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Fiber Deployment Study

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Expanded Fiber Deployments: Is Now the Time?

As subscribers' bandwidth demands continue to surge, broadband providers are seeking smart ways to add capacity while delivering faster and more reliable connections.

Many are turning to fiber network expansions to meet these needs and to prepare for future technologies that could cause additional increases in capacity requirements.

In 2017, Verizon signed a deal to purchase more than 37 million miles of optical fiber from Corning over the next three years.[1] A recent survey of CED subscribers showed that while most respondents are expanding or planning to expand their fiber footprint, some are instead opting to focus on their current network.

The CED survey was conducted in October and November 2017 and received 117 responses. Survey participants were largely made up of professionals in the cable and broadband industry and held a range of positions including president, CTO, CEO, VP of business development, systems administrator, director of operations, senior architect, senior engineer, lead system technician, head of IT telecom & network, and HFC network manager, among others.

Though some respondents are committing to fiber all the way to the home/premises (FTTH/FTTP), others, while driving fiber deeper into their networks, are taking a more constrained approach given the cost and time needed for deployment. Where fiber expansion doesn't make sense, some respondents are looking to technologies like DOCSIS 3.1 to help expand capacity.

In this report, we'll take a dive into challenges of fiber expansions, the benefits of FTTH/FTTP deployments, and the alternative technologies respondents are leveraging to meet customer needs.

Expanding Fiber for Future Needs

The majority of those participating in the CED survey said they currently have fiber expansion plans. Forty-one percent said they were already in the process of expanding their fiber footprint, while nearly 9 percent plan to get started within the next six to 12 months. About 15 percent planned a future expansion, but were unsure of timing.

Responses to the CED survey reflected a range of reasons for choosing to go the fiber route, with many respondents citing capacity, long-term strategy, and future-proofing operations as drivers. Pushing fiber to the premises was commonly cited as an expansion tactic.

"We see FTTP as the long-term answer for the escalating bandwidth demand, as well as plant stability," one respondent wrote. Another said they decided to expand their fiber footprint to centralize "technology on one platform—fiber—as the long-term solution."

These responses are in line with what consultants at IBB Consulting, a firm involved in guiding fiber initiatives for several top cable operators, are seeing. In an interview with CED, IBB fellow Dan Dodson said that in the last couple of years he's seen operators taking a longer-term view in terms of fiber strategies and developing 10-year plans.

"[Operators] look forward to demand growth, and then also technology evolution," Dodson said. "[They] think about the differences in the footprint, and come up with a plan so that they can get busy doing the right thing in each market, or each part of the market they have."

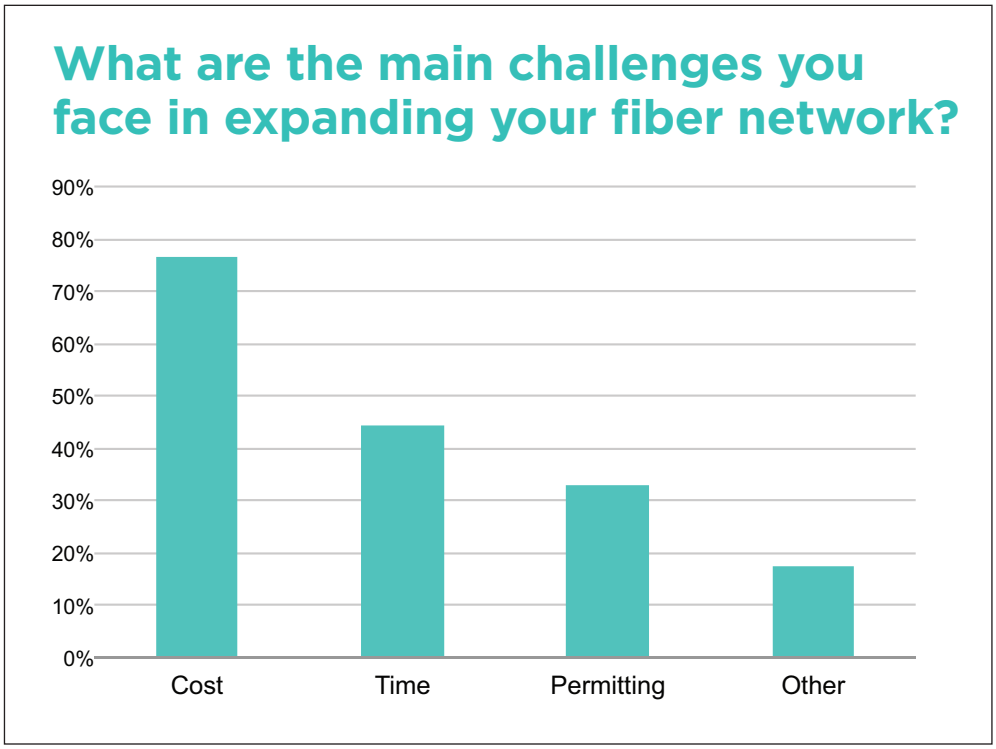
One CED survey respondent said their company had already added new technologies, and "the next step will be getting fiber deeper to shrink node sizes." Another said, "Once fiber is to the customer, the plant portion is complete forever. To add more capacity you just have to change the equipment at the ends." The same respondent added that operation costs are less.

In addition to expanding their own footprint for internal use, some survey participants said their companies are looking to build out infrastructure that others may use, like wireless operators. One respondent noted the reason for fiber expansion was to "enlarge our customer base and have the infrastructure to lease dark fiber."

However, 35 percent of respondents said they planned to focus on their current network infrastructure rather than new fiber deployments.

Many of those surveyed who are focused on their

1 CED magazine, "FCC Chairman Applauds Verizon's Fiber Deal with Corning." April 2017. https://www.cedmagazine.com/news/2017/04/fcc-chairman-applauds-verizons-fiber-deal-corning



current network said they planned to make use of DOCSIS 3.1 to expand capacity.

One respondent indicated their company also intended to make use of "microwave, copper, and fiber facilities where available, and fixed wireless."

Costs vs. Capacity

When making the decision to deploy more fiber there are a variety of challenges to consider, but one factor stood out in CED's survey results: cost.

Slightly more than three-quarters of respondents named cost as the main challenge in expanding their fiber network.

Although costs can vary depending on the type of build (brownfield vs. greenfield, underground vs. aerial), construction and labor costs were mentioned repeatedly in interviews with industry executives.

Since a large chunk of labor is cost per cable, John Chamberlain, the director of the office of the CTO at CommScope, suggested that if operators have made the choice to spend money on fiber construction, for whatever reason, they put in as many fibers as they can afford.

Labor is not only costly, but intrusive and time-consuming. By laying down additional fiber, even if it's not all connected at the time, operators will have the ability to meet future market and capacity needs without having to spend money on labor again to put in more fiber later on, according to Chamberlain.

This sentiment was echoed in responses to the CED survey, with "futureproofing the network" and "increasing bandwidth demand" as notable factors driving respondents' fiber count decisions.

"Explosion of network demands and possible future usages," one respondent wrote regarding their fiber count decision. Another participant said they were putting in as many strands of fiber as possible, adding, "Why repeat labor costs?"

When it comes to fiber-to-the-home deployments, IBB Consulting's Dodson noted the majority of costs are unlikely to decrease in the future. He indicated an IBB analysis conducted for a client a few years ago found that most of the cost of deploying FTTH is labor—not the technology itself—and labor costs tend to increase over time.

A large majority of survey participants are not leaning on the Federal Communications Commission (FCC) or federal government for funding to defray costs to complete their fiber expansions.

Less than 20 percent said they are receiving monetary support for their fiber deployments from the FCC's Connect America Fund or other government funding, in contrast to nearly 81 percent of respondents who are not utilizing federal support.

However, the FCC is planning to award nearly $2 billion over the next ten years to expand broadband service in underserved areas through the CAF Phase II reverse auction, which is set to begin in 2018.[2] The FCC provides support to local service providers to subsidize the cost of building new network infrastructure or performing network upgrades to provide voice and internet service in underserved areas.

Among survey respondents, rural areas accounted for 36 percent of fiber expansion plans. Other responses were fairly split between urban and suburban deployments, with 58 percent indicating they were deploying fiber in urban areas, and 56 percent focused on suburban fiber expansions.

Dodson said another factor to consider when choosing to expand fiber is the expected growth in that area. He noted that a university town, for example, would likely see different demographic trends than a community with many retirees.

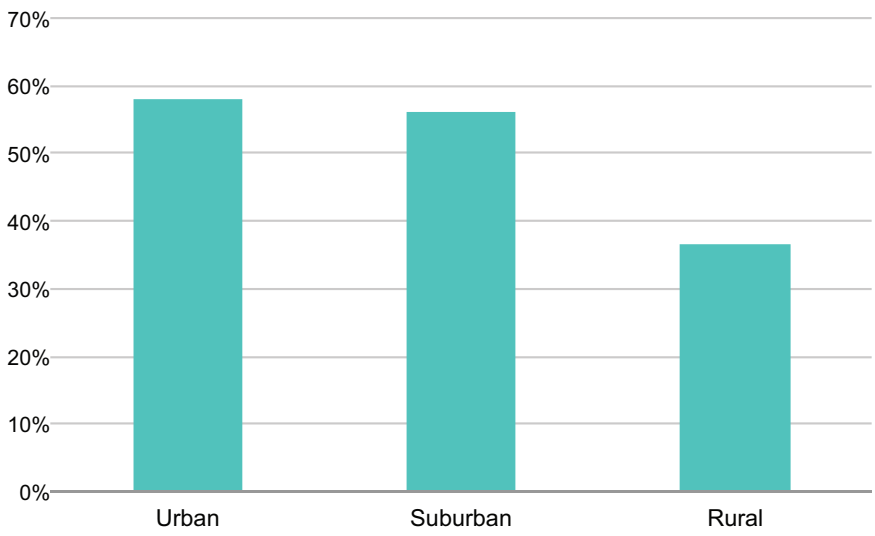
Time Expenditures and Permitting Delays

In addition to cost, 44.5 percent of respondents named time as one of their greatest fiber expansion challenges. Timing issues are related to costs—time is money in any construction project. But time also is linked to the third-biggest challenge facing respondents: the permitting process, identified by 33 percent of participants as a major hurdle.

Receiving permits from local governments and access to right-of-ways can be time-consuming obstacles on their own, but some new entrants also have faced pushback from incumbent operators.

For example, the Nashville Metro Council tried to get ahead of the problem in 2016 by passing a "One Touch

Is your expansion focused primarily on urban, suburban, or rural areas?



2 CED magazine, "FCC Seeks Comment on Procedures for 2018 Connect America Fund Auction." August 2017
https://www.cedmagazine.com/news/2017/08/fcc-seeks-comment-procedures-2018-connect-america-fund-auction

Make Ready" (OTMR) ordinance that gives new ISPs faster access to utility poles by allowing a company to adjust and install their wiring on poles instead of waiting for incumbents to do the work.[3] Google Fiber ran into trouble when AT&T and Comcast sued the metro government in U.S. District Court and convinced a judge to nullify the ordinance on the grounds that federal and local laws preempted the OTMR rule.[4]

In that case, Google Fiber indicated it would move ahead with installation by instead relying on shallow digging installation techniques called microtrenching.

Despite another lawsuit from AT&T, a similar ordinance survived in Louisville because Kentucky is one of 20 states that opted out of regulations that give the FCC jurisdiction to regulate pole attachments for privately owned poles.[5]

Just over 17 percent of respondents cited other obstacles as main challenges, with manpower cropping up as a recurring theme. Many participants echoed one respondent's comment that a significant hurdle to fiber expansions was the "availability of experienced installers and technicians."

The worker shortage has risen to the attention of the FCC, with Commissioner Brendan Carr noting in October that the issue is impacting broadband, wireless, and infrastructure companies alike. Carr vowed to work with telcos to ensure operators have access to the skilled workforce necessary to build next-generation networks.[6]

Survey respondents seemed to have some hope that these challenges will be worked out over the next two years, or at least not intensify. Nearly 32 percent said they expect these problems will be alleviated in that timeframe, while another 39 percent felt the hurdles would remain the same. Almost 16 percent of respondents, however, expected deployment challenges to get worse, and an additional 14 percent said they were not sure what to anticipate.

Drivers for FTTH/FTTP

Fiber-to-the-home or fiber-to-the-premises approaches are gaining traction, the survey found, with a sizable number of respondents reporting that more than half of their fiber deployment plan was FTTH/FTTP.

In 2016, more than 1,000 entities were providing FTTH services in the U.S.[7]

At least one major U.S. cable operator, Altice USA, has committed to a full FTTH strategy, while AT&T has committed to reaching 12.5 million locations with its FTTP build by mid-2019. Speaking at a December conference, AT&T CFO John Stephens said the company's penetration rates are significantly higher in markets where it offers fiber than in other areas.

Results from the CED survey showed about 32 percent

Top 10 Reasons to Expand Fiber Footprint

1. Broaden bandwidth/meet bandwidth demands
2. Immunity to electromagnetic interference
3. Low attenuation loss over long distances
4. Material cost and theft prevention
5. Electrical insulator
6. Security of information passed down the cable
7. Speed and reliability
8. Future expansion capabilities; capacity
9. Increase customer base and have the infrastructure to lease dark fiber
10. Increase last mile

3 CED magazine, "Nashville Sees One-Touch make Ready Approval Finalized." September 2016.
https://www.cedmagazine.com/news/2016/09/nashville-sees-one-touch-make-ready-approval-finalized

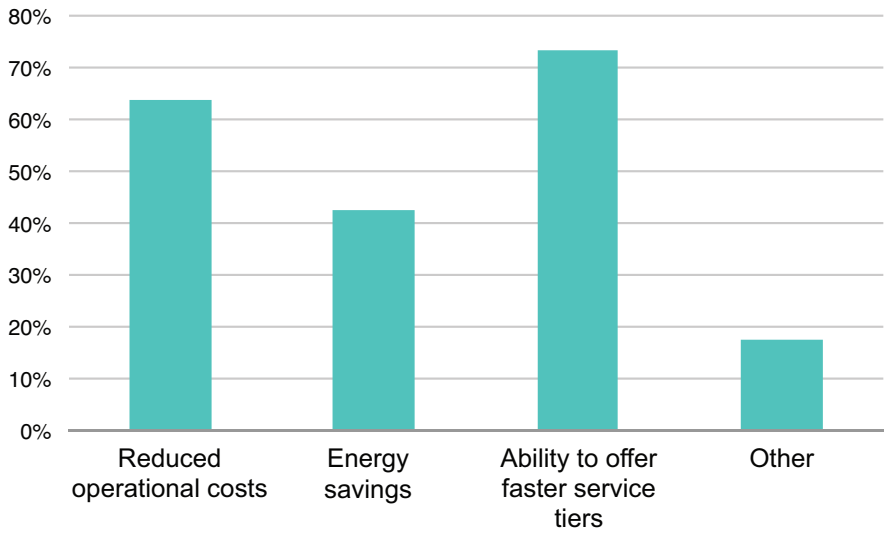
4 Tennesseean, "Judge Rules Against Metro Nashville, Blocks Google Fiber-backed Utility Pole Policy." November 2017.
https://www.tennessean.com/story/money/2017/11/22/judge-rules-against-metro-blocks-google-fiber-backed-utility-line-policy-at-t-poles/889313001/

5 CED magazine, "Utility Poles Make Louisville, Ky., Gigabit Internet Plans Trickier." February 2016.
http://www.cedmagazine.com/news/2016/02/utility-poles-make-louisville-ky-gigabit-internet-plans-trickier

6 Wireless Week, "Carr Says FCC Will Take Up Wireless Infrastructure Permit Review at Next Meeting." October 2017.
https://www.wirelessweek.com/news/2017/10/carr-says-fcc-will-take-wireless-infrastructure-permit-review-change-next-meeting

7 BBC Mag, "What Fiber Broadband Can Do for Your Community." November 2016.
http://www.bbcmag.com/Primers/BBC_Nov16_Primer.pdf

What benefits are you expecting to reap from FTTH/FTTP deployments?



When asked, "What the main challenges are in expanding fiber network?," top answers included:

cost (76.5%), time (44.4%), and permitting (33%).

But other key challenges included: government and politics, lack of experienced installers and technicians in a respondents' territory, and technology adoption.

of respondents are planning to run fiber all the way to the home or premises. About 23 percent said that more than 75 percent of their fiber expansion would be FTTH/FTTP, while nearly 21 percent said more than 50 percent would be FTTH/FTTP, with other options where necessary. Almost a quarter of respondents said they were going mostly with other options and using a FTTH/FTTP strategy where possible.

Many respondents with plans to deploy FTTH/FTTP said they opted for that route because of cost-effectiveness. Others named bandwidth capacity, scalability, and longevity as drivers for FTTH/FTTP deployments.

One respondent named "competitive pressure" as an influence, while another said bridging the last mile from existing nodes was a feasible option for them. A third respondent noted their company is running fiber to the home in new builds to gain bandwidth and longevity, but using hybrid technologies in retrofits.

The majority of respondents running FTTH/FTTP said they planned to deploy Gigabit Passive Optical Network, or GPON, technology across their fiber. Others indicated they plan to use IPTV and fixed wireless in their deployments. A number of respondents choosing not to run FTTH/FTTP

said they instead opted to push fiber deeper to the last active, or N+0, while others were pursuing DOCSIS 3.1. Some said they were utilizing existing hybrid fiber coax (HFC) networks or copper.

Faster Speeds and Operational Savings

The CED survey also dug into which benefits respondents expected to reap from FTTH/FTTP deployments. At the top of the list was the ability to offer faster service tiers, with 73.1 percent of respondents naming this as the biggest benefit.

While competitive marketing pressure plays some part in the need to offer faster service, Kevin Bourg, optical network architect for Corning Optical Communications, said FTTH also eases future upgrades.

"One of the key benefits an operator will gain from a FTTH deployment is the ability to expand service tiers going forward with few, if any, changes to the outside plant," Bourg said.

He noted that since the early 2000s, technology advances have allowed cable operators to upgrade their deployed FTTH network from 1 Gbps speeds to between 10 and 40 Gbps today.

"In many cases, these upgrades allow operators to support backward compatibility with no changes to the outside plant," Bourg added.

Such upgrades also have happened in the fiber network before the last mile in the core network through DWDM and CWDM technology for both cable MSO and other operators, according to ATX Networks CTO Mani Ramachandran.

"This can continue in the future so core fiber network build is not an added financial burden," Ramachandran said. "Sometimes these portions of the network are the most expensive to enhance with more fibers especially in denser areas."

More bandwidth is a key feature of fiber. In an interview with CED, Dean Stoneback, senior director of engineering and standards with the Society of Cable Telecommunications Engineers (SCTE), pointed to fiber's "virtually unlimited capacity" as one of its biggest draws.

"Today's PONs are doing 10 gigabit, 40 gigabit, 100 gigabit, but it's still only using a fraction of what the fiber can really do," Stoneback said.

How much of that capacity will actually be needed in the foreseeable future is up for debate.

"Since capacity growth can be significantly impacted by local demographics, the network needs over a large region can show enormous variation," Ramachandran said. "A close study of this will lead to more cost-effective deployments which target these highly profitable venues through a combination of technologies like DOCSIS with PON."

If fiber is not your option, how will you expand capacity? Top answers:

> Cloud
> DOCSIS 3.1

Even though upfront costs were one of the top challenges for survey participants, nearly 64 percent of respondents named reduced operational costs as one of the main benefits of FTTH/FTTP expansions.

"As operators further evaluate the deployment of a FTTH network, a secondary benefit is a reduction in operational costs. All-optical networks are not impacted by environmental contaminants such as cellular bands, lighting, and other noise sources," Bourg said. FTTH networks also lower the risk of consumer-caused contaminants such as in-home network distribution or unterminated connections.

There are quite a few scenarios where the existing fiber assets can be utilized more effectively to eliminate small facilities by outdoor equipment, as the optical transport technology has evolved to increase capacity in fiber by 40x to 160x with DWDM technology, Ramachandran noted. "Finally, leakage from the cable TV plant into the environment is a phenomenon that doesn't exist with FTTH, saving operators the chore of leakage testing within the access network," Bourg added.

The third top benefit, with about 42 percent of responses, was energy savings.

According to Stoneback, the outside plant in an HFC network has a relatively high electric bill, but generally saving on the electric bill alone doesn't deliver enough return to justify the expense of replacing HFC with fiber.

"Nevertheless, [operators] will save a lot of OpEx on energy if they did have a fiber plant instead of an HFC plant," Stoneback said.

About 17 percent of respondents expected to see other benefits from FTTH/FTTP deployments, including flexibility,

"Futureproofing the network demands and capacity" was the most notable driver for responding companies making fiber count decisions.

better quality of service, a more secure network, and a future-proofed network.

When it comes to return on investment from fiber expansions, 34 percent of respondents said they anticipate a three- to five-year ROI, while 28 percent expected a return in one to three years. The percentage of respondents that expected a swift return of less than one year was 15 percent.

Nearly a quarter of respondents expected a much longer payback period, with about 11 percent anticipating an ROI of five to 10 years, and approximately 11 percent expecting to wait more than a decade for a return.

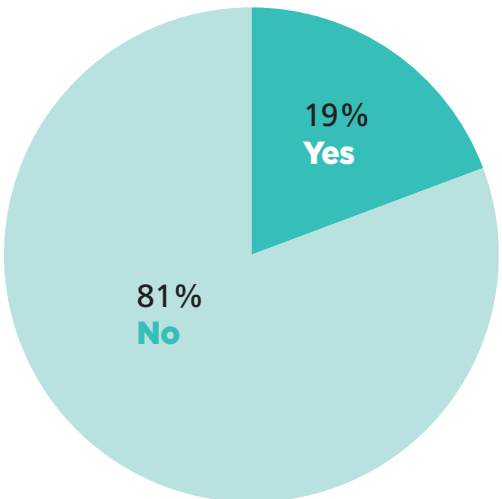
"The ROI is very significantly impacted depending on whether the fiber deployment is ubiquitous over the entire footprint or targeted and phased in as capacity needs in different portions of the network grow at various rates," ATX Networks' Ramachandran said. "In this sense, the fiber deployment will evolve to cover more and more customers but the initial focus will be on anchor customers or neighborhoods."

Alternatives to Fiber

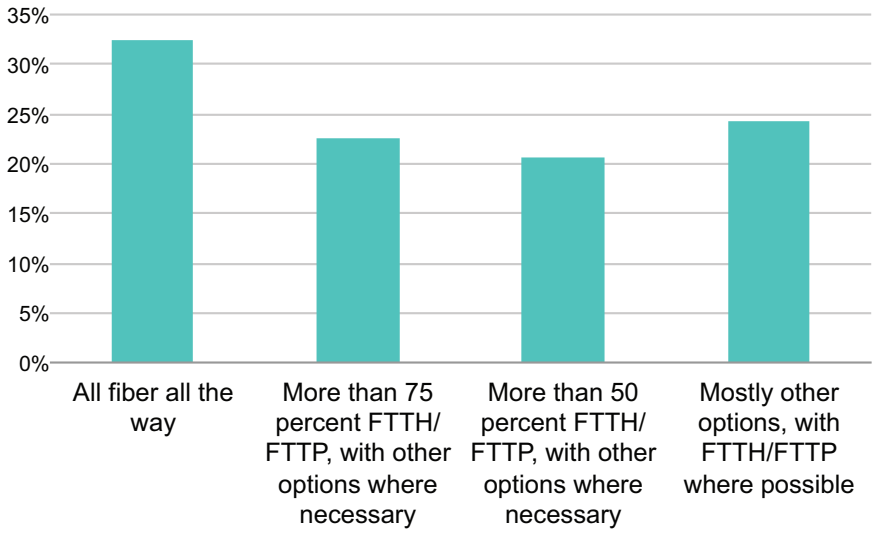
Although fiber deployments were the focus of the CED survey, some respondents indicated they were opting for fiber alternatives. Instead, some outlined plans to leverage existing networks or lean on other technologies.

Based on the challenges associated with fiber

Are you using Connect America or other funding from the FCC/federal government to complete your fiber expansion?



As part of the expansion, are you planning to run fiber all the way to the home/premises in all cases, or are you also considering alternatives?



expansions, many respondents said they have looked into alternative solutions to expand capacity without adding more fiber. More than half indicated they had explored other options, while 21 percent said they had not made a decision yet between fiber and alternatives.

One alternative mentioned earlier is DOCSIS 3.1, which enables the delivery of gigabit speed broadband over fiber or an existing HFC network. The technology allows higher transmission rates through different signaling technologies without the need to touch the physical infrastructure. Comcast has chosen to go the DOCSIS 3.1 route in many areas and has deployed the technology to about 75 percent of its residential footprint so far.

"DOCSIS 3.1 really enables business as usual, continuous capacity, pay as you grow expansions, and there are some areas where operators decide to do a little bit of leap frog and invest in fiber all the way to the last active and all the way to the home," SCTE's Stoneback noted. "In the absence of that, DOCSIS 3.1 is an excellent tool to give more life to the HFC network."

"Combining DOCSIS 3.1 technology with DWDM analog optical transmission technology allows operators to significantly increase the capacity in their existing fiber networks in a cost-effective, evolutionary, and non-disruptive manner," Ramachandran said.

Full Duplex DOCSIS 3.1, meanwhile, aims to deliver symmetrical upstream and downstream speeds of 10 Gbps, but requires an operator's infrastructure to be at N+0, with no actives in the coax line.

Survey respondents also seem to be taking different

Top 5 Reasons Respondents chose FTTH/FTTP

1 Bandwidth Capacity
2 Reliability
3 Scalability
4 Longevity
5 Cost-effective

approaches in bridging the last mile. A majority of participants said they would deploy FTTH/FTTP, but fixed wireless also was high on the list of responses.

Fixed wireless delivers broadband via a connection between a cell tower and an outdoor antenna. The technology is seen as a less expensive option to bring broadband to rural customers in particular.

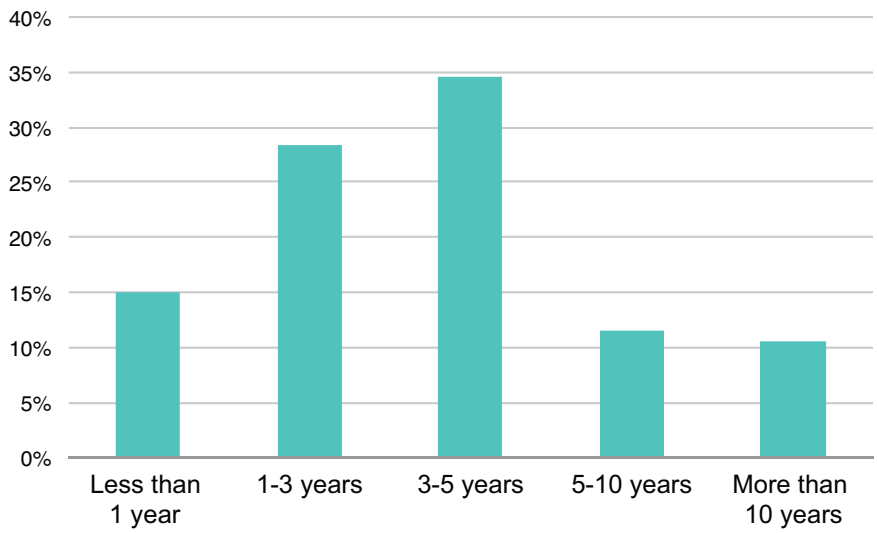
Both Verizon and AT&T are conducting field tests of next-generation 5G fixed wireless technology, using millimeter wave spectrum to deliver increased bandwidth over short distances. Despite concerns about mmWave spectrum's propagation characteristics, Verizon executives revealed trials showed the technology can deliver gigabit speeds across distances of more than 2,000 feet and in buildings up to 20 stories high. Verizon recently announced plans to deploy the technology commercially in a handful of markets in the second half of 2018.[8]

A recent report forecasted that service revenue from fixed wireless 5G subscriptions would hit $1 billion by the end of 2019.[9]

Synchronizing Fiber Plans for Commercial and Other Services

In fiber network planning, residential services are only a piece of the equation. CED's survey showed respondents also are focusing on using fiber

How quickly do you expect a return on investment from your fiber expansion?



8 CED magazine, "Verizon to Debut commercial 5G Fixed Wireless Broadband in Select Markets in 2018." November 2017. https://www.cedmagazine.com/news/2017/11/verizon-debut-commercial-5g-fixed-wireless-broadband-select-markets-2018

9 CED magazine, "Verizon, AT&T to Lead Fixed Wireless 5G Revenues to $1B by 2019." August 2017. https://www.cedmagazine.com/data-focus/2017/08/verizon-t-lead-fixed-wireless-5g-revenues-1b-2019-report-says

deployments for commercial service and cellular backhaul. Overall, the survey found that the average percentage of fiber builds focused on services other than residential was nearly half.

Traditionally, commercial and residential builds operated in different silos, but now service providers are starting to take a more comprehensive view when planning, according to SCTE's Stoneback.

"By being smart about what direction you pull your commercial fiber, you can have fiber laid where it will maximize the benefit to your residential network," he said.

This appears to be true for a leading U.S. operator, who in an interview with CED said when choosing to invest in fiber, the company uses a multi-use approach to its rollout.

"We do it strategically so that consumer and enterprise services can take advantage of it," Kevin Smith, VP of Network One Fiber initiatives for Verizon, said. "It gives us an opportunity to do so much more with our fiber rollout, leveraging it as a common asset across all lines of the business."

Convergence of cable and wireless has implications for fiber strategy, Smith indicated, noting the company has shifted away from a point-to-point approach.

"Our current network build mentality is much more of a point-to-multipoint configuration that has multiple endpoints. If you're expecting a 4G dense network or a 5G high capacity network, you need to come in and build this type of grid approach."

Conclusion

Fiber is an increasingly attractive option as both home and business customers' bandwidth demands continue to increase and operators look to future-proof their networks for the technologies of tomorrow.

While a majority of CED survey respondents indicated they are either planning or actively expanding their fiber footprint, it is an expensive and time-consuming undertaking, and a sizable number remain focused on their current networks.

Service providers want to be able to offer customers faster speeds, a trend that shows no sign of slowing. A 2017 report indicated 17 percent of the U.S. population now has access to gigabit internet. While technologies like DOCSIS 3.1 can deliver 1 Gbps speeds over existing HFC infrastructure, the report found that 91 percent of gigabit offerings are based on fiber.[10]

For those respondents that are running FTTH/FTTP the technologies they plan to deploy across the fiber include:

- GPON (including RF overlay for some respondents)
- SD-WAN
- Data transmission (classic data, video, VoIP)
- Ethernet
- Transport TXs, Passive Splitters, Mini Fiber nodes (RXs)

Whether choosing to take fiber all the way to the home or just deeper into the network, companies have to consider whether an investment now will benefit them down the road, with factors like geography, costs, customer demand, and time coming into play.

With 5G cellular service on the horizon, the densification of mobile networks and small cell deployments also will provide an increasing opportunity for fiber infrastructure to provide mobile backhaul, and some respondents indicated they were keeping an eye on such opportunities.

Fiber offers nearly unlimited capacity, a factor that must be taken into consideration when thinking about future needs.

If they opt to invest in fiber buildouts, many hope to reap benefits such as increased capacity, reduced operational costs, and energy savings.

"The question is do you need it [capacity] yet, is it worth the money to do it yet," Stoneback said. "But fiber is viewed by almost everybody as the end game." CED

10 CED magazine, "More than 200 Million People Worldwide Have Gigabit Internet Availability, Tracker Says." May 2017.
https://www.cedmagazine.com/data-focus/2017/05/more-200-million-people-worldwide-have-gigabit-internet-availability-tracker-says

About This Report

The information found in this report is based on executive interviews and data from a recent survey of CED readers compiled by the CED editorial team.

The survey, "Fiber Deployment Strategies," was conducted between October and November 2017 and received 117 responses. CED's audience is largely made up of professionals in the cable communications engineering and design industry.

This is the first quarterly research report from CED. To learn more about CED, visit cedmagazine.com.

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