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# MORE ON CMT SNR

By RON HRANAC

In last month's column I discussed carrier-to-noise ratio (CNR) versus cable modem termination system (CMTS)-reported signal-to-noise ratio (SNR). CMTSs that use Broadcom's 3137 upstream burst demodulator silicon are capable of providing an upstream SNR estimate.This function is a very useful tool, but it has resulted in a lot of confusion. Indeed, in recent weeks there has been a flurry of e-mails on the SCTE-List about CMTS-reported SNR and establishing thresholds for dispatching technical personnel to look for outside plant problems. As is often the case, this task is easier said than done.

To see why, one must understand what CMTS-reported SNR is and isn't.

First and foremost, what it isn't: CMTS-reported SNR is not the same thing as CNR that one measures with a spectrum analyzer.

First: A Definition

Here's what it is: As previously mentioned, the upstream SNR value is an estimate provided by the Broadcom 3137 upstream receiver chip used in almost every CMTS available today. The SNR estimate, which is derived after the upstream data is demodulated, is really more like modulation error ratio (MER), and as such includes the effects of the cable network's upstream CNR, in-channel frequency response, group delay, microreflections, cable modem transmitter phase noise, etc. Because the SNR estimate is really more like MER, it's useful for tracking long-term average trends. Interestingly, it's not unusual to have a reported low SNR number, yet find the measured CNR to be just fine. Why? Because impairments that don't show up on a spectrum analyzer—poor in-channel frequency response, group delay, microreflections, and even data collisions—may cause the low reported SNR.

So, should one even set SNR thresholds? It depends. The SNR estimate alone won't necessarily tell you what the upstream CNR is, because it's not a CNR measurement. It generally won't tell you if you have impulse noise, because of the way the Broadcom chip derives its SNR estimate. However, it may indicate when the CNR is low, and it also may tell you if microreflections exist, in-channel frequency response is bad, or if group delay is severe. But just like MER, the reported SNR number won't identify the specific impairment(s) that caused it to be low in the first place. For that you need to use other tools.

Codewords can help

You need to consider the SNR estimate as one of many tools in your troubleshooting toolbox. Others include parameters monitored by the CMTS itself—for example, uncorrectable versus correctable forward error correction (FEC) errors and the flap list. According to Motorola's Marc Belland, using upstream uncorrectable codewords is one of the best ways to complement the CMTS' SNR estimate.

Says Belland, "I know of several operators who use the following three management information base (MIB) values to calculate, using a script, what can be called codeword error ratio (CER) on their CMTS upstream ports." They are:

docsIfSigQUnerroreds
docsIfSigQCorrecteds
docsIfSigQUncorrectables

“A total of all three divided into the uncorrectables number will give you a CER at that point in time. Subsequent polls at user specified intervals—for example, every five minutes—can give you a trend as to whether the upstream is getting better or worse. Obviously if it’s getting worse you’ll need to pro-actively get someone to attend to the issue, depending on the rate of upstream degradation.”

Belland provided the following example, which could be ported to an Excel spreadsheet:

unerroreds: 1,562,456
correctables: 803,867
uncorrectables: 209,134
total: 2,575,457
loss %: 8.120%
CER = 8.12E-02

Watch for changes

Here’s something I see fairly often. Let’s say that a CMTS consistently has been reporting an SNR value in the upper 20s for many months. If the long-term trend starts to show a gradual decrease, or should even drop abruptly (and not change back to the earlier high value), then it’s definitely a good idea to get out the spectrum analyzer and check to see if anything obvious is going on. If one observes that CNR has dropped, that would clearly be an indication that something isn’t right. Did someone recently adjust reverse amps or upstream optoelectronics? Was it done correctly? Did the upstream splitting/combining setup get rearranged? More nodes added per CMTS upstream port (oops!)?

But what happens if the reported SNR is low, yet the spectrum analyzer doesn’t show anything obvious? Did you check uncorrectable FEC errors? The CMTS’ flap list? Anything unusual there? If not, and data throughput and cable modem performance is not affected, wait a bit and see if the reported SNR numbers change.

Impairments that aren’t visible on a spectrum analyzer will be harder to sort out. Unfortunately, the reported SNR number, just like MER, may show that something is wrong, but it doesn’t indicate exactly what is causing the problem. What does the upstream frequency response look like? Any changes? Microreflections, perhaps? These are more difficult to track down, but some cable operators have figured out clever ways to do so. What about isolation problems in the headend or hub upstream splitting/combining network?

Test equipment can help

Test equipment vendors have provided us with a wealth of tools for troubleshooting upstream problems. Here are a few with which I’m familiar; this list is by no means comprehensive. There’s Agilent’s venerable 8591C spectrum analyzer (www.agilent.com) for tracking down the usual RF gremlins. Large systems have simplified the task of monitoring multiple upstreams with Acterna’s PathTrak (www.acterna.com).

Upstream group delay can be a challenge, but is measured easily with Holtzman, Inc.’s Cable Scope (www.holtzmaninc.com). What does the upstream digitally modulated carrier’s constellation and MER look like? These can be checked with equipment such as Filtronic Sigtek’s ST-261 DOCSIS protocol analyzer (www.sigtek.com). The Hukk CM-1000 can measure lost upstream packets and a parameter called block error rate, a metric that is similar to bit error rate (www.sunrisetelecom.com/broadband), and Acterna’s DSAM-2500 is capable of measuring packet loss and throughput.

Bottom line: The CMTSs reported SNR estimate should be considered just one tool of many in your toolbox. A good spectrum analyzer, QAM analyzer with upstream test capability, maybe even a DOCSIS protocol analyzer with PHY layer capability (and upstream constellation display) are also part of the toolbox, as are CMTS-monitored parameters such as correctable versus uncorrectable FEC errors and the flap list.

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