Gigabit Internet Over Coax? DOCSIS 3.1 Revs up the Cable Connection

By Craig Leddy

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About the Author

CRAIG LEDDY is a veteran cable industry writer, speaker and market analyst, and a contributing analyst for Heavy Reading, an Informa property. Leddy founded Interactive TV Works, a media consultancy, to promote understanding of advanced digital services. He is a former editor of Cablevision Magazine, senior analyst for The Myers Group and contributing editor for Multichannel News. He teaches the popular How Cable Works industry courses that include CTAM's How Cable Goes to Market. He also founded and hosts the Interactive Launch Competition, a leading case study contest for business students.

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FACT OR MYTH: TO PROVIDE BUSINESS CUSTOMERS WITH GIGABIT INTERNET SPEEDS, CABLE PROVIDERS MUST USE

a dedicated fiber-optic connection rather than traditional coaxial cable.

The answer: myth. While some business customers may prefer a fiber connection, cable is adopting new technologies that are enabling multigigabit speeds over existing coaxial connections, just like fiber. What's more, additional technological upgrades will support gigabit speeds symmetrically — downstream and upstream — to better prepare businesses for richer cloud solutions, more video applications, virtualization and the Internet of Things (IoT). By relying upon existing network connections, cable and its channel partners will be able to offer gigabit speeds in many areas without the additional time and expense of building new fiber plant to business locations.

These advances are the result of DOCSIS 3.1, the latest specifications for cable internet services. DOCSIS 3.1 (sometimes referred to as D3.1 or just "three-dot-one" and branded as Gigasphere) enables downstream speeds on the order of 10 gigabits per second using cable's traditional hybrid fiber coaxial (HFC) delivery architecture. For a business customer, the only equipment required for the higher speed coax connection is a new 3.1 cable modem, which most likely will include an advanced Wi-Fi router to support ultra-high-speed wireless internet service as well.

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Make no mistake: Cable providers love fiber and will continue to deploy it religiously. Dedicated fiber connections empower cable's Metro Ethernet services. Even while preserving HFC architecture, cable providers are pulling fiber-optic wires further into their networks in a strategy known as deep fiber (or fiber deep, depending on your semantic preference). In new-build, greenfield areas, cable often is using fiber-to-the-home (FTTH) architecture. One major cable provider, Altice USA, owner of the former Cablevision Systems and Suddenlink Communications cable systems, is breaking ranks with the HFC faithful by embarking on an effort to go all-fiber by the end of 2022.

But upgrading a network with all fiber can become laborious and expensive, largely due to all of the construction that must be done. For businesses that insist on a fiber connection for their internet needs, a provider today often has to build a dedicated fiber line to their industrial park, commercial zone or company location. Yet if the HFC plant already passes those businesses, then a connection to the customer potentially can be made much more quickly and deliver gigabit internet using 3.1. It might require some education to convince IT administrators that they can get the same bandwidth capacity with coax as they do with fiber, a concept that once seemed preposterous.

Similarly, channel partners themselves need to get educated about DOCSIS and learn about their cable partners' plans. When asked if they were familiar with DOCSIS, more than one-quarter of channel partners responding to the Channel Partners' 2017 Cablecos & The Channel: State of the Market survey said "no."

Are You Familiar With DOCSIS?

Yes
71%

No
29%
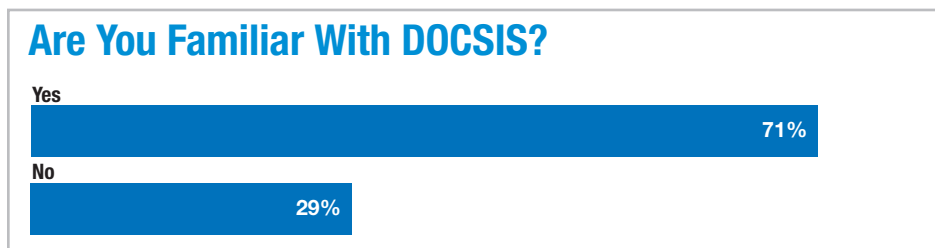
Source: Channel Partners' Cablecos & The Channel: State of the Market Survey, March 2017

Channel partners and their customers will be hearing more about DOCSIS 3.1 as it enters the business arena. Comcast Business is rolling out Business Internet 1000, a DOCSIS 3.1-based gigabit internet service that it plans to offer throughout its service areas. The 3.1 service was cited in Comcast's recent statements about a forthcoming SD-WAN (software-defined wide area network) product, first announced during the 2017 Channel Partners Conference & Expo. In May, Comcast said it is beta testing the SD-WAN product, which uses Versa Networks' Cloud IP Platform, and will roll it out later this year.

DOCSIS 101

Although it's hard to imagine today, there was a time when cable providers debated whether to adopt the internet as a cable service offering. In the early 1990s, some questioned whether the internet was a passing fad along the lines of CB (citizens band) radio, the truckers' communications that in the 1970s gave us such wonderful cultural expressions as "10-4 good buddy."

Most cable leaders foresaw the advantages of the internet and moved to embrace it. The question was how to do it — how to make the internet "interoperable" with standard cable technology and its hybrid fiber-coaxial (HFC) architecture.

The task of figuring that out fell to CableLabs, a consortium of cable providers and technology suppliers headquartered near Boulder, Colorado. Their crowning achievement was DOCSIS (data over cable service interface specification, pronounced *dock-sis*), a clunky piece of jargon with a huge impact. DOCSIS provides the specifications that cable providers use to enable internet service over cable. Additionally, CableLabs established processes to certify DOCSIS cable modems and related products, both for cable providers and the retail market.

The original DOCSIS specs morphed into various versions aimed at improving speed and capability while preserving HFC architecture. The table below by CableLabs shows the evolution of DOCSIS capability and the large leaps in downstream capacity in DOCSIS 3.0 and 3.1. Upstream capacity also has increased but not to the symmetrical gigabit levels that some believe will be required in the future, which has promoted the effort to increase upstream speed through a specification extension, full duplex DOCSIS (FDX).

Cable Broadband Technology Evolution, 1990s to Present

Broadband Generation	DOCSIS 1.0	DOCSIS 1.1	DOCSIS 2.0	DOCSIS 3.0	DOCSIS 3.1
Highlights	Initial cable broadband technology	Added voice IP service	Higher up-stream speed	Greatly enhanced capacity	Capacity and efficiency progression
Downstream Capacity	40 Mbps	40 Mbps	40 Mbps	1 Gbps	10 Gbps
Upstream Capacity	10 Mbps	10 Mbps	30 Mbps	100 Mbps	1-2 Gbps
Production Date	1997	2001	2002	2008	2016

Source: CableLabs

What Is DOCSIS 3.1?

After powering cable's high-speed internet rollout for nearly 20 years, DOCSIS technology is ready to take cable into the gigabit era. 2017 is poised to be "the year of 3.1." Specifications have been transformed into products, field trials are ongoing and more deployments are in the offing.

In January 2016, CableLabs certified the first DOCSIS 3.1 cable modems. Comcast has developed its own 3.1-compatible gateway for internet, video and wireless, originally called the XB6 and recently renamed the xFi Advanced Wireless Gateway. Cable's typical strategy is to introduce new products in the residential market before the commercial market, so at this point it isn't clear how quickly the 3.1 gateways will be made available to businesses.

DOCSIS 3.1 represents a quantum leap in capability compared to previous DOCSIS versions. The technology increases the efficiency of the traditional HFC plant largely by introducing orthogonal frequency-division multiplexing (OFDM), a signal modulation technique often used in mobile and other telecommunications. The following is a list of key technical benefits of 3.1:

- **Speed:** Support for up to 10 gigabit/s downstream and 1-2 gigabit/s upstream network capacity.
- **Fluid Deployment Strategy:** Backward compatibility provides a flexible migration path for cable providers.
- **Cost Reduction:** Up to 50 percent more data capacity over the same spectrum relative to DOCSIS 3.0.
- **Higher Capacity Over Existing HFC Network:** No plant upgrades required. Supports more spectrum for even more capacity.
- **Quality of Experience (QoE):** Active queue management (AQM) improves responsiveness for richer web applications.

Comcast started trialing 3.1 in 2015 and began an aggressive plan to continue launches, according to Robert Howald, vice president of network architecture for Comcast. "Being able to do gigabit on coax is an extremely powerful thing. We're tracking the performance and it's been very robust. It's a great success story for the industry and we're excited about where it's going to take us," Howald said, during a webinar hosted by Light Reading, a Channel Partners sister publication.

While most of the major cable providers are embracing 3.1 and supporting HFC, each company will be careful to manage costs and their return on investment, which includes expenditures on new modems or gateways and eventual upgrades in the cable access network.

"Coax has a long useful life, but we have to optimize each and every spend and justify the next steps," said Jeff Finkelstein, executive director of advanced architecture, Cox Communications.

The following chart shows cable MSO (multiple system operator) plans for DOCSIS 3.1 in North America and abroad.

Cable Service Provider DOCSIS 3.1 Deployment Plans

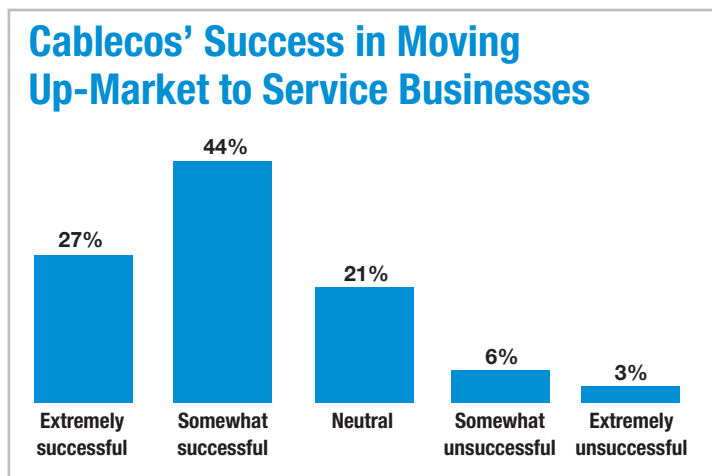| MSOs	Deployment Plans
Comcast	Launched D3.1 service in five markets (Atlanta, Chicago, Detroit, Miami and Nashville) in 2016; plans call for adding 10 more residential markets in 2017 Launched D3.1 service for business customers in four markets (Atlanta, Chicago, Detroit and Nashville) in January 2017
Charter Communications (Spectrum)	Issued RFP to vendors for D3.1 cable modems; considers plant ready
Cox Communications	Testing D3.1; plans to start deploying D3.1 commercially later in 2017
Mediacom Communications	Launched D3.1 service in fall 2016; now offers service to 40% of homes passed Plans call for covering rest of its three million-home footprint by August 2017
WOW	Launched D3.1 service in five markets in fall 2016; plans to extend service in 2017
Rogers Communications	Plans to start deploying D3.1 commercially in Canadian markets later in 2017
Shaw Communications	Plans to start deploying D3.1 commercially in Canadian markets in 2017
Liberty Gold	Plans to start field trials of D3.1 in Europe in late 2017
NBN	Plans to start deploying D3.1 commercially in Australian markets in 2017
Vodafone New Zealand	Launched D3.1 service in New Zealand markets in November 2015
TDC	Launched D3.1 in Denmark last summer; will complete plant upgrade by end of 2017

Source: Heavy Reading, Light Reading

Moving Up-Market

For cable and its channel partners, DOCSIS 3.1 provides more opportunities to solidify cable's SMB market and move up-market to attract large companies and multisite enterprises. While DOCSIS 3.1 pricing and packaging has not emerged yet for business customers, it's anticipated that marketers will use the new capability to upsell customers to higher-speed tiers and bundle it with services such as security, cloud applications and SD-WAN.

Two years ago, Comcast, which sees enterprise as a $13-$15 billion annual revenue opportunity in its market, launched a separate Enterprise Services unit to attract Fortune 1000 businesses. Now Comcast Business is adding its 3.1-based Business Internet 1000 and SD-WAN to its product mix.

In making its recent SD-WAN announcement, Comcast noted that D3.1 adds to its wide range of multigigabit, fiber-based Ethernet services across the country. The company said, "The combination of SD-WAN capabilities and high-performance broadband and Ethernet network services creates a powerful offering for midmarket and large enterprises investing in hybrid WAN solutions."

Cable's up-market moves are getting noticed among channel partners, according to Channel Partners' seventh annual Cablecos & The Channel: State of the Market survey. More than 70 percent of survey respondents, including agents and others in the channel partner sales and distribution chain, said cable providers have been extremely or somewhat successful in their efforts to move up-market from their SMB base to serve larger companies and enterprise businesses.

Cablecos' Success in Moving Up-Market to Service Businesses

Extremely successful	Somewhat successful	Neutral	Somewhat unsuccessful	Extremely unsuccessful
27%	44%	21%	6%	3%

Figures do not total 100% due to rounding.
Source: Channel Partners' Cablecos & The Channel: State of the Market Survey, March 2017

Going Symmetrical

Now that DOCSIS 3.1 is enabling multigigabit speeds downstream, the next task is to facilitate those same high speeds upstream. Cable providers want to offer symmetrical gigabit speeds and serve business customers that transfer large files, use video extensively and will engage in richer interactive applications, cloud services, virtualization, augmented reality and IoT.

Broadband usage, now fueled by video and mobile, is escalating in double-digital percentages annually, with higher use expected from IoT and other apps. For years, DOCSIS development was focused largely on downstream capacity. HFC posed limitations in the upstream path, which really didn't matter — until now.

CableLabs is working on an extension of DOCSIS 3.1 called full duplex DOCSIS (FDX) that vastly increases upstream speed. FDX uses the same bandwidth for upstream that is used for downstream. It is like a high-speed train going in one direction, sharing a track with a high-speed train traveling in the opposite direction. To avoid a collision, FDX employs echo cancelling technology and unique techniques to eliminate any interference.

Like DOCSIS 3.1, FDX relies upon cable's existing HFC architecture, although it requires significant changes in the cable access network, or "last mile." Due to the complexity, CableLabs's FDX specifications are not expected to be completed until the end of 2017, with trials and rollouts to follow in 2018 and 2019.

As cable prepares to take advantage of DOCSIS 3.1 and FDX capabilities, providers are embarking on the most significant upgrade of their access networks since they first embraced fiber networking and digital technology.

In a series of changes in the last mile of their networks, cable providers are pulling fiber deeper into their HFC plants and pushing more functionality to the network edge in what's known as distributed access architecture (DAA). To maximize capacity for the upstream path, cable engineers eventually will remove the amplifiers located between fiber nodes and homes to create a passive network (in engineering speak this is called node+0).

These technologies support cable's ongoing migration to an all-IP cloud delivery network. While a primary focus is to increase overall bandwidth capacity, the next-generation architecture is designed to support more efficient routing by tailoring capacity to meet high-density usage and peak traffic demands.

To create a smart access network, cable providers are employing big data analytics to better manage internet traffic and performance. For example, Time Warner Cable, prior to its acquisition by Charter Communications, prioritized its fiber nodes based upon areas of high business concentration to ensure customers got the bandwidth they needed. Similarly, Cox Communications uses predictive modeling to determine placement of Wi-Fi host spots for anticipated wireless traffic.

The result is a faster, smarter access network that can manage traffic in a more efficient manner — a positive effect for any businesses that are heavy internet users.

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