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How Cable Can Conquer the Enterprise Market

A Heavy Reading white paper produced for Accedian Networks Inc.



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INTRODUCTION: MOVING ON UP

Over the past decade, cable operators have made strong inroads into the small to medium-sized business (SMB) markets, capturing up to 20 percent of revenues from these lucrative, rapidly growing commercial telecom market segments. In a few geographic regions of North America, operators have actually become the largest players in the lower end of the commercial market, commanding market shares of 30 percent or higher. The six largest U.S. MSOs alone collectively generated more than \$12 billion in business services revenues last year, with the total still rising about 20 percent annually.

Emboldened by their striking success with very small firms and SMBs – and needing to maintain their strong momentum in the business service market because of slowing or even lagging growth in their core residential service markets (especially video) – cable operators are now setting their sights higher, on an even bigger prize: the enterprise market of larger businesses and nationwide corporations.

In one of the latest prime examples of this effort, Comcast, the largest U.S. MSO, established a new Comcast Enterprise Solutions group last fall to tackle the big-business market and has launched a nationwide enterprise initiative with other large MSOs.

As in the small office/home office (SOHO), very small business, and SMB spaces, cable operators boast a number of assets that should serve them well in their great enterprise chase. These assets include:

- Far-reaching hybrid fiber/coaxial (HFC) networks in most geographic markets
- Substantial fiber rings in metro areas
- A strong fiber concentration in their access networks
- A tight focus on four or five main vertical markets with experienced sales teams
- Growing portfolios of managed services and other key enterprise products
- An enthusiastic embrace of Ethernet and other newer technologies
- Considerable experience deploying operationally efficient residential services
- Experience with SMBs
- An aggressive pricing approach
- The ability to offer various connectivity options as enterprise applications migrate to the cloud, meeting customer demand for faster, yet cheaper, links

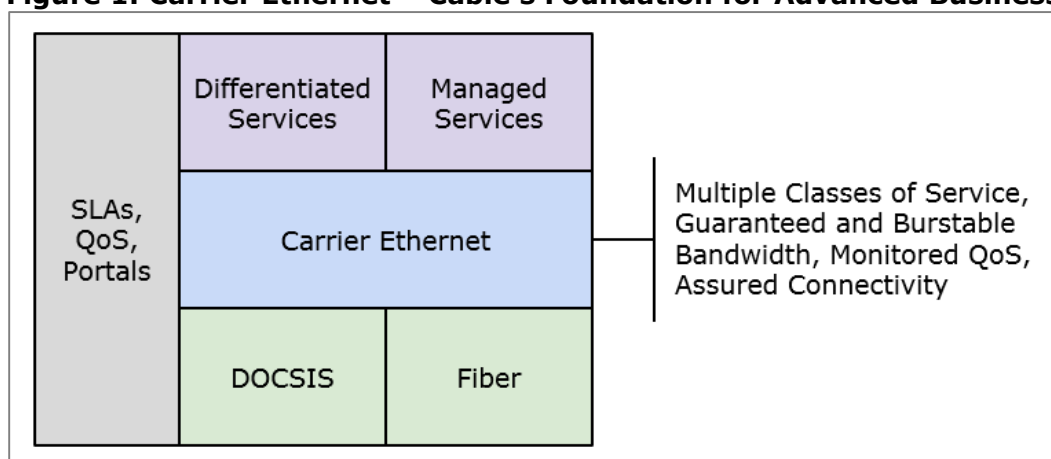
However, cable operators also face myriad challenges in trying to move up-market because the enterprise space is markedly different than the lower end of the commercial market. Big companies have very different needs than smaller firms, such as high-level IT services backed by stringent service-level agreements (SLAs) and guarantees, and more sophisticated service attributes that require more complex customer premises platforms.

Thus, cable operators require very different solutions, such as fiber-based services and comprehensive managed service offerings. Also, big regional and national companies are often looking for service providers with the same kind of large service footprints, which is a tall order for nearly every cable operator because of their limited franchise reach.

Fortunately for cable operators, there are clear ways for them to overcome these seemingly daunting obstacles in a cost-effective and operationally efficient manner. By embracing virtualization technology and the newest software-defined tools, operators can not only compete, but also offer differentiated services that leapfrog the offerings of incumbent providers.

Specifically, MSOs can use their expertise in delivering MEF-certified Ethernet services with multiple class-of-service (CoS) profiles to develop a solid foundation for new, more advanced services. They can then leverage this foundation to build a highly agile service delivery architecture that facilitates best-in-class and emerging business service differentiators: customer self-service Web portals, real-time SLA reporting, bandwidth-on-demand, and software-defined wide-area network (SD-WAN) functionality in a fabric that unites their HFC and fiber footprints.

Figure 1: Carrier Ethernet – Cable's Foundation for Advanced Business Services



Source: *Accedian*

Technological tools that enable this extensible service portfolio for cable include:

- Virtualized customer premises equipment (vCPE) solutions
- Customer portals for self-service and SLA reporting
- Virtualized instrumentation
- Lossless remote packet capture
- Big data analytics
- Network functions virtualization (NFV)
- Intelligent software-defined network (SDN) control

This white paper explores the opportunities that the enterprise market offers for cable operators. It examines the challenges that operators need to overcome so that they can compete effectively for large-business customers. It looks at the various new technologies, tools and services that cable operators must deploy to become serious contenders in the enterprise space. And it examines some lessons from pioneering MSOs such as Comcast that are already starting to put these new technologies and techniques in place, after years of lab work and pilot projects to evaluate and validate the best deployment options.

Figure 2: U.S. MSO Business Service Revenues, 2016

MSO	1Q16	2Q16	3Q16	Year-to-Date	Projected Full Year
Comcast	\$1.31 billion	\$1.36 billion	\$1.40 billion	\$4.07 billion	\$5.50 billion
Charter	\$1.30 billion	\$1.34 billion	\$1.38 billion	\$4.02 billion	\$5.44 billion
Cox	\$520 million*	\$540 million*	\$560 million*	\$1.62 billion*	\$2.20 billion
Altice USA	\$290 million*	\$300.8 million	\$297.6 million	\$887.4 million*	\$1.20 billion
Mediacom	\$55.7 million	\$57.4 million	\$58.1 million	\$171.2 million	\$230 million
CableOne	\$23.8 million	\$24.5 million	\$25.4 million	\$73.7 million	\$100 million

* Heavy Reading estimate

Source: Heavy Reading

THE LURE OF THE ENTERPRISE MARKET

In their sales and marketing approaches to the commercial services market, cable operators have typically focused on several key business verticals: education, hospitality, healthcare, government, and financial services. These various verticals encompass entities such as local and regional school systems and universities; hotels, casinos and convention centers; hospitals, medical offices and health care networks; municipal offices, libraries and police departments; and banks, insurance and investment companies. To their credit, cable operators have generally succeeded in making deep inroads into all these verticals with SMBs.

However, cable providers have generally not been able to capture the cream of the crop of these vertical sectors – the bigger enterprises with one large facility or multiple facilities across a large region – for a variety of reasons that this paper will explore. So cable players have been largely left to pine away for the biggest telecom services contracts that still lie mostly beyond their reach.

It's easy to see why cable is so motivated to go after the elusive enterprise market. It consists of prestigious global, national or regional corporations and institutions, topped off by the giant Fortune 500 companies. Consider such huge examples as Microsoft, Marriott, Citigroup, Google, UnitedHealth, Apple, Bank of America and Costco, as well as thousands of smaller but still substantial companies. Enterprise companies and organizations have significant broadband networking needs and increasingly are relying upon the cloud and online service applications. These entities also have huge employee bases that demand the fastest and most reliable connectivity and highest-quality service.

Indeed, even though there are no more than 21,000 truly large companies and institutions in the U.S., the enterprise market is sizable and extremely lucrative. Speaking at Light Reading's Future of Cable Business Services conference in New York in December 2015, for instance, Glenn Katz, VP and GM of Comcast Enterprise Solutions, estimated that the enterprise market represents a \$13 billion to \$18 billion revenue opportunity within Comcast's footprint. Top business services executives at other large MSOs such as Charter Communications, the former Time Warner Cable (now part of Charter), Cox Communications and the former Cablevision Systems (now part of Altice USA) have figured that the enterprise market represents up to a \$4 billion opportunity in their markets.

Beyond its size, luster and prestige, the enterprise market also appeals to cable operators because they realize that they could soon be out of runway in the SMB market, where they already command market shares as high as 30 percent. While operators continue to perform well in the SMB space, they know that the growth rates must start slowing down. In contrast, cable operators still have plenty of room to grow in the enterprise world, where they now command less than 1 percent market share.

Further, the enterprise market offers cable operators another golden opportunity to boost their market position by stealing business and revenues from their telco archrivals. Even more so than the SMB market, the big telcos rule the enterprise space. In fact, at the Light Reading event, Katz cited estimates that AT&T and Verizon Communications together dominate about 80 percent of the U.S. enterprise market. As they have in the SMB market, cable business services executives think they can take substantial share away from those two giants.

Finally, the enterprise market looks increasingly attractive to cable operators because, like the SMB market, it still has many companies that are using old, outdated technologies. As Katz noted at the Light Reading conference, most enterprises still have T1 lines, multiprotocol label switching (MPLS) transport, digital subscriber line (DSL) Internet connections, or related legacy technology that is ripe for a change. With cable providers building on their basic high-speed connectivity products to offer a wide variety of advanced data, video, voice, wireless and cloud-based services, they think they can lure some enterprises away from the incumbents.

"There's a lot of market share that we haven't captured that we can capture with Ethernet Internet, voice and trunking services," said Scott Fairchild, senior director of network products for Charter's Spectrum Business division, speaking at Light Reading's Cable Next-Gen Technologies & Strategies conference in Denver in March 2016. "Our product portfolio will continue to change, and that's close to our heart."

In the near term, such enterprise-oriented products include Metro Ethernet, business bundles (video, voice, data, WiFi), enhanced voice (unified messaging, SIP, PRI) and managed services (WiFi, security, WAN support). Over the longer term, cable operators are developing and deploying even more sophisticated products, such as cloud services (hosted voice, unified communications, call centers, SaaS), mobility support (mobile backhaul, small cells), managed services (threat management, telepresence) and leased capacity (bandwidth on demand, network management).

Take Comcast, for instance. Listing its big-business capabilities under the banner of a Managed Enterprise Solutions portfolio, Comcast now offers products for managed connectivity, WiFi, router, security, business continuity, voice and professional services (consulting, network design and management), among others.

Not surprisingly, then, cable's efforts to sign up enterprise customers have shifted into a higher gear. Previously, various MSOs or cable divisions occasionally reached out to providers in adjacent systems to jointly serve a business customer. Now major U.S. cable operators are taking bigger aim at the enterprise space, including by wholesaling services to one another in more diverse markets.

As Katz explained at the Light Reading event, Comcast has already initiated conversations "at the highest level with the major MSOs" about the effort. That move, which followed

Comcast's enterprise service launch in September 2015, builds on some existing wholesaling partnerships that the big MSOs have put together to serve larger business customers.

The joint effort began in December 2015 with a meeting of seven large MSOs: Comcast, Time Warner Cable, Charter Communications, Cox Communications, Cablevision Systems, Bright House Networks and Suddenlink Communications. "But in the end, we really want to have it not as a Comcast initiative; we want to have it as an MSO industry initiative," Katz said.

Katz also foresees CableLabs "working with the industry to improve the customer experience for enterprise customers," even before the more widespread rollout of SDN and NFV – referring to the twin pillars of New IP technology that should vastly simplify the collaborative process needed to support the delivery of enterprise services across multiple network footprints. Noting that the behind-the-scenes management of multiple MSO accounts with businesses now is "a mess," Katz said cable needs an overlay to manage private networks for enterprises.

Katz stated that working with other MSOs to help serve out-of-market customers could open up opportunities to access \$1 billion in enterprise business for the cable industry over the next five years, which seems doable given cable's success in the SMB market over the past decade. However, the achievement of that goal may depend heavily on how well partners do at keeping cable a collegial business – one in which MSOs that compete against each other nonetheless work together for a common good. Because that collegiality is fragile, it could break down if one MSO seeks to go after a larger slice of an enterprise's business than another. Cable operators also must be careful about how closely they work together, to avoid attracting scrutiny from government officials concerned about potential antitrust or other trade issues.

Figure 3 shows the estimated business services revenue potential for the former top five U.S. cable providers, including from large businesses, based on Heavy Reading estimates and company reports.

Figure 3: Commercial Potential – Top 5 U.S. MSOs Entering 2016

MSO	Number of Firms in Region	Market Opportunity
Comcast	5.2M – very small (<20 workers) 5.6M – total	\$10B-\$12B – very small \$10B-\$12B – SMBs \$10B-\$12B – carriers \$13B-\$15B – large enterprises \$43B-\$51B – total
Time Warner Cable	2.3M-2.7M – very small 2.5M-3.0M – all SMBs 3.0M – total	\$6.3B – very small \$17B-\$21B – all SMBs \$21B-\$25B – total
Cox Communications	820,000 – very small 1.3M – total	\$5B – total
Charter Communications	1M – total	\$9.5B – total
Cablevision Systems	685,000 – small (<100 workers) 50,000-60,000 – midsize & larger firms	\$3.0B – small firms \$3.2B – midsize & larger firms

Source: Heavy Reading

THE GREAT ENTERPRISE CHALLENGE: HITTING THE BIG TIME

Cable operators face a number of major hurdles in entering the large-business market and differentiating their offerings from those of the market-leading incumbents. As spelled out earlier, these hurdles include the enterprise market's growing requirements for an array of more sophisticated offerings, including high-level IT services, stronger SLAs, fiber-based services, comprehensive managed services, self-service Web portals, bandwidth-on-demand, and SD-WAN capabilities.

The primary challenge for cable enterprise service, though, is simply finding ways to serve nationwide or global corporations that have facilities and business lines crossing multiple MSO service areas. Overcoming this challenge requires a high level of coordination, cooperation, and business customer service support across various MSO territories.

Adding to the challenge are ownership changes affecting several major MSOs, namely: Charter's acquisition of Time Warner Cable and Bright House Networks; Altice's acquisition of Cablevision Systems; and Altice's acquisition of 70 percent of Suddenlink. With all three deals just closed within the last year or so, it will take time for those companies to sort through management changes and operational mergers before they can focus heavily on combining efforts with other MSOs to pursue enterprise customers.

Here are some of the other major challenges facing cable providers as they begin to pursue enterprise customers:

Provider Partnerships

Even as cable operators seek to develop support for each other's enterprise efforts, there are questions about the right models for partnering. In various quarters, cable providers have partnerships or sales agreements with telecom resellers to support service delivery. Similarly, some foresee a wholesale carrier model in which one MSO would serve as the lead customer contact and other providers would buy into that customer relationship.

As Dan Templin, group VP of Mediacom, pointed out at the Light Reading event, cable operators must be able to cover multiple regions and offer convenience across multiple locations, all through a single client relationship. In a similar vein, Brian Rose, director of product development for Cox Business, stated that "the opportunity for enterprise is ripe, but cable needs to be careful and thoughtful about how we approach it." To that end, Cox has been testing out-of-franchise partnerships to enable business in tandem with other MSOs or even rival telcos.

Rose also said that MSOs need to deploy new tools, such as ones being developed by the Metro Ethernet Forum (MEF), for more seamless interconnection of networks, so that services can be more easily and quickly turned on and end-to-end customer service can be delivered.

Without a national footprint, cable providers may have to rely on telcos or telecom resellers to connect enterprise locations scattered across the country. But where a cable company might team up with a telco for wholesale network access outside the cable provider's regional base, that telco is less likely to return the favor. As Katz explained it, AT&T and Verizon would rather not resell cable network access when the telcos can bundle in more of their own network services.

There are also financial disincentives for other types of service providers to partner with cable companies. On the one hand, noted Katz, a cable operator might offer the best connectivity option overall; on the other hand, if that MSO does not have network lines already built out to all of a customer's sites, there are potentially hefty construction costs that the managed service provider must weigh.

Operational Standardization

The idea of joining cable companies together to create a unified business services offering certainly makes sense on paper. But just because the umbrella technology is the same does not mean that implementation across different MSO footprints will be easy. There can be many differences in the back office, customer support policies, contract terms and more.

"From the operational side as an industry, we have to do much better," Katz said, speaking at the Light Reading conference. "We all have different SLAs. We have different ways in which we do serviceability. The reliability of those serviceability results are questionable many times. And it's very, very, very frustrating to a large enterprise CIO who is sitting there saying 'I want cable first. Your sales guy told me you can get to 80 percent of my locations. Then you go run a serviceability [check], and you really can only get to 60 percent.' That's not good."

Virtualizing and automating various commercial functions is one way that cable operators can deliver uniform services and support across their boundaries. Yet MSOs are just at the early stages of exploring how to utilize these capabilities, such as SDN and NFV, as will be detailed later in this paper.

Enterprise Service Needs

Besides being much bigger, enterprises are much different than SMBs, according to those in the commercial business. Enterprises have high-level IT needs backed by SLA requirements that can be daunting for any service provider to fulfill. Large firms generally prefer fiber-based services over cable's HFC lines, which can lead to construction costs for fiber builds to their facilities (although it is possible that some enterprises could be satisfied with the forthcoming gigabit speeds that cable operators plan to deliver with the industry's new DOCSIS 3.1 spec).

Depending on the company, enterprises may have a strong need for comprehensive managed or hosted services, including data, voice, mobile and even video. With all these services, security is paramount and will undoubtedly become more complex. While cable companies are expanding their product lines in those areas, many of those products are still in the early development stages.

Further, many enterprises are not only regional or national, but also global. Unlike the large telcos, cable companies lack critical experience in serving businesses with international locations.

Cloud Connectivity

At the most basic level, cloud service is a data center business. Whether it's about access to the public cloud or a private cloud, delivering telecommunications services to enterprise

customers means providing connectivity to the data centers that host cloud-based information and applications. Unfortunately, most cable operators traditionally haven't been involved in the data center market.

Time Warner Cable was an exception, with a track record in data centers due to its 2011 acquisition of cloud services company NaviSite. Beginning in 2015, the company started bundling cloud services from NaviSite with its own network connectivity offerings. At the December 2015 Light Reading event, Time Warner Cable executive VP Phil Meeks highlighted the importance of NaviSite as part of the company's overall business services strategy.

Comcast Business, meanwhile, has taken a different approach. "We've chosen to be data center-agnostic," said Comcast VP John Guillaume in a Light Reading interview. "Our strategy is make sure we have the right connectivity into the right data centers." Guillaume said the company measured significant growth in data center connectivity in 2015, and that momentum looks like it will continue in 2016.

Competition

As noted earlier, telcos dominate the enterprise market – and they are not sitting still. AT&T, Verizon and CenturyLink are all leaders in the Carrier Ethernet market and have been increasing their adoption of cloud-based solutions. Competition over managed services for the enterprise market also comes from major computer companies, including Microsoft and Hewlett-Packard, as well as internet players such as Google and Amazon.

Speaking at the Light Reading conference, Craig Cowden, then-chief network officer and SVP of enterprise solutions for Bright House Networks, said he no longer views AT&T and Verizon as the top players in the enterprise space. Instead, he is seeing aggressive activity from competitive players such as Level 3 Communications and XO Communications, as well as from over-the-top (OTT) players such as 8x8 Inc. "AT&T and Verizon aren't as focused on this space as they used to be," he noted, saying the operators seem more focused on their wireless business. "Other competitive operators are, but there is no reason cable can't serve this market and dominate it."

Phil Meeks, then executive VP and chief operating officer for business services at Time Warner Cable and now in charge of Charter's spectrum business division, said the competition from all sides is strong. "Time Warner Business Services will gain as much market share as we have the right to win," he said. "Companies don't like having their customers taken away from them. We are going to have to win customers one customer at a time. But we have the opportunity to do that."

Cowden said cable must improve its managed services game to compete more effectively for bigger businesses. Both he and Mediacom's Templin said their companies are gearing up to offer dynamic services that allow businesses to ratchet up their bandwidth on demand and pay for what they use.

Customer Service

To attract prominent Fortune 500 companies, cable operators must show that they can also overcome the industry's longstanding reputation for poor customer service. Each MSO can point to myriad success stories about serving schools, healthcare networks and SMBs. But

even though the industry's service issues have largely been in the residential market with cable TV, that poor reputation lingers, creating image problems that cable providers simply can't avoid.

In recent years, perceptions of cable business services among SMBs have been generally positive, according to J.D. Power & Associates' annual rankings based on its annual Business Data Satisfaction Study. However, the rankings among SMBs softened somewhat in 2014 and 2015. Moreover, large companies traditionally have ranked cable below telcos.

That trend continued in 2015, as both Time Warner Cable and Comcast fell below the segment average, as shown in **Figure 4**.

Figure 4: Data Satisfaction Rankings – Large Enterprises

Service Provider	Index Score
Verizon Communications	827
AT&T	806
Segment Average	806
CenturyLink	797
Time Warner Cable	787
Comcast	769

Source: J.D. Power & Associates 2016 Business Data Satisfaction Survey

ENTERPRISE SOLUTIONS: CABLE'S GROWING TECHNOLOGICAL TOOLBOX

How can cable operators overcome the challenges discussed above and win enterprise market business? By coupling their established expertise and assets with a growing array of new technologies and services. Namely, MSOs can use their expertise in delivering MEF-certified Ethernet services with multiple CoS profiles as a solid foundation to build a highly agile service delivery architecture. They can deliver differentiated services over this infrastructure in a cost-effective and operationally efficient manner by starting with a flexible vCPE strategy.

Indeed, by deploying a combination of efficient edge traffic processing with NFV and virtualized instrumentation, cable operators can be in a position to deliver all existing and future service scenarios without needing to carry out expensive customer premises equipment (CPE) upgrades or local site visits over subscription lifelines.

Fortunately for cable operators, their infrastructure to serve businesses remains solid. Providers can utilize their HFC plant for small businesses and build out fiber extensions for large businesses. Cable's continuing progress with Metro Ethernet, DOCSIS, WiFi and cloud are providing multiple avenues for providers to tailor services to meet business needs. In addition to utilizing its access network to provide high-speed connectivity, cable is focusing on software solutions to virtualize and automate processes.

Figure 5 charts many of the leading emerging technologies that support cable's enterprise efforts.

Figure 5: Emerging Technologies Supporting Cable Enterprise Services

Technology	Details
Carrier Ethernet	Ongoing MEF specifications, standards and tools continue to improve performance and service
DOCSIS 3.1	The next level of DOCSIS promises gigabit speed through HFC plant
Carrier-grade WiFi	HotSpot 2.0 (Passpoint) and related technologies can improve WiFi capability for business data, voice and enterprise managed services
SDN & NFV	Virtualized operations will support enterprises across MSO footprints
Big data	Usage data analytics provides insights to improve customer care and performance
Backhaul	Fiber network deployment supports cell tower backhaul, small cells and mobile data

Source: Heavy Reading

When discussing how cable operations can support enterprises, words such as virtualization, automation and dynamic services often come up. The general idea is to utilize software solutions and the cloud to serve enterprises in ways that can be easily implemented, updated and adapted. Enterprises themselves are taking advantage of these capabilities as they seek to offer more virtual services and support for their customers.

Speakers at the Light Reading conference repeatedly raised the prospect of using NFV and SDN solutions. SDN is being viewed largely for commercial service automation, and NFV as a means to centralize services in the cloud to help eliminate, or at least reduce, the need for CPE in commercial facilities. Some cable technologists believe that the industry should initially deploy NFV primarily in the commercial market, rather than in the residential space.

There are several reasons why it makes sense for MSOs to start leveraging virtualization techniques for commercial network services. First, NFV should enable MSOs to launch new business services faster, easier and less expensively, because it would eliminate, or at least reduce, the need to install new, purpose-built equipment at the customer location. Instead, MSOs could use, or reuse, existing standard hardware to deliver new cloud-based and managed services.

With such increased ease of delivery, cable providers could also develop substantially more business services than they can today. They could boost their portfolios in relatively little time by speedily trotting out new products, tweaking them when necessary, discarding the ones that don't pan out and replacing them with more worthy entries. As a result, providers could improve their competitive posture against the incumbent telcos, which already offer large, well-established suites of commercial products, particularly for larger firms.

Further, NFV offers cable operators a more flexible and agile architecture to craft and tailor services to the particular needs of different business customers, rather than just offer standard, cookie-cutter products to all firms. With the aid of virtualization techniques, operators can customize their offerings through software upgrades or app settings, instead of needing to carry out costly truck rolls to maintain and switch out equipment.

What's more, the adoption of virtualization techniques promises to cut both capital expenditures and operating costs for MSOs in the long run. Despite the hefty initial up-front investments they must make in network virtualization, operators could reduce their overall costs significantly by having less purpose-built equipment to order, install, maintain, fix and replace.

These benefits can make a notable difference to cable's bottom line. In a recent study commissioned by Amdocs, Analysys Mason calculated that the deployment of vCPE solutions could produce \$1.1 billion in net present value (NPV) benefits over the next five years for a service provider, with that sum almost equally split between added revenues and cost savings. The study estimated that it would take slightly more than three years for providers to pay back the investment in virtualization.

Analysys Mason also emphasized the importance of providers investing in vCPE early, noting that the "first movers' advantages" could include higher profit margins. As they use vCPE to cut costs, early movers could still keep prices steady because rival providers would not be able to cut their prices yet. In contrast, providers that are late to adopt virtualization would bear increasingly higher lost opportunity costs.

Of course, cable operators also face some daunting challenges in adopting NFV for business services. For one thing, operators must possess the technical capability to virtualize their networks and make the shift from a hardware-driven to a software-driven architecture. That's no easy task, and it does carry some risks.

Also, cable operators must thoroughly automate and orchestrate their service delivery, provisioning and billing processes to take full advantage of NFV's potential. As part of this effort, they must turn to a more advanced toolset that will enable them to design, test and launch new services rapidly. Otherwise, they will be stuck with long, drawn-out, harder-to-manage manual processes, impeding their ability to roll out new services to business customers quickly and efficiently while realizing significant cost savings.

During the Light Reading conference, panelists listed the primary challenges involved in implementing SDN and NFV for cable business services:

- More standards needed, especially open standards
- Maturity level of emerging technologies
- Operational processes, particularly the integration with OSS/BSS
- Need for customization to accommodate the needs of different businesses and organizations

But the migration to virtualization is not about to happen overnight. Consequently, cable providers will likely find themselves operating in a hybrid world for at least several years. To cope in this hybrid environment, providers will need to improve the delivery of their traditional business services through the use of service automation and orchestration. That will make it easier for them to manage traditional and virtualized services at the same time and upgrade to greater virtualization over time.

In the next section, we will describe how one large U.S. MSO, Comcast, is trying to attack the virtualization question in the commercial services space.

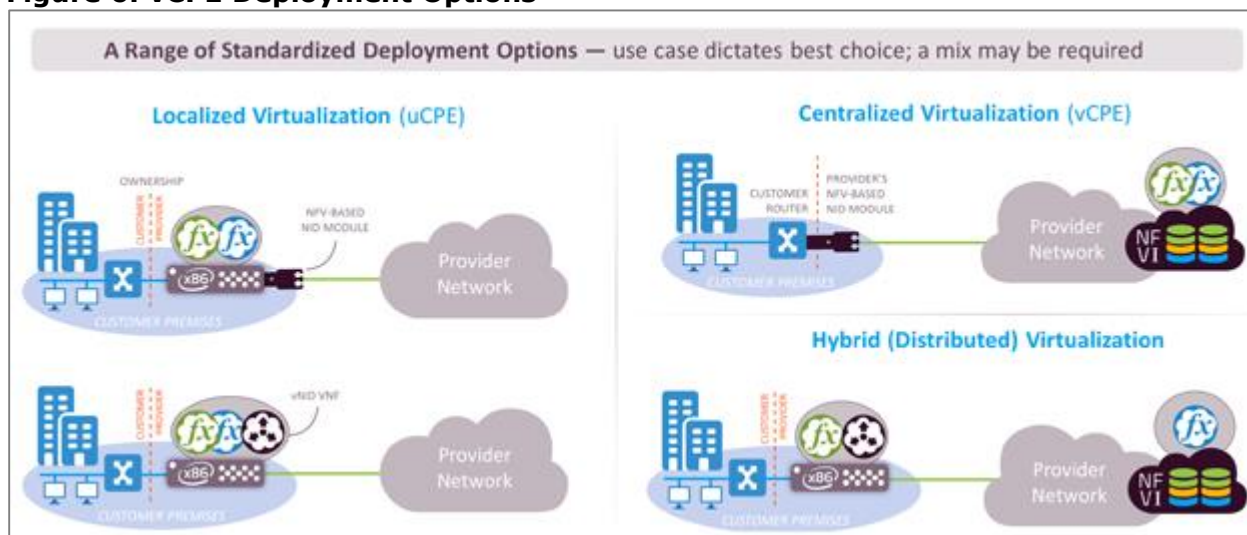
MSO CASE STUDY: COMCAST BUSINESS TACKLES vCPE

Like a number of large North American MSOs, Comcast is experimenting with the use of virtualization to deliver communications services to enterprises and other business customers and prospects. North America's largest MSO is aiming to leverage SDN and NFV technologies to improve scalability, introduce new products faster and easier, enable greater customer self-service, and generally offer better performance and execution to its commercial clientele.

In particular, seeking to install commercial off-the-shelf (COTS) equipment in the customer premises and shift key physical network and equipment functions to the cloud, Comcast executives are now sorting through various virtual CPE (vCPE) options and studying different use case models. "Pretty much every network function can be virtualized," said Nagesh Nandiraju, director of network architecture for Comcast, speaking at Light Reading's Cable Next-Gen Technologies & Strategies event in March 2016. "Whether it makes business sense, or makes technological sense, is where we're evaluating these different functions."

For more than a year, Comcast has been exploring a number of virtualization options in its Philadelphia labs. These options include: two types of localized virtualization, or uCPE; centralized virtualization, or vCPE; and a hybrid, or distributed, combination of these.

Figure 6: vCPE Deployment Options

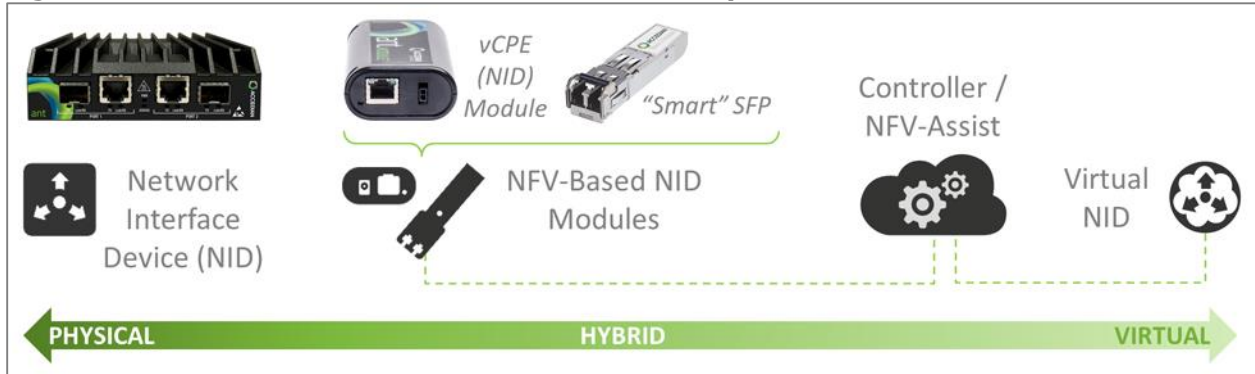


Source: Accedian

In an interview, Ken Countway, VP of Network Architecture at Comcast Cable, explained that "everything is on the table" for the MSO right now. He said a virtualization solution could just be a simple network interface device (NID) in the customer premises, with "the rest of the horsepower in the cloud." However, like Nandiraju, he cautioned that "some things work better in the customer premises," while others work better in the cloud.

Among other things, Comcast is weighing the development of a lower-featured vCPE approach and a higher-featured option where more virtualized network functions (VNFs) could be enabled at the customer premises. The "real question," Countway said, is how many other "flavors" to craft for commercial customers that fit in between the two ends of the scale."

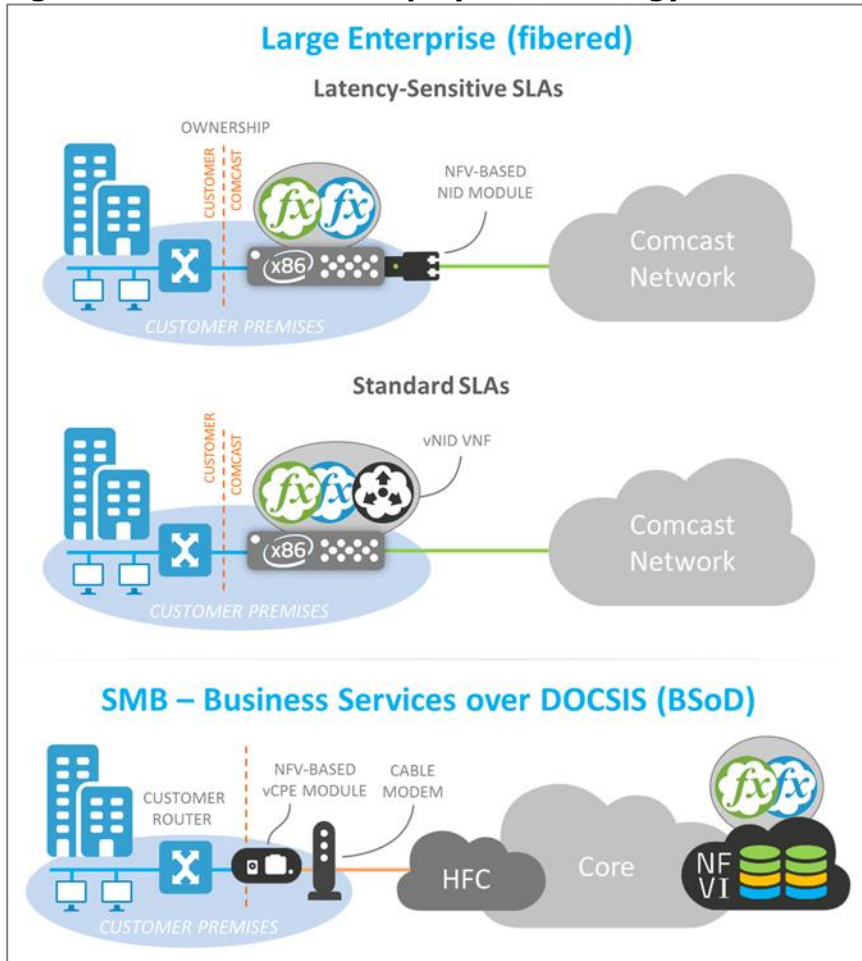
Figure 7: Customer Site Network Demarcation Options



Source: Accedian

As Comcast executives gain experience with this approach, they will be able to migrate to a distributed vCPE approach that adds scale and flexibility with cloud-based VNFs. This allows functions to be offloaded from localized, on-premises COTS as they age, and as capacity constraints start to emerge when customer usage and service diversity increases.

Figure 8: Comcast vCPE Deployment Strategy



Source: Accedian

Comcast's overall large business vCPE strategy seems well thought-out and efficient. It allows the MSO to gain experience with VNFs immediately and reduce the footprint of on-premises appliances while providing a pathway to a highly scalable, centrally orchestrated, distributed vCPE model in the future. It should allow Comcast to move ahead while other cable operators watch vCPE technology evolve from the sidelines.

Finally, Comcast is looking at how to leverage SD-WAN technology for WAN edge routers, which are used to connect enterprise networks, including branch offices and data centers, over large distances. With the benefit of such a virtualized, software-defined WAN, cable enterprise customers should be able to rely more on broadband lines and less on private links, with similar SLAs. If all goes well in the lab, Comcast officials hope to start trials of some virtualization solutions by early 2017.

CONCLUSION

Over the past decade, cable operators have made great strides in serving SMBs. Business services have proven to be a valuable revenue driver for operators at a time when the core residential video business has flattened out or started to decline. In addition to carving out a large share of the SMB market, cable providers have established an important role with key business verticals and institutions, including education, healthcare, hospitality, finance and government.

This stunning success with SMBs and key verticals has now put cable in a position to achieve a goal that it has long craved: serving large companies and nationwide enterprises. While the potential business payoff is larger for cable, so is the risk. Cable providers must prove that they can compete with telcos and other service providers that play in the enterprise market, and that they have the chops to fulfill enterprises' high-performance requirements.

To succeed, cable operators must ensure that their broadband networks can consistently and reliably deliver gigabit-level service and support the managed and cloud-based services that enterprises will increasingly demand. Cable providers must also prove that they can be reliable partners and possess the flexibility to grow with their enterprise customers. Much of the fiber network infrastructure is in place or will soon be, and the rollout of the new DOCSIS 3.1 spec over HFC lines should help as well. But cable providers will still need effective tools and technologies to manage and serve enterprises, whether that means leveraging NFV, SDN, vCPE, or other means.

There are many challenges in serving large businesses that straddle MSO service territories, but Comcast Enterprise Solutions is taking the first steps toward breaking down the barriers. The big question now is how well the MSOs can work together, and how well enterprises will respond to their approach. But if the MSOs can jointly win over one major enterprise, like a Fortune 500 company, it will go a long way toward making cable a viable option for others.

As cable operators delve into the enterprise sector, they will make network improvements and add capabilities that should benefit all of the industry's commercial service efforts, and perhaps provide upside for residential service as well. It seems clear that for the enterprise market, it is time for cable to get down to business.