



TECHNICAL COLUMNS

Official archives of articles and columns written by Ron Hranac for Communications Technology and some of its sister publications, published by Access Intelligence, LLC. Reprinted with permission of the author.

By **Ron Hranac**, former *Senior Technology Editor*, *Access Intelligence* and *Communications Technology Magazine*

Originally appeared in the **July 2006** issue of *Communications Technology*.

SELF-TERMINATING TAPS AND MICROREFLECTIONS

By **RON HRANAC**

A Communications Technology reader recently sent me the following via email. "In your article 'Linear Distortions, Part 1' (July 2005, www.ct-magazine.com/archives/ct/0705/0705_lineardistortions.htm), you mention the use of self-terminating taps as a possible cause of reflections. Are you referring to the 8 and 4 dB self-terminating taps? If so, what do you propose as a replacement? We are a small system, which just recently launched Internet, and I am searching for any advice that will improve the system and lessen any chance of problems."

Variations of these questions come up frequently during SCTE seminars in which I discuss micro-reflections and other network impairments, so it makes sense to share the discussion with a wider audience. Micro-reflections and digitally modulated signals don't get along too well, so it's a good idea to understand and keep them under control.

Context

The comments in the article do indeed refer to 4 dB two-port, 8 dB four-port, and 11 dB eight-port so-called self-terminating taps. These end-of-line taps are actually splitters: two-way, four-way and eight-way respectively. As such, they have no provisions for directly terminating the feeder cable because there is no through leg where one can install a 5/8-24 port terminator. And no, they don't have a built-in terminator that terminates the feeder. I'm not sure where the name "self-terminating tap" originated because they don't terminate anything. But they've incorrectly been called that for decades.

The only way to properly terminate the feeder when a self-terminating tap is located at the end-of-line is to install 75-ohm resistive terminators on each of the tap's F-spigots. (Quick side note: Locking terminators without resistors or center pins don't count, since they need to be the kind with a 75-ohm resistor to be able to provide a proper termination.) That's easy to do if there are no subscriber drops connected to the tap, but what happens when drops are hooked up? The bottom line is that the feeder is not really terminated in 75-ohms if the self-terminating tap's F-spigots aren't properly terminated. Can you say "impedance mismatch?" This is true even, for example, if the drop goes directly to a cable-ready TV set.

"Cable-ready," sort of

Despite the presence of what we call a 75-ohm connector on the back of a cable-ready TV set, that set doesn't provide a particularly good impedance match for the drop. Most cable-ready TV sets have no better than about 6 dB return loss on the channel to which the set is tuned and 0 dB to 2 dB on every other frequency. 6 dB return loss means the amplitude of the reflection (echo) will be only 6 dB less than the amplitude of the incident signal. 0 dB to 2 dB return loss means that all, or nearly all, of the incident signal will be reflected by the impedance mismatch. Yikes! The cable-ready set is nearly as bad as an open or short circuit, from the perspective of being a source of a potentially nasty micro-reflection. The thing that saves our bacon is the additional loss in the drop cable, splitters, etc., which further attenuates reflections from the impedance mismatch.



The use of a set-top box at the TV set can help because the return loss of most set-tops is usually better than that of a cable-ready TV set. But what happens if the subscriber doesn't want a set-top?

One trick

In extreme situations, where a cable-ready TV set's low return loss (poor impedance match) has been found to actually affect the performance of a cable modem in the same household, there is a fix. If you have enough downstream signal level to do this, install a 6 dB in-line pad at the input to the TV set. Doing so will improve the return loss of the TV set as "seen" by the drop by double the value of the pad (12 dB in this example) assuming, of course, that the in-line pad itself is of decent quality and doesn't have its own return loss problem that creates another unwanted micro-reflection.

This does NOT mean that you should go out and install in-line pads on all cable-ready TV sets. Just keep this trick in mind should you run across a situation where a cable-ready TV set has been found to be, or is suspected of, causing a problem.

The ideal

Regarding the reader's question about a replacement for self-terminating taps: The ideal solution would be to replace them with higher value directional coupler-based taps and install 5/8-24 port terminators on the through leg of those taps. This is simply not practical, though, because of the need to essentially redesign the feeder portion of the plant to accommodate the new tap values! In the old days of downstream-only operation, one way we gauged the efficiency of a design was to look for lots of self-terminating taps at ends-of-line. That was a hint that as much of the signal as possible was being used (remember that "dB" also equals "dollar bills"), which helped to keep the actives count per mile down. These days, we have to take into account the fact that upstream operation has a bunch of different requirements.

Reality

Since it doesn't make sense to go out and replace the self-terminating taps, just be aware that some of them may be the source of micro-reflections. Ensure that all unused F-spigots on all taps are properly terminated—including those on higher value taps. The same goes for unused F-spigots on drop splitters and couplers. If you run into problems, deal with them on a case-by-case basis.

My personal preference is to not use self-terminating taps at all. Instead, during your future rebuilds, upgrades or new builds, consider using a higher value directional coupler-based tap at the end-of-line locations. That way, it's possible to actually terminate the tap's through leg with a 5/8-24 port terminator. As mentioned previously, all unused tap ports still must be properly terminated.

Ron Hranac is technical leader, HFC Network Architectures, for Cisco Systems, and former senior technology editor for *Communications Technology*. Reach him at rhrnac@aol.com.