EPON, The Future of Cable Business Services

A Technical Paper prepared for the Society of Cable Telecommunications Engineers
By

Bill Beesley
Principal Solutions Architect
Fujitsu Network Communications
2801 Telecom Parkway
Richardson, TX 75802
972.469.2801
Bill.beesley@us.fujitsu.com

Overview

While video revenues are flat or declining and residential data installations are quickly approaching market saturation, cable operators are continuing to enjoy double digit annual growth in commercial services, especially in the small to medium (SMB) enterprise market segment. While small to medium enterprise customers have been lucratively well served by traditional DOCSIS technology, their increasing adoption of technologies such as cloud services is quickly beginning to drive bandwidth demands beyond what can be practicably served by a cable modem. This paper will outline the financial and operational advantages of using 1 and 10 gigabit Ethernet Passive Optical Networking (EPON) to deliver high bandwidth support for business services. The paper will outline the potential market size that can be captured using EPON as well as provide its cost comparison to both DOCSIS® and dedicated fiber Ethernet methodologies. In addition, the author will explain how operators can leverage technology developments that provide economies of scale and reuse existing operations practices and tools to deliver EPON services, such as the CableLabs® DOCSIS® Provisioning of EPON (DPoE™) specification. Finally, the author will look toward future EPON developments such as EPON over Coax and WDM PON and how they will provide expanded commercial market opportunities beyond SMB.

Contents

It is no great secret in the Cable Industry that residential revenues, especially video revenues have been flat or declining over the past several years. In many cases, operators are struggling to keep their video net adds above their churn rate in order to avoid negative RGU growth. As an example, in their 2012 annual report Time Warner cable reported that their residential services revenues grew 6.2%. This number is inclusive of voice, video and data services and if we only account or video revenues, Time Warner Cable reported subscriber growth of only 1.2%. In comparison, their Business Services revenue increased 29.4% to $1.9 billion. It's hard to not notice revenues that accounted for 9% of the company's overall $21 billion in 2012 revenue and that are growing at close to 30%. Time Warner Cable is not alone in enjoying strong growth in the lucrative Business Services market, Comcast is now making more than $2 billion annually from business services and Cox has repeatedly announced they will reach the $2 billion mark in the near future. If fact, nearly every North American operator is reporting they are focusing on taking advantage of the strong growth of their commercial services segment.

In order to understand where this growth is occurring, we begin by taking a look at the population of businesses in the United States. In the 2010 Statistics of U.S. Business annual report, the U.S. Census reported that there were 5.8 million businesses in 7.4 million locations. Of these, 5.2 million companies represented the small to medium business sector with 20 or fewer employees.

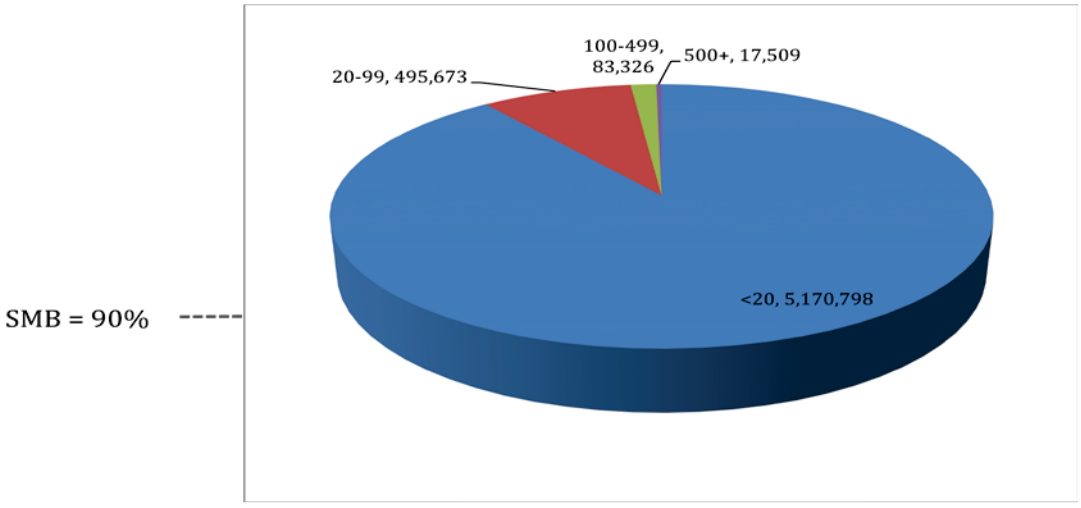
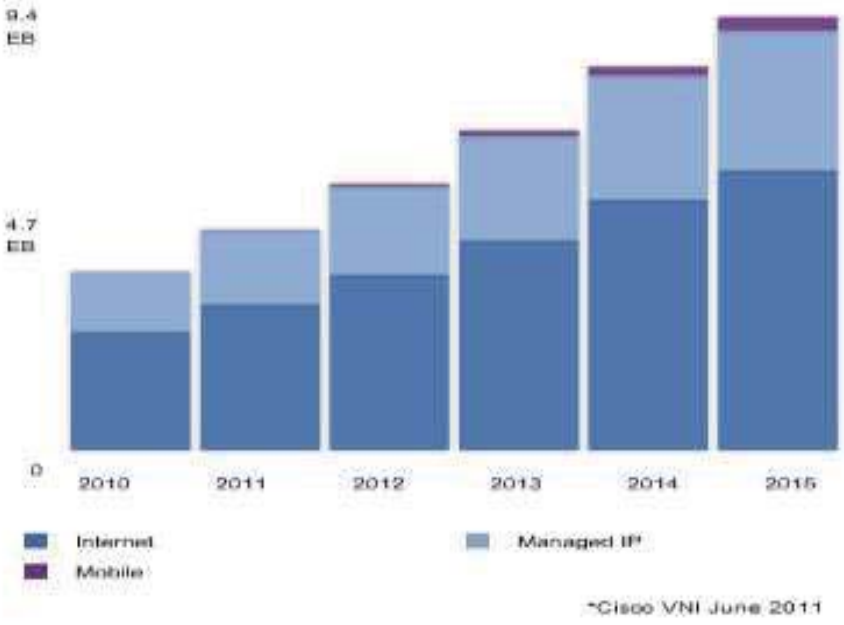


Figure 1 U.S. Businesses by Employment Size

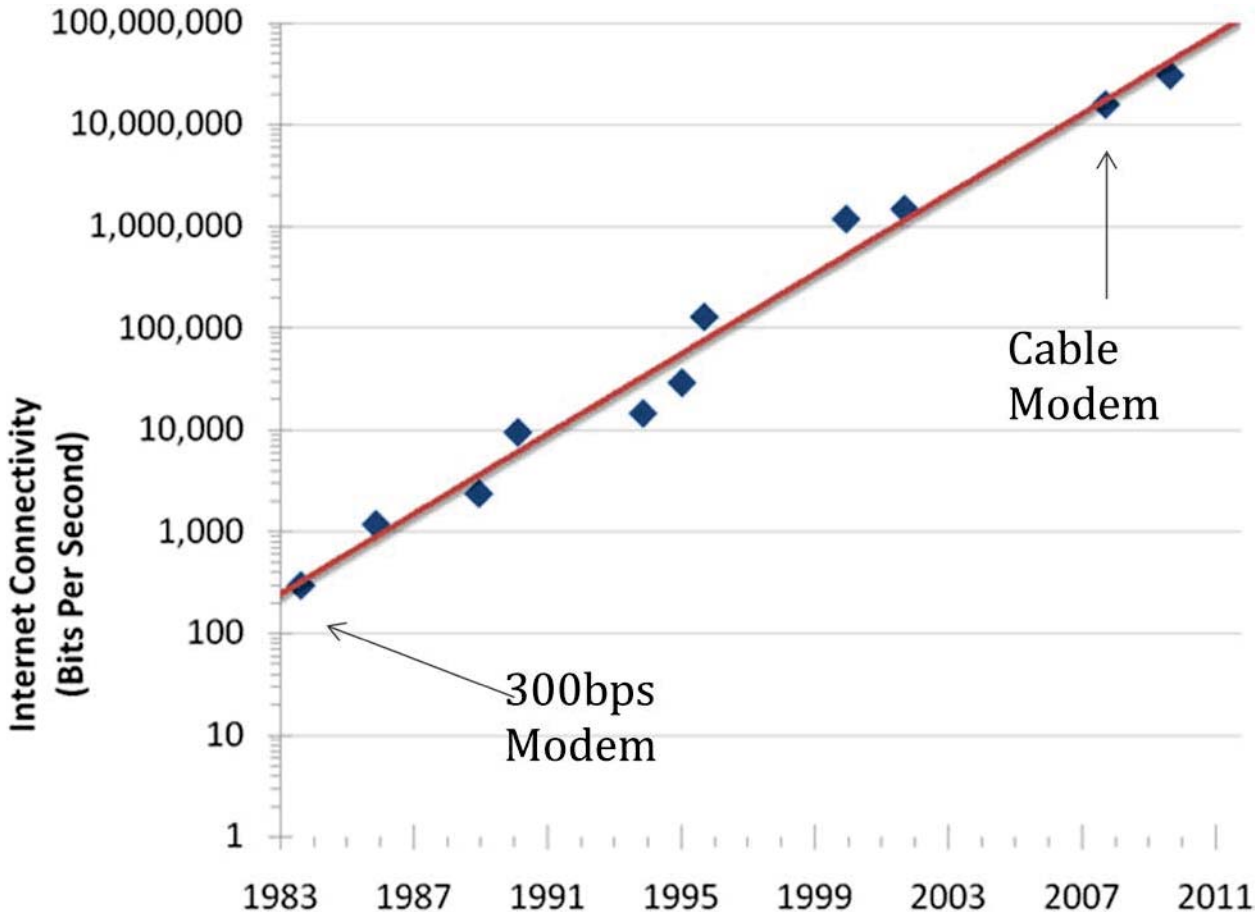
These small to medium enterprise customers represent the majority of the cable business segment as they have been relatively easy to serve using the same HFC delivered cable modem voice and data services already in place for residential services. This is where the cable companies have been most successful, delivering an average of 3.6 phone lines and 20Mbs of data at an average revenue rate of $300 per month. Because small businesses are typically located in strip and office parks that are adjacent to residential developments, it has been relatively easy to acquire these new customers as the commercial properties are relatively close to the existing HFC network. However, it is often the case that expensive plant extensions are required when a commercial customer calls requesting service. This is primarily because the initial network build outs were engineered to serve the franchise requirement for residential, not commercial services. This causes gaps in commercial coverage where the HFC plant is not built out to allow a simple drop-connect but must be extended. One Tier 1 MSO executive shared with me privately in 2012 that at that time, their plant only passed 45% of the existing commercial businesses in their footprint requiring expensive construction for the majority of customer additions. Another challenge in obtaining new customers is that even where the HFC network has been built to the property, because of the larger physical size of commercial properties such as office parks and strip malls, the distance from the existing tap to the customer's physical office may be too great to effectively serve high speed data via DOCSIS. When you consider that at 860Mhz, RG6 cable loses 6db per 100' and RG11 looses 4db, this means that after 200-300 feet, attenuation of the cable makes it problematic to deliver a consistent service. In this instance, operators must again extend hard line and potentially place a line extender on the property. Finally, a good portion of the HFC network is aerial and normally on poles on the back of the property intersecting with a residential neighborhood. Since the back alleys of commercial properties are used for delivery truck traffic, an aerial drop is not practicable and we are once again back to expensive construction in the form of directional boring or trenching and repairing the commercial alley or parking lot. Since they are doing construction to obtain the customer anyway, many cable operators are asking themselves whether it makes more sense to just invest in fiber.

As stated previously, in interviews with executives for the Tier 1 MSOs, the author has learned that the average small to medium business takes around four phone lines and about 20Mbs of data at an average rate of $300 per month. This example service is easily served with today's DOCSIS 3 EMTAs, which cost of few hundred dollars per subscriber, including a portion of the CMTS costs. Conversely, dedicated Ethernet products that can deliver data and voice are priced around $1000 or more per endpoint. It is the high cost of typical dedicated Ethernet and its high operational overhead in comparison to DOCSIS technologies that has had the cable industry for years coming to the conclusion that fiber to the business just wasn't justifiable.

Of course, this conclusion only holds true as long as the market demand for features can be delivered using DOCSIS technologies. However it seems unlikely that just like residential data subscribers, current commercial data subscriber bandwidth demands will remain fixed. This is particularly true of small to medium enterprise customers. Since the majority of these companies have too few employees to justify dedicated IT staff, small to medium enterprise customers are quickly adopting cloud based email and storage solutions to eliminate the expense of maintaining on-site mail and file servers. As they begin to migrate their data to the cloud, their need for increased bandwidth is becoming more difficult to satisfy with HFC, especially in the upstream where DOCSIS technologies perform worst. Cisco's visual network index would seem to support the conclusion that commercial subscriber bandwidth requirements will soon exceed DOCSIS capabilities, since it shows that commercial bandwidth demand will nearly double from 2012 to 2015.

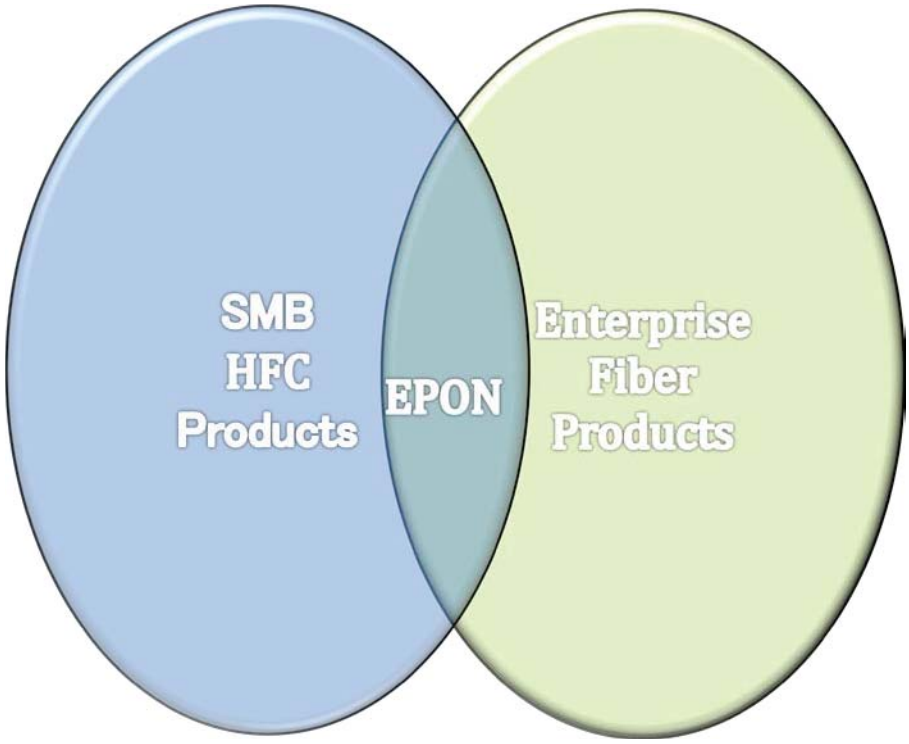


It should be noted that as a population, commercial subscribers behave more like high-end residential subscribers. They tend to adopt bandwidth intensive applications like cloud storage, which has usage and demand patterns similar to peer to peer file sharing in that they are both consistent and always running, making them very difficult to oversubscribe on a shared network. Since we know that commercial subscribers behave similarly to our high-end residential subscribers, we can use Neilson's law to predict demand growth and anticipate the increasing demands of the growing commercial segment. In 2008, Jakob Neilson observed that the bandwidth growth of high-end customer had grown fifty seven fold over the last ten years—about 50% per year. One cable engineering executive shared privately that they are observing a doubling of bandwidth for commercial subscribers nearly ever year.



With growth rates at that pace, it is not going to be long before the expectation of commercial subscribers will require network capabilities at symmetrical speeds that are financially and operationally impractical using DOCSIS.

Unfortunately, even though the cost of constructing fiber is similar to coax, the industry is still left with dedicated Ethernet equipment costs. Using this technology would force either an increase in prices or changing financial models to allow a longer payback on the capital costs. Neither of these is particularly appealing to cable operators who need to compete for commercial subscribers on both service performance and price. Fortunately, there is a lower cost method to deliver high performance services over fiber and that is Passive Optical Networking. PON provides the performance of fiber Ethernet and per subscriber equipment costs that are similar to, if not lower than DOCSIS.



Additionally, PON provides cable operators operational advantages because fiber installations are immune to RF impairments that can impact the business customer's ability to consistently operate fax machines and credit card point of sale systems that still utilize analog modems. There are many cable operators who have been using PON to connect business customers and while GPON has traditionally been the technology of choice in North America for delivering multiservice capabilities to both residential and commercial customers, EPON, for reasons that are well outlined in the author's paper "The EPON Advantage," will be the dominant shared medium fiber service delivery mechanism in terms of market share, price and performance.

As was previously stated, subscriber expectations are not stagnant and what is well served by EPON today will continue to grow exponentially over time. With this in mind it is important to look at where EPON is and what is coming next.
Today, EPON products are predominantly 1G with 10G symmetrical products just beginning to come to market. Serving customers taking a few hundred megabytes per second up-to one gigabyte per second with a 10Gps shared network is easily possible. In order to meet increased future demand the IEEE is currently working on a 40G EPON specification which will allow EPON to stay well ahead of the bandwidth growth demands of commercial subscribers. Meanwhile, the ITU is currently working on adding WDM capabilities to PON. With WDM PON we will be able to take customers who are currently sharing the same fiber and devote individual wavelengths to prevent bandwidth contention that must be managed on a shared medium. This means that not only will operators be able to deliver ever increasing amounts of bandwidth for small to medium commercial entities via EPON, but they will also be able to serve cell tower backhaul and large enterprise markets which cannot be bandwidth oversubscribed on the access network. Another strength of EPON over GPON is the CableLabs DPoE and IEEE SIEPON standards which allow for vendor interoperability and well defined management. In October of 2012 CableLabs released version 2 of the DOCSIS Provisioning of EPON standard which greatly benefits the delivery of commercial services by expanding the operations and management capabilities of EPON equipment. Lastly, the IEEE Is currently working on finalizing a new physical layer standard called EPON over Coax that will allow operators to utilize already existing coaxial drops to deliver PON services to both commercial and residential subscribers, further lowering the cost of acquiring new customers.

With performance that well exceeds even capabilities of future DOCSIS technologies while maintaining low subscriber equipment costs, EPON is an ideal solution for delivering high bandwidth, highly reliable services that the growing and lucrative segment of commercial customers are demanding. Clearly, the future of EPON in cable operator's network is pretty bright.

Bibliography

"Time Warner Cable 2012 Annual Report." N.p., n.d. Web. http://ir.timewarnercable.com/files/doc_financials/Annual%20Reports/468244_010.pdf

"Statistics of U.S. Businesses." US Census Bureau. U.S. Department of Commerce, n.d. Web. 16 Aug. 2013.

"Visual Networking Index (VNI)." Cisco. N.p., n.d. Web. 16 Aug. 2013.

"Nielsen Norman Group." Nielsen's Law of Internet Bandwidth. N.p., n.d. Web. 16 Aug. 2013.http://www.nngroup.com/articles/law-of-bandwidth/

Beesley, Bill. "The EPON Advantage." N.p., 26 Mar. 2013. Web http://www.fujitsu.com/downloads/TEL/fnc/whitepapers/EPONvsGPON.pdf

Abbreviations and Acronyms

CMTS	Cable Modem Termination System
DOCSIS	Data over Cable Service Interface Specification
DPoE	DOCSIS Provisioning of EPON
EMTA	Embedded Multimedia Terminal Adaptor
EPON	Ethernet Passive Optical Network
GPON	Gigabit Passive Optical Network
HFC	Hybrid Fiber-Coax
IEEE	Institute of Electrical and Electronics Engineers
ITU	International Telecommunications Union
RGU	Revenue Generating Unit
MSO	Multiple System Operator
PON	Passive Optical Network
WDM	Wavelength Division Multiplexing