



TECHNICAL COLUMNS

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Originally appeared in the **March 2012** issue of *Communications Technology*.

UNTANGLING SOME OF THE CONFUSION

By **RON HRANAC**

Do you know which channel plan is used by North American cable operators? Is it IS-6? The NCTA channel plan? How about the NCTA/EIA channel plan? Or is it simply the EIA channel plan? Perhaps it's the EIA/CEA channel plan? The answer is none of these – well, not any more – despite what you may see in various references.

Around 2003, the Consumer Electronics Association (CEA) re-designated what had previously been known as EIA/CEA standards, and those EIA standards, under CEA's auspices, as CEA standards. That means the cable channel plan in use today has, for several years, been defined in a CES standard "Cable Television Channel Identification Plan." The latest version, dated February 2009, is CEA-542-C. A copy is available for purchase from the CEA at www.ce.org.

For the curious, CEA-542-C spells out three types of channelization: STD is standard frequencies, IRC is incremental-related carriers and HRC is harmonic-related carriers. Other references call these "standard," "incrementally related carrier" and "harmonically related carrier." I've also seen "standard," "incrementally related coherent" and "harmonically related coherent." It's probably easier simply to use the abbreviations STD, IRC and HRC.

CEA-542-C includes downstream cable channels and frequencies to 1,002 MHz. For example, the document's "Table 1. Cable Television Channel Identification Plan" lists the analog visual carrier frequencies for Channel 2 as 55.2500 MHz (STD), 55.2625 MHz (IRC) and 54.0027 MHz (HRC). The table also includes frequencies for STD, IRC and HRC channels carrying 8-VSB (vestigial sideband) and QAM (quadrature amplitude modulation) signals.

By the way, a copy of the channel table from CEA-542-B is included in Appendix A of the book *Modern Cable Television Technology*, 2nd Ed. It's my understanding that the channels and frequencies in both CEA-542-B and CEA-542-C are the same.

Repeat after me: The North American cable channel plan is CEA-542-C. Borrowing a famous saying from the late Paul Harvey, now you know the rest of the story.

While on the subject of channels, what lineup comes to mind when you think of over-the-air UHF TV broadcasting in the United States? Channels 14-83? Those of us who are old cable dawgs (or have a really old TV set in the spare bedroom) might remember that UHF channels used to go all the way to Channel 83, but that hasn't been the case for many years. Channels 14-83 at one time occupied the 470 MHz-896 MHz band, but the 806 MHz-896 MHz portion was reallocated to cellular and mobile telephony, and public-safety and commercial two-way radio (think 800 MHz trunked radio systems) back in the 1980s.

What about Channels 14-69? Nope. The upper end of that band was auctioned off by the government in early 2008. The 698 MHz-806 MHz portion of the band, formerly where UHF-TV Channels 52-69 lived, is where one will find Long Term Evolution (LTE) and similar services. The once mighty UHF-TV broadcast band has been whittled down to Channels 14-51 – and remember that Channel 37 can't be used for TV because it's reserved for radio astronomy – and word is the powers-that-be are considering whittling it down even more.

Digital Leakage

I keep hearing of cable operators that believe that once the switch is made to mostly- or all-digital operation, then it's no longer necessary to worry about signal leakage. Not so fast. Field tests in which I participated with several colleagues in 2009 clearly showed that leaking QAM signals can cause harmful interference under the right circumstances. We presented a paper at the 2009 SCTE Cable-Tec Expo with the findings from our field tests. More recently, leaking QAM signals in the 700 MHz band have been found to cause



problems for LTE operators. Take a gander at my October 2011 column ([click here](#)) and my November 2011 ([click here](#)) column for some background on this.

The gist of the argument that leakage isn't a big deal in a digital world has to do with the fact that the average power in a 25-kHz bandwidth for any QAM signal in a cable network likely will fall below the FCC's 10-4 watt threshold (+38.75 dBmV) outlined in §76.610 for operation in the aeronautical bands. The equivalent power in a 6-MHz occupied bandwidth is $+38.75 \text{ dBmV} + 10\log_{10}(6,000,000 \text{ Hz}/25,000 \text{ Hz}) = +62.55 \text{ dBmV}$, certainly greater per-QAM signal digital channel power than one would see anywhere in the outside plant. One might see a single-channel level like that at the output of a headend or hub site QAM modulator cranked way up.

I've been reading through the various sections of Part 76 applicable to signal leakage, and I have some thoughts. Disclaimer: I'm not a lawyer nor am I a member of the FCC, so my interpretation may or may not be correct. That said, here's my take.

First, §76.605(a)(12) is quite clear that cable networks must comply with the listed signal leakage field strengths, and that measurement of leakage must be done as described in §76.609(h)(1) through (5). There is nothing in these two sections that pertains specifically to operation in the aeronautical bands. I read these sections as meaning that cable operators must comply with the stated maximum leakage field strengths in the specified frequency ranges, period.

Where things get tricky is in §76.610. This spells out the various sections of Part 76 that are applicable if a cable operator carries signals in the aeronautical bands (108 MHz-137 MHz and 225 MHz-400 MHz) AND the average power of those signals equals or exceeds 10-4 watt across a 25-kHz bandwidth in any 160 μ s period. What this section does NOT state is that the various other sections listed are NOT applicable if signals in the aeronautical bands are below the aforementioned 10-4 watt-in-a-25-kHz-bandwidth threshold. Looking at the other sections referenced in §76.610, I find that most of them specifically include a statement relating to operation in the 108 MHz-137 MHz and 225 MHz-400 MHz aeronautical bands. Those sections that include a direct or indirect reference to aeronautical band operation are §76.611, §76.612, §76.614, §76.616, §76.1803 and §76.1804. The sections that DO NOT include a statement about aeronautical band operation are §76.605(a)(12), §76.613 and §76.617.

What the latter tells me is that some of the leakage rules, including the basic requirements in §76.605(a)(12) pertaining to maximum permitted leakage field strength, the harmful interference clause in §76.613, and the responsibility for leakage from devices inside the home (§76.617), can be interpreted to apply to systems NOT carrying any signals in the aeronautical bands as well as systems carrying signals in the aeronautical bands when the average power of each of those signals is less than the 10-4 watt threshold.

In other words, cable operators have to at least comply with §76.605(a)(12), §76.613 and §76.617. If signals also are carried in the aeronautical bands at an average power of 10-4 watt or greater in a 25-kHz bandwidth, it's necessary to also comply with §76.611, §76.612, §76.614, §76.616, §76.1803 and §76.1804. I'm occasionally asked if frequency offsets are necessary for QAM signals. Offsetting a noise-like QAM signal won't make any difference with respect to reducing or eliminating harmful interference when leakage occurs. But what do you suppose might happen if a QAM modulator were inadvertently or intentionally switched to CW mode, which would leave a nice center-of-the-channel unmodulated carrier with all of the channel power now concentrated in that carrier? Just in case, you might think about ensuring that offsets are in place on those QAM modulators. As just stated, frequency offsets don't make any difference for noise-like QAM signals, but they sure do if a QAM modulator's output is a CW carrier!

While I could be wrong, I think my interpretation of the leakage rules is pretty much spot on, especially about harmful interference (§76.613). The FCC has been quite strict about the definition of and responsibility for harmful interference in various other Parts and Chapters of its regulations. You can be sure the commission will hold a cable operator responsible for harmful interference to a licensed over-the-air service, even if the leakage field strength is significantly less than the limits in §76.605(a)(12) and even if the cable operator is not using the aeronautical bands or the average power (25-kHz bandwidth) of signals in the aeronautical bands is less than the 10-4 watt threshold.

Bottom line on leakage? You gotta keep the plant tight, no matter what kinds of signals are carried in those cables. And how does one know if the plant is tight? Signal-leakage monitoring and measurement. Doing the latter in a mostly- or all-digital network means one either must use digital-compatible leakage detection gear or keep a CW carrier or analog TV channel in the VHF aeronautical band for leakage purposes and to maintain compatibility with your existing leakage detectors.

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