, say, cable channel 16 (133.2625 MHz visual carrier frequency) and 750 MHz. What this means is the effective sensitivity of leakage-detection equipment for 750 MHz has to be about 15 dB better than for 133.2625 MHz in order to produce the same RF signal level at the antenna terminals for a given field strength.

To put this in perspective, a 20 $\mu\text{V}/\text{m}$ field strength at 133.2625 MHz will produce a signal level of about -43 dBmV at a resonant half-wave dipole's terminals, while a 20 $\mu\text{V}/\text{m}$ field strength at 750 MHz will produce a signal level of about -58 dBmV at the terminals of a resonant half-wave dipole — a 15 dB difference.

Final Thoughts

Here are a few thoughts going forward:

- First, cable operators seriously should consider checking for leakage in the vicinity of 750 MHz in addition to the measurements being performed in the VHF aeronautical band. A potential "gotcha" is that the vast majority of leakage detectors are designed to work only in the VHF midband. The previously discussed "old-fashioned" method is one way to do it. On my Christmas wish list: When designing future products, especially digital-compatible detectors, I'd like to see the detector manufacturers include leakage-detection functionality at higher frequencies, perhaps as an option.
- Second, it would be a good idea to conduct periodic over-the-air signal surveys using a broadband antenna and a spectrum analyzer, and see just what signals are present and how they overlap the cable network's downstream spectrum. You might be surprised.
- Third, while the main focus of this column has been on leakage and ingress, it's likely that some set-tops and modems might experience direct pickup interference from nearby LTE devices and vice versa.
- Fourth, if field engineers from a carrier like Verizon contact you about suspected signal leakage interfering with their LTE or other over-the-air service, by all means work with them to figure out what's going on and get the problem fixed.

Finally, if you're interested in more information about LTE interference, Rohde & Schwarz's Paul Denisowski will be presenting a paper — Recognizing and Resolving LTE/CATV Interference Issues — during November's SCTE Cable-Tec Expo in Atlanta.

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