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EDITORIAL GUIDE

Optical Access Strategies for MSOs

Even with ongoing work on advances such as DOCSIS 3.1, fiber will become even more critical for cable operators as bandwidth demands grow. These articles highlight potential future pathways.

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Cable's shift to wired fronthaul acquisition now makes sense

by **THOMAS WAHLUND**, Net Insight

C**ABLE MSOS FACE** numerous challenges that threaten their subscriber base. These include the increased focus on multiscreen architectures, content owners becoming distributors via over-the-top (OTT) services, and new players entering the market. In addition, developments in codecs and new encoding formats are driving more efficient distribution, and the convergence to all-IP infrastructures is reducing the price of bandwidth. These emerging challenges mean cable providers must look at new ways to maintain user loyalty by providing more attractive service offerings and better positioning themselves in a changing media landscape.

Fortunately, the evolution of technology can now offer cable MSOs new tools to better use their core assets and provide more robust and cost-effective services that enable them to deliver a higher quality of service (QoS) in media transport. By using these opportunities in the right way MSOs can gain a competitive edge on rivals, protect their business, and increase profitability.

Fronthaul content acquisition offers one of these opportunities. Until now MSOs have used satellite for fronthaul content acquisition because of its relatively low cost, since programmers are normally the ones that pick up the bill for this (Figure 1). However, cable providers have two major issues when using satellites for fronthaul. First, they get the same feed quality as everyone else—and that quality usually is low. Second, they have no control over the fronthaul content acquisition.

These problems have been apparent for some time, but cable operators have lacked a suitably profitable and low-cost solution—until now.

The wired alternative

Historically, the cost for high-quality wired connectivity has been too great for fronthaul applications. But over the last two decades a rapid increase in network capacity has seen the price for that capacity reach a “tipping point” where wired content acquisition has become an affordable alternative to satellites (Figure 2). This

fact is having a big impact on cable MSOs, particularly in terms of offering the flexibility to optimize their business, improve service delivery, and more effectively use their distribution networks and QAMs. This increase in efficiency can be used in two ways: either to improve picture quality to increase competitiveness and secure subscriber loyalty through delivering a higher quality of experience (QoE), or to reallocate QAM bandwidth to more profitable services or to free up broadband capacity.

As the need grows for a lower cost, more flexible, and higher quality alternative

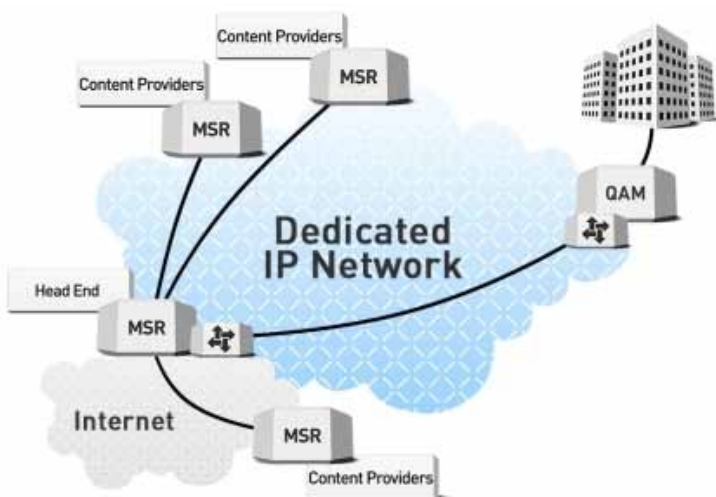


Figure 2. Moving content acquisition from narrow-band satellite to high-quality wired networks.

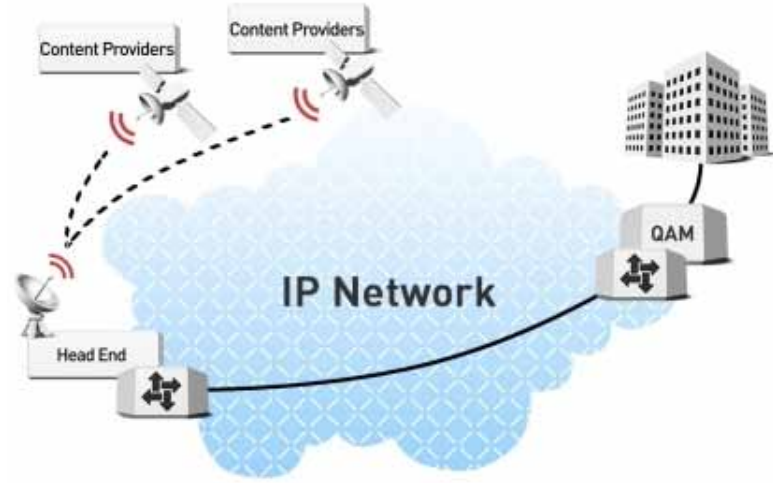


Figure 1. MSO using satellite for fronthaul content acquisition.

to satellite for delivering TV programmers' content to cable headends, the innovative terrestrial transport approaches that broadcasters use are gaining the attention of even the largest cable operators in the U.S. and Europe. Many factors contribute to this rise in interest in alternatives to satellite, including the need to aggregate more

channels of niche programming, support the delivery of local programming from centralized headends, and bring onboard video at much higher levels of quality than has traditionally been the case.

The ability to support high-quality access of contributed live content over local public Internet connections is a key part of an end-to-end terrestrial approach. While cable operators may have their own backbone networks optimized for high-quality video transport, the costs of getting content from broadcast and cable network sources onto those backbones over dedicated networks has been a barrier to all-terrestrial replacement of satellite transport. Yet as the number of local and national contributors to the channel count of cable services increases, adding satellite capacity becomes cost-prohibitive too.

As MSOs try to differentiate themselves by optimizing headend transcoding to lower distribution bit rates and improve QAM utilization, the quality of downlink feeds has become a major limiting factor too. Moving content acquisition from narrow-band satellite to high-quality wired networks provides MSOs with significantly better input quality to the headend (Figure 3). The rise in input quality results in more efficient use of encoding/transcoding processes, such as JPEG2000 and uncompressed feeds, and increases distribution quality at lower bit rates. This means MSOs can leverage the lower bit rates to gain a competitive advantage over rivals by offering more or better channels to subscribers, or reallocate bandwidth to other profitable service offerings by freeing up QAM.

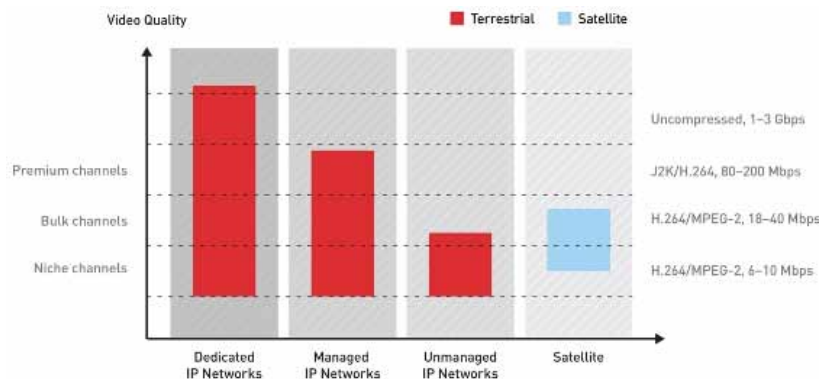


Figure 3. Fronthaul content acquisition—terrestrial versus satellite.

The wired difference

This alternative approach enables cable MSOs to use their core infrastructure for a cost-efficient transition from satellite to wired fronthaul content acquisition. The difference in this method, as opposed to traditional media

gateways, lies in the ability to deliver a high-end quality of service (QoS) combined with more efficient bandwidth management. Here, media transport is tightly integrated with network functions, enabling lossless transport and end-to-end control over any type of network infrastructure. It also offers unique provisioning, monitoring, and resilience capabilities that not only improve reliability, but also simplify network operations.

In the new media landscape MSOs are being challenged by online competition and have a genuine need to ensure subscribers continue to remain loyal to their services. Technology is now giving them a real opportunity to deploy new tools to better use their core assets and in turn provide more robust and cost-effective services with better quality to their users. By using these opportunities in the right way MSOs can achieve huge competitive advantages that not only future-proof their business, but also enable them to introduce new ways to be increasingly profitable.

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Cable MSOs target 1 Gbps

by **STEPHEN HARDY**

WITH COMPETITORS SUCH as Google Fiber and CenturyLink offering 1-Gbps services via their FTTH networks, cable operators have started to respond. Some have already deployed FTTH themselves. Others are awaiting the arrival of DOCSIS 3.1 technology, which should generate the most buzz in the space in 2015.

DOCSIS 3.1 promises to support a shared 10 Gbps downstream, certainly enough to keep up with the average cable MSO's competitors if the number of subscribers per node is kept relatively low. The traditional weakness in DOCSIS and hybrid fiber-coax infrastructure has resided in the upstream. For now, most DOCSIS 3.1 technology vendors quote an upstream target of 1 to 2 Gbps.

The first wave of DOCSIS 3.1-related products surfaced this fall; trials should begin soon, and CableLabs product certifications should begin to appear in the first half of 2015.

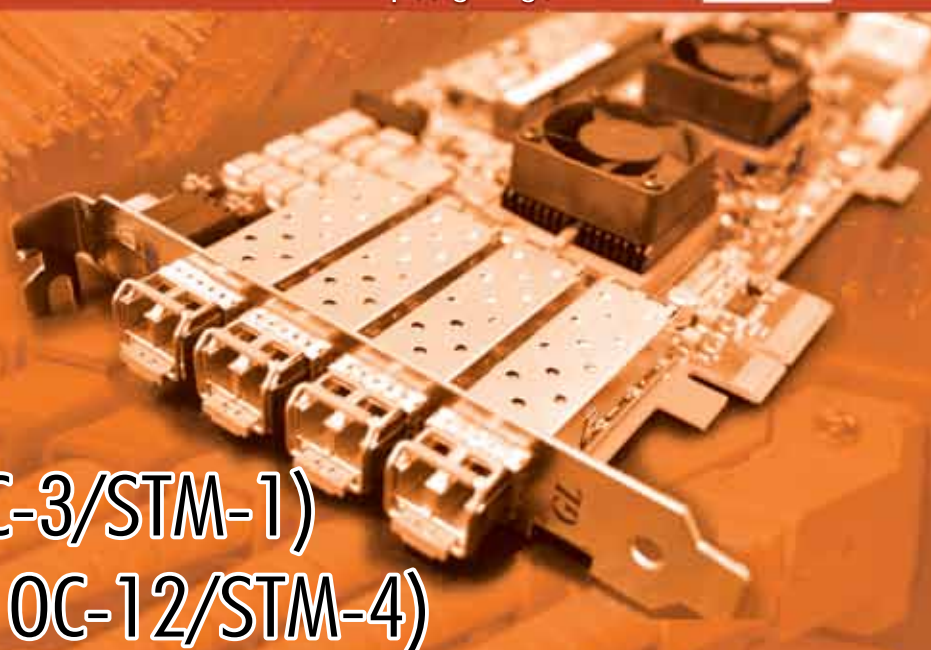
Meanwhile, CableLabs is hard at work on new specifications for operators who have recognized the power of fiber, particularly for business services. At the top of the to-do list sits a GPON version of the DOCSIS Provisioning of EPON (DPoE) specifications, driven by the many operators who decided to fight FTTH fire with fire via GPON architectures. Completion of the first set of DPoG specifications sets the stage for a GPON vs. EPON turf war for DOCSIS-friendly all-fiber infrastructures. GPON's FTTH popularity aside, at least one source active in the space suggests that because it's more easily compatible with DOCSIS and provides a clearer path to 10-Gbps support, EPON eventually will win.

Deployments of Converged Cable Access Platform (CCAP) technology, which supports IP services delivery, also will continue in 2015. These deployments

should push fiber deeper into operator networks, further solidifying the role of optical communications in cable MSO networks.

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STEPHEN HARDY is editorial director & associate publisher of [Lightwave](#).



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Next gen PON struggles for traction

by **STEPHEN HARDY**

ONE REASON PON has proven so popular in optical access networks is its reputation as a “futureproof” technology, one that promises to support operators’ evolving requirements. But it has also proven futureproof in another sense: The current generation of GPON and EPON technology refuses to give way to any successors.

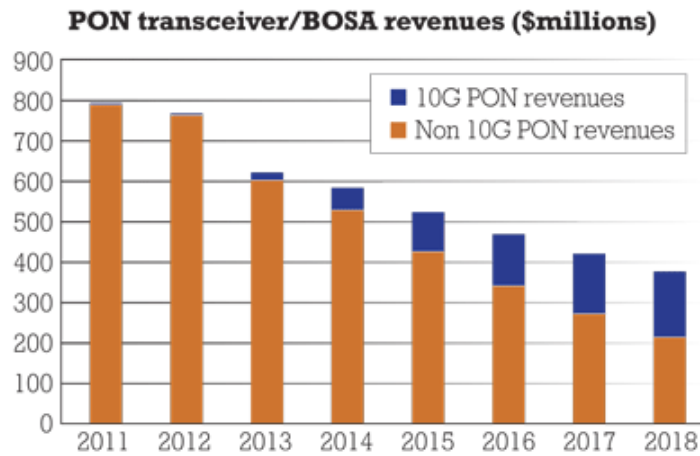
“One would think that by this point in time, given standard amortization and depreciation rates of network equipment, that you would start to see an upgrade cycle,” offers Jeff Heynen, principal analyst, broadband access and pay TV, at Infonetics Research. “And we haven’t seen that.”

The reasons for this lack of interest in the next generation of PON technology are simple to understand. But they have created an environment that could make an eventual decision on what comes next more complex.

Enough already

Heynen says the lack of interest in “what comes next” -- currently, 10-Gbps versions of EPON and GPON -- is particularly puzzling for EPON, given that it has seen widespread deployment far longer than GPON and that 10-Gbps versions of EPON have been available for a longer time as well.

The poor traction of 10G PON of any sort initially surprised vendors, too. Frank Effenberger, Huawei Fellow and vice president, Access R&D Department, Network Product Line, for Futurewei Technologies, recalls operators expressed significant interest and support while the IEEE developed 10G EPON specifications and the ITU-T, with support of FSAN, tackled 10G GPON under the rubric of XG-PON1 (10 Gbps downstream, 2.5 Gbps upstream) and XG-PON2 (10 Gbps symmetrically). Systems providers dutifully developed prototypes that carriers such as Verizon



Ovum reports that while sales of 10G PON technology will ramp by a compound annual growth rate of 118% between 2012 and 2018, current PON systems will continue to compose the majority of PON component sales.

and Portugal Telecom happily tested. Based on the results of the tests, commercial systems ensued -- to little response so far.

The principal barrier to deployment of 10G PON is probably the most difficult to overcome.

“The simple reality is that GPON today gives you plenty of bandwidth for residential deployments, even for business services,” explains Stefaan Vanhastel,

marketing director for wireline fixed access at Alcatel-Lucent.

The same statement can be made for EPON as well. The advancing tide of 1-Gbps services isn’t likely to change this scenario anytime soon, Effenberger and Vanhastel point out.

“It’s rather difficult for a residential subscriber to continuously fill a 1-Gbps pipe,” Vanhastel explains. “So I think it’s a fair assumption from service providers offering 1-gig services that they mainly need to support 1-gig peak speeds and not necessarily a sustained 1-gig speed for every single subscriber, non-blocking.”

Even if the amount of sustained bandwidth were to climb, most carriers could simply adjust their split ratios, asserts Ovum’s principal analyst for components, Julie Kunstler. Based on her calculations, as well as discussions with service providers, Kunstler reports most PONs aren’t operating at anywhere near their maximum split ratios.

Cost, of course, also plays a role. Effenberger points out that the popularity of EPON and GPON have reduced equipment costs at a pace 10G PON can’t match, particularly given 10G PON’s limited deployment volume. Vanhastel estimates the

cost per subscriber for XG-PON is about 20% more than for GPON.

Conflict of interest

The lack of traction for 10G PON has allowed two factors to create uncertainty about future technology directions that further complicate the next gen PON decision. The first is the development of an alternative to 10G PON -- WDM-PON, particularly the TDM/WDM hybrid for which the ITU-T is developing specifications within its NG-PON2 effort.

While PONs already use multiple wavelengths -- one each for upstream and downstream traffic, with possibly a second downstream wavelength added for RF video -- WDM-PON takes the multiwavelength concept further. In a classic WDM-PON architecture, each CPE receives its own wavelength. Such an arrangement offers the utmost in dedicated bandwidth. It also offers the utmost in per subscriber cost, which is why the carrier members of FSAN backed the hybrid approach that combines WDM's multiple wavelengths with GPON's support of multiple subscribers by each of those wavelengths. Specifications for the architecture, most commonly referred to as TWDM-PON, likely will support as many as eight wavelengths of 10 Gbps each, although Vanhastel expects initial TWDM-PON systems will only support four.

The 40-Gbps capacity may not be those first TWDM-PON systems' primary benefit. "I think the first consideration is the flexibility; it's the fact that you can use different wavelengths for different applications," offers Vanhastel. "You could also wholesale one of those wavelengths to a different service provider. That can be interesting in countries where you have to provide access to your fiber infrastructure to other service providers as a way to unbundle."

The proposed TWDM-PON wavelength plan nestles alongside the wavelengths GPON uses, which means clean upgrades via overlay. Operators can follow a pay-as-you-grow approach, adding one wavelength at a time to existing GPON infrastructure as demands require.

This graceful migration feeds into the second point of uncertainty facing some network planners -- whether to stick with EPON or move to GPON. The IEEE currently isn't working on WDM EPON. And while EPON leveraged the overall

1-Gbps Ethernet embedded base to offer low capex, that head start isn't as pronounced at 10 Gbps. With GPON deployments catching up to EPON, the cost difference between the two technologies continues to shrink, too.

"I think there's some concern about the long-term viability of EPON as a technology, with even China Telecom and China Unicom having switched over a greater percentage of their purchasing to GPON," Heynen says. "Does that mean that EPON is stranded as a technology? I'm sure that consideration is being made by operators in Japan and Korea and elsewhere, maybe even cable operators."

Those cable operators, especially in North America, have long been seen as unified EPON supporters, particularly for business services provision that leverages Cable Labs' DOCSIS Provisioning of EPON (DPoE) specifications. However, that unity appears to be wavering, based on the number of GPON installations cable operators have pursued. "If you had asked last year which way maybe [cable] operators would go, I would have definitely said EPON and follow up with 10G EPON," Heynen offers. "But I don't feel that way anymore, just given the mix of technologies."

What is it good for?

All this is not to say that there isn't a use for 10G PON. China Telecom has deployed 10G EPON to support fiber to the building, Effenberger reports. Alcatel-Lucent has announced U.S. cable operator Bright House Networks as a customer for its DPoE technology, which supports symmetrical 10-Gbps data rates; Vanhastel adds that his company has more DPoE customers than just Bright House.

Bright House will use the 10G technology for business services. And if 10G PON is to find a niche for itself, business services will likely be the driver, Ovum's Kunstler says. "If I look at where 10G is being deployed and where I'm getting the most inquiries around 10G from service providers, it's coming from business services -- with mobile backhaul included in 'business services,'" she explains.

Finally, Heynen notes that a technology currently cast as a threat to PON -- G.fast -- may actually prove a boon. G.fast promises gigabit speeds over copper infrastructure, but at very short link distances. Fiber will need to be installed

deep into access networks to support G.fast fiber to the distribution point (FTTdp) architectures.

“I think XG-PON1, for this FTTdp and G.fast, as a backhaul technology, I think it’s very well suited for that. And the timing works out well from a cost perspective,” Heynen theorizes.

WDM-PON, meanwhile, has been offered as a business services option from a variety of equipment suppliers as well, with multiple deployments reported.

Pondering the future

The fact that TWDM-PON products probably won’t reach the market until 2015, according to Vanhastel -- and perhaps not until 2016 or later, in Effenberger’s view -- gives 10G PON more time to become established in carrier networks and proceed down the cost-reduction curve. Yet the fact that TWDM-PON systems are at hand may help relegate the technology to niche application status.

The capacity expansion potential of current GPON and EPON systems remains the most significant hurdle to wide-scale deployment of 10G PON, however -- as well as TWDM-PON and basic WDM-PON. Effenberger, for one, believes current PON infrastructures, particularly GPON, won’t run out of capacity on a significant scale until at least 2020.

Which may not have been the kind of futureproofing vendors would prefer.

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