

Cable Evolves Toward Fiber

New, cable-friendly standards for fiber to the home position cable operators to serve enterprise customers today and to meet residential demands once hybrid fiber-coax plant becomes obsolete.

By Masha Zager ■ *Broadband Communities*

For historical reasons, the telephone industry was first to develop and adopt fiber-to-the-home technology on a large scale. Cable companies, by and large, have been successful at using the DOCSIS protocol to meet residential bandwidth demands without taking fiber all the way to the home.

Even upstream bandwidth – traditionally the area in which cable fell far short of FTTH – is beginning to be addressed in DOCSIS 3.0 with channel bonding and digital return path technology. Shridhar Kulkarni, software product manager at Aurora Networks, says digital return is “definitely cost-effective today and gives an operator the assurance that what’s being deployed isn’t a rip-and-replace when more sophisticated services come along.” Aurora, which develops and manufactures advanced optical transport systems for the cable industry, recently released a new digital return technology that doubles return path capacity by using the recently reclaimed broadcast television spectrum.

DOCSIS 3.0’s channel-bonding and quality-of-service capabilities also allow cable operators to evolve gradually toward IPTV, a flexible and low-cost way to deliver hundreds or thousands of video channels. Several evolutionary paths toward IPTV have been proposed, including the Converged Multiservice Access Platform approach favored by Comcast.

Kulkarni says over-the-top video is leading the way to IP-based video for cable, with VoD the next possible candidate. The “classic video offering” will likely be the last to transition to IP. “I

think it’s going to happen, but at its own speed,” he says. (Aurora recently acquired GoBackTV, a company whose technology enables IPTV over cable.)

However, even though DOCSIS 3.0 keeps hybrid fiber-coax (HFC) viable in the short to medium term, fiber is now recognized as the endgame for cable companies as well as for telcos. Several years ago, cable industry associations began working to develop cable-friendly FTTH standards, and today the adoption of these technologies, especially to serve

or RFoG, standard. An operator using RFoG technology places HFC micronodes at customer premises. From the viewpoint of a cable headend, the node appears to be part of an ordinary HFC network – only it has no coax on the other side. Jim Farmer, chief technology officer of access equipment vendor Enablence, says the combination of RFoG with cable’s DOCSIS 3.0 protocol works well and is next best to passive optical networks (PON) in terms of functionality. Enablence announced in

The RFoG standard allows cable operators to manage fiber-to-the-home connections as part of a hybrid fiber-coaxial network. By replacing the electronics, operators can easily upgrade RFoG to true passive optical networks.

business customers, appears to be picking up steam. (In addition to technologies developed specifically for cable operators, some cable companies use GPON and active Ethernet technologies.)

RFoG FOR RESIDENTIAL CUSTOMERS

The simplest way to transition an HFC network to an all-fiber network is by using the radio frequency over glass,

late 2010 that it would add RFoG to its portfolio.

Farmer says, “RFoG gives cable operators a way to move into FTTH without having to change anything they’re doing now and without having to really retrain their people – they already know how to splice fiber ... and they’re working with the DOCSIS systems they know and love. Their back-office software and procedures stay the same.”

About the Author

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RFoG has several advantages over HFC. It is more capable than HFC of achieving DOCSIS 3.0's theoretical upstream capacity – which will eventually be needed – because the coaxial cable upstream spectrum is plagued by electrical interference. In addition, RFoG operating costs are lower than HFC operating costs because fiber is more reliable than copper, because no power or emergency backup equipment is needed in the outside plant and because the dreaded “CLI sweeps” (FCC-mandated measurements of cumulative leakage index) are not required for fiber.

Nevertheless, these advantages are usually not sufficient to induce cable operators to replace up-to-date HFC plant. As a result, RFoG is used today primarily in greenfield builds, where, as Farmer says, “cable operators have got to build something anyway, and it doesn't cost significantly more to put in fiber than coax.”

Dawn Emms, Aurora's marketing director for optical transport solutions, adds that many of today's greenfield deployments are on the outskirts of existing cable franchises, where the housing density is so low that HFC may not be cost-effective to deploy. RFoG sometimes actually has a cost advantage in such low-density areas.

THE LIFE EXPECTANCY OF RFOG

However, the same features that make RFoG appealing also limit its capabilities – the bandwidth supported by DOCSIS 3.0 is nowhere near that of PON. For this reason, Farmer and many others consider RFoG to be a transitional technology.

How long will the transition last? “Unfortunately, they sent the crystal ball out for repairs,” Farmer says. “At one time I was thinking it would be 18 to 24 months, but now I'm thinking it will be longer than that – five years, 10 years, I'm not sure.”

Because RFoG emulates coax, it makes sense only as part of a coax network. Thus, the RFoG transition will last as long as HFC remains competitive. How long that is depends on the competitive landscape and on the arrival of new, high-bandwidth applications.

To serve enterprise customers, cable operators are using DOCSIS Provisioning of EPON. With this best-of-all-worlds approach, cablecos can take full advantage of fiber speeds without changing their back-office systems.

Farmer adds, “For the first couple of years in the broadband era, nothing very much happened, but as cable and DSL modems became widespread ... they enabled everything from over-the-top video to Skype – all sorts of things that weren't possible with dial-up. I expect the same thing to happen again as fiber to the home becomes more widely deployed. We'll hit a critical mass.

“I think the cable-DSL critical mass was at about 25 percent of the online population, and when FTTH hits those numbers [in the U.S., about 8 percent of online households currently use FTTH], I suspect there will be new applications developed and people without fiber will be left out.” (For more on this subject, see Gig.U and the Next Generation of Broadband in this issue.)

TRANSITION TO PON

After RFoG outlives its usefulness, “the upgrade to PON will be relatively easy if [operators have] chosen the 1610nm upstream wavelength in RFoG,” Farmer says. “That allows them to overlay EPON or GPON on top of it. They can easily drop in the EPON system over RFoG by putting wave-division multiplexing at the headend ... and selectively changing out RFoG units for optical network terminals. It's very easy to operate a PON with both EPON and RFoG equipment on it at the same time. The primary application would be an area with both residences and businesses. They would serve the businesses with EPON and the residences with RFoG at the same time.”

He adds, “That was the key to the whole situation – to make sure the architecture was compatible so people could easily move to EPON when they were ready to.”

THE ARRIVAL OF DPOE

Though cable operators provide good residential service today with DOCSIS 3.0 over HFC or RFoG and can even serve small and mid-sized businesses well with these technologies, larger businesses require a higher quality of service. “You can't guarantee 100 Mbps to several businesses on DOCSIS,” says Farmer.

Kulkarni agrees, saying, “Capacity and reliability are the two top requirements for serving any commercial customer. You have to provide bigger, fatter, more reliable pipes. More and more software is now hosted on remote computer sites because companies don't want to spend a whole lot on huge data centers. ... Cloud computing requires symmetrical bandwidth.”

To address these requirements of commercial customers, in March 2011 the cable research consortium CableLabs and its members, led by Bright House Networks, Comcast and Time Warner Cable, issued specifications for a new standard, DOCSIS Provisioning of EPON, or DPoE 1.0. The specifications outline an approach for cable operators to use existing DOCSIS back-office provisioning processes to deliver business services over EPON networks. This lets operators take advantage of PON's performance benefits without losing the operational benefits of DOCSIS-based software.

Even though the “E” in DPoE stands for EPON (Ethernet passive optical network), and though EPON is the cable industry's preferred FTTH standard, DPoE actually works equally well over active Ethernet or wave-division multiplexing (WDM-PON) networks.

With DPoE, cable operators can deliver IP and Metro Ethernet-based

CABLE OPERATORS

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commercial services applications – and in fact, Comcast followed up in May by launching Metro Ethernet enterprise services in 25 metropolitan areas.

According to Kulkarni, “Commercial service deployment is where a lot of fiber is going in because those access networks are very IP-oriented. Providers are taking Ethernet and IP all the way to the premises. DPoE leverages the investment in software – whatever back-office software they have, such as OSS, will be used in the new PON networks.”

He adds, “Last year, nobody knew

what DPoE was all about – there was no meat behind the conceptual stuff. Publishing the specifications was probably the turning point. Everyone will now rally behind DPoE and gear themselves up to support those specifications. A lot of vendors, including Aurora, already have proprietary solutions that make EPON systems DOCSIS compatible. We have a couple of customers who have successfully tested these solutions, and they’re pretty happy with them. In the next six to 12 months, we’ll ... upgrade them to be standards-compliant.”

MIX AND MATCH IN THE MDU

A chassis-based EPON optical line terminal (OLT) that Aurora introduced after BROADBAND COMMUNITIES spoke with Kulkarni is, in fact, DPoE-compliant. However, this OLT was not designed primarily for commercial applications. Paul Whittlesey, Aurora’s director of product management for access network solutions, says the device is mainly for use in high-density housing, especially outside the United States.

The new OLT is designed for campus-type environments or large high-rise developments where the cable headend is internal to the community. Occupying a slot in the same chassis as the HFC headend, the OLT can serve those customers with highest bandwidth needs. Whittlesey says, “It’s a very low-cost, introductory solution that complements the HFC platform and expands the capabilities of the installed base. Now operators can launch PON and mix and match it with HFC in the same platform.” ♦

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