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VOIP RELIABILITY

By RON HRANAC

Voice over Internet protocol—VoIP—is a popular topic these days. It's gone beyond the "VoIP is still a couple years away" stage and is now being rolled out in a number of trials and even some full-blown deployments with paying customers. But there is a much-too-common myth out there: "High-speed data works fine in my system, so voice should be no problem."

What's wrong with this statement? The obvious answer is that with plain old high-speed data, if the packets don't get through the first time, they'll be retransmitted. Voice packets have but one opportunity to get through. If those packets don't make it on the first attempt, they're gone. Can you say voice quality problems, or even dropped calls? Yet the cable modems seemingly continue to hum along just fine.

Have you ever checked to see just how well your cable modem service really performs? Network problems may cause some apparent slowdown in throughput, but end users may just attribute that to the Internet or perhaps a slow server somewhere. You might be surprised at what's going on with your modem service because of cable network problems. I've seen numerous VoIP rollouts—trials and paying customer deployments—where voice quality or other gremlins cropped up, and the problems ultimately were traced to the outside plant. There have been nonplant issues, too, but I'm not going to touch on the cable modem termination system (CMTS), routers, softswitches, gateways, or back office stuff like operations support systems (OSS). Let's look at what it takes in the cable plant itself to make VoIP play reliably.

Here's the bottom line: High-speed data and voice services can in most cases be successfully deployed on a cable network if the entire system—headend, distribution network, and subscriber drops—meets or exceeds certain minimum technical performance parameters.

The first are the technical requirements in relevant government cable regulations, such as Part 76 of the Federal Communications Commission Rules for U.S. cable systems www.access.gpo.gov/nara/cfr/waisidx_03/47cfr76_03.html. The second is the assumed RF channel transmission characteristics outlined in the Data Over Cable Service Interface Specification (DOCSIS) 1.1 Radio Frequency Interface Specification www.cablemodem.com/specifications. The third is ensuring the plant's unavailability contribution does not exceed 0.01 percent as described in the PacketCable Availability Reference Architecture www.packetcable.com/specifications.

Part 76 and DOCSIS RF

At first glance, you might be inclined to ask what the heck government technical regulations have to do with VoIP. After all, the technical parameters in Part 76 were originally intended to address analog TV channel signal quality, not the digitally modulated signals we now carry on our networks.

If your system meets or exceeds the cable rules, you're probably 80 percent of the way toward being able to provide reliable data and voice service. But merely complying with, say, Part 76 isn't enough. For instance, the FCC's 20 microvolts per meter (V/m) signal leakage limit isn't even close to what's necessary for reliable two-way operation, let alone something as critical as VoIP.

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Many operators have found it's much easier to manage ingress by tightening leakage thresholds to 10 V/m or even 5 V/m. I know of one cable company that has set an internal spec of no more than 2 V/m. That `2' is not a typo! If you're doing flyovers, figure 98th or 99th percentile rather than the FCC's 90th percentile.

For more on how ingress can take out voice but appear to leave cable modem service unaffected, see my May 2004 column: www.broadbandpbimedia.com/archives/ct/0504/0504_broadband.html.

The second criterion on my list is the assumed RF channel transmission characteristics in DOCSIS. The DOCSIS 1.1 Radio Frequency Interface Specification includes a handful of tables that detail assumed RF parameters for the downstream, upstream and cable modem input; you'll also find a few miscellaneous parameters such as the level at which the downstream digitally modulated signal should be relative to analog TV channels, cable modem post-forward error correction (FEC) bit error rate (BER) and so forth.

Unlike the FCC rules, which are the law of the land, there is no such requirement that a cable network be DOCSIS-compliant. But here's the rub: If your network doesn't meet or exceed the assumed RF parameters in DOCSIS, it's really questionable whether you'll be able to provide reliable VoIP.

Several of the assumed RF parameters in DOCSIS can be measured with a spectrum analyzer, but a number of them require specialized test equipment. Some of today's newest quadrature amplitude modulation (QAM) analyzers—in some cases in conjunction with companion test equipment in the headend—support the more unusual measurements: downstream and upstream in-channel frequency response, group delay, microreflections, even downstream and upstream modulation error ratio (MER)—the latter not a DOCSIS parameter, but an important one nonetheless.

Another nonDOCSIS measurement to perform is upstream packet loss, which can be done using one of several QAM analyzers that incorporates a built-in cable modem. This facilitates pinging the CMTS, measuring throughput and getting a grasp on packet loss. For the latter, figure no more than about 0.1 percent to 0.5 percent for reliable VoIP operation.

Four Nines

The third criterion on my list is making sure the cable network's unavailability contribution does not exceed 0.01 percent. That translates to 99.99 percent availability—the holy grail four nines—for just the hybrid fiber/coax (HFC) network. PacketCable assumes 99.94 percent end-to-end availability, which includes the CMTS, cable modem, multimedia terminal adapter (MTA), cable network, edge router, managed IP network, gateway, etc. Interestingly, the PacketCable Availability Reference Architecture excludes network powering, but my personal preference is to model everything in the outside plant.

For more on reliability and availability, see Chapter 20 in Modern Cable Television Technology, 2nd Edition, by Walt Ciciora, Jim Farmer, Dave Large and Michael Adams (Morgan Kaufmann Publishers, 2004, ISBN 1-55860-828-1). This book is available from SCTE's bookstore www.scte.org, as is a recording of a Live Learning on-line seminar that I did in August on "PacketCable Reliability in the Outside Plant." The latter is available only to SCTE members.

Put all of this together, and you'll be well on the way to providing reliable voice service!

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