LightReading HEAVY READING

Cable Fiber Outlook Survey Report 2020

In Partnership with

SCTE·ISBE
Society of Cable Telecommunications Engineers
International Society of Broadband Experts

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Introduction

By Alan Breznick

Fighting fiber with fiber. That seems to be the cable industry's mantra these days.

Even as the industry completes its rollout of DOCSIS 3.1 technology around the world and is gearing up to launch the new DOCSIS 4.0 specs from CableLabs, cable operators are scrambling to install more and more fiber in their constantly evolving hybrid fiber-coax (HFC) networks. That's because fiber continues to be the biggest enabler of most—if not all—of the technological, financial, operational, and competitive gains that operators are seeking.

Whether they are building massive fiber-to-the-home (FTTH) networks like Altice in the US and Europe, pursuing a fiber deep strategy that eliminates all the network amplifiers like Comcast, or simply splitting more fiber-optical nodes like Charter, Cox, and many other cablecos, operators are still fiercely fortifying their networks with fiber. With the assistance of more fiber, they aim to deliver broadband speeds of 1Gbits or more, offer more advanced video services, slash operational costs, support 5G and other new wireless services, boost service performance and reliability, and generally improve their competitive posture against rival providers.

Yet, even as operators continue to invest more heavily in fiber, they still face critical questions about how to leverage those investments to the fullest. While a few large multiple system operators (MSOs) have outlined their general fiber ambitions, the industry has generally not settled on a comprehensive fiber buildout strategy. Nor have most cable operators disclosed much about how they will carry out their fiber expansion plans in tandem with other key upgrades such as DOCSIS 4.0, distributed access architecture (DAA), next-gen passive optical network (PON) technology, network virtualization, 5G mobile, automation, artificial intelligence, and the like. Finally, few, if any, operators have spelled out how they intend to monetize their massive fiber investments.

Seeking to answer these and other key questions, Light Reading and Heavy Reading teamed up again with SCTE/ISBE, as well as with four major industry vendors—Ciena, Corning, Incognito, and VIAVI—to survey cable operators and other wireline providers about their fiber buildout plans and challenges. In this report, we present the responses to that comprehensive 44-question survey, look at where cable's fiber-feeding frenzy is heading, and examine what it all means.

This third annual Cable's Fiber Outlook Survey, which was conducted online during late August and early September 2020, produced a healthy 116 fully complete and another 11 qualifying partial responses from cable and other service provider executives. As is typical, given SCTE/ISBE's prime role in promoting the survey again this year, a large majority of the survey responses came from the US and Canada. In fact, those two nations generated 84 qualifying responses, or two-thirds of the 127 total responses received.

Yet, operators in other parts of the world made significant contributions to the survey results as well. European cable executives accounted for 18 qualifying responses, or slightly more than 14% of the total. Central/South American operators followed with 13 qualifying responses, or just over 10% of the grand total. The other four regions surveyed—Southeast Asia, the Middle East &Africa, Northeast Asia, and India—collectively accounted for the remaining 10% or so of the responses.

Where is your company located? (N=127)
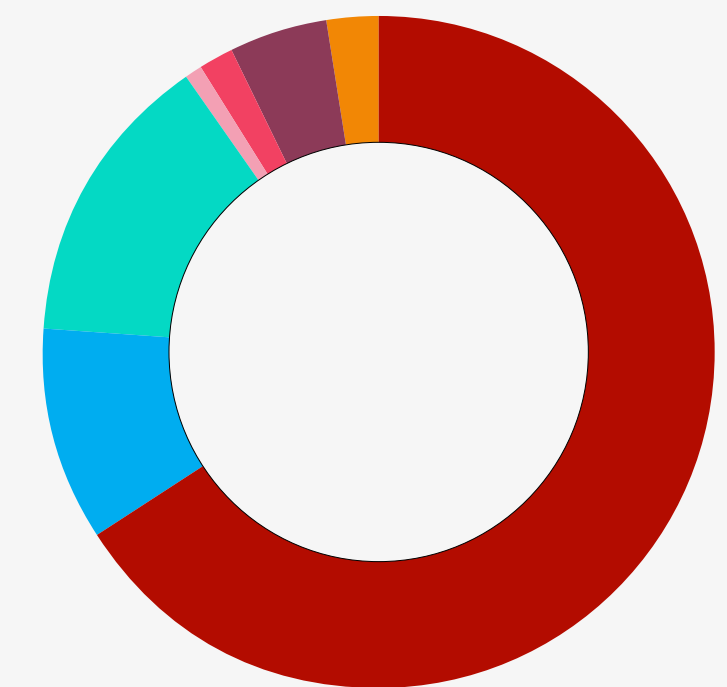
- **66.1%** | North America (U.S. or Canada)
- **10.2%** | Central/South America (including Mexico & the Caribbean)
- **14.2%** | Europe
- **0.8%** | Middle East/Africa
- **1.6%** | Northeast Asia
- **4.7%** | Southeast Asia
- **2.4%** | India

Source: Heavy Reading

Similar to the results of the past two annual surveys, a fair number of the study responses streamed in from the largest cable operators in the world, especially those in the US. Just about one-quarter of the responses came from companies generating over $10bn in annual revenue. Almost one-half (47%) came from companies producing at least $1bn in revenue each year.

However, small to midsize cablecos figured strongly in the survey results as well, with slightly over18% of the responses coming from providers bringing in $50m or less in annual revenue. Another 9% came from operators producing between $50m and $200m. Overall, providers with less than $500m in annual revenue accounted for nearly 39% of the replies.

Predictably, most of the responses came from providers that have been offering fiber-based services to their subscribers for a while. About two-thirds of respondents, or nearly 68%, said their companies have been delivering fiber-based services to customers for at least two years. Another 12% said their companies had started delivering fiber services in the past 12 months. Roughly 7% said their companies plan to begin offering fiber-based services by the end of this year and about 10% intend to start doing so in 2021.

As might be expected, most respondents were well acquainted with their company's fiber deployment strategy. Some 85% said they were either "very familiar" or "familiar" with those plans. The rest were at least "somewhat familiar."

Similar to the results from the previous two annual surveys, most of the responses came from executives involved in some aspects of network planning, operations, or engineering. Those three job categories combined for over two-thirds, or nearly 69%, of the replies, with network engineering leading the way at just over 36%. IT operations specialists accounted for nearly 12% of the responses and business strategy and development executives accounted for another 11% of the total.

What is your company's annual revenue? (N=127)

- **18.1%** | Less than $50 million
- **8.7%** | $50 million to $199 million
- **11.8%** | $200 million to $499 million
- **14.2** | $500 million to $999 million
- **15%** | $1 billion to $4.99 billion
- **7.1%** | $5 billion to $9.99 billion
- **25.2%** | $10 billion or more

Source: Heavy Reading

How familiar are you with your company's fiber deployment strategy? (N=127)

- **40.9%** | Very familiar
- **44.1%** | Familiar
- **15%** | Somewhat familiar

Source: Heavy Reading

What is the focus of your job responsibilities? (N=127)

- **36.2%** | Network Engineering
- **21.3%** | Network Operations
- **11.8%** | IT Operations
- **11%** | Network Planning
- **11%** | Business Strategy and Development
- **4.7%** | Other
- **2.4%** | Sales
- **1.6%** | Marketing

Source: Heavy Reading

Alan Breznick
Cable/Video Practice Leader
Light Reading

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The Evolution of Fiber Skills

By Steve Harris

Broadband operators continue to increase their fiber build-out strategies with capital expenditures dedicated to new and existing fiber optic deployments. Operators are building and expanding fiber optic architectures in the areas of fiber deep networks (FD), optical distribution networks (ODN), private Ethernet networks (e.g., E-PVL) and access networks using distributed access architectures (DAA).

FD architectures allow operators to push analog fiber optics closer to the subscriber, while reducing active devices and coaxial cable in the access network. The ODN architecture is used for various passive optical networks (PON), the most popular being the centralized split architecture. Both small and large North American providers shared last year that FTTH/FTTP PONs will be significant parts of their ecosystems going forward. Popular versions of xPON technologies used in an ODN are the IEEE Ethernet PON (E-PON) and ITU gigabit PON (G-PON).

Operators are now distributing layers of the telecommunication network between their headend and access networks. In DAA, operators are able to relocate physical (PHY) layer and media access control (MAC) layer components with the access network pushing the edge. An approach called remote PHY (R-PHY) relocates the PHY layer of the converged cable access platform (CCAP). DAA has additional benefits as it uses dense multiplexed digital fiber and a roadmap to virtualize the layers of the network.
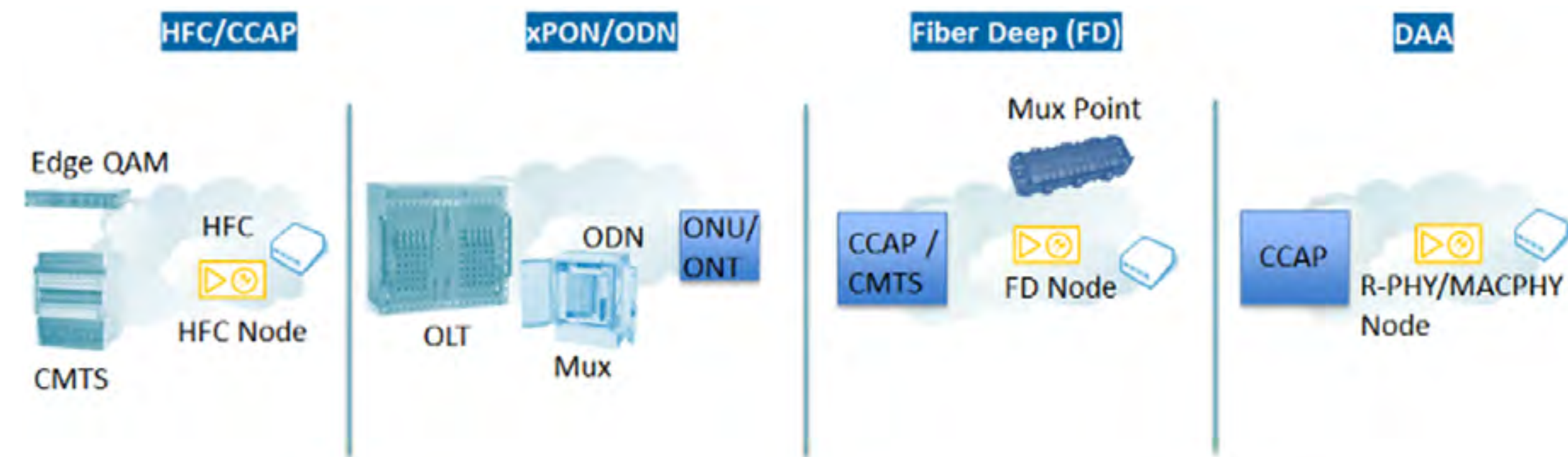
Figure #1 – HFC, xPON/ODN, FD and DAA

Optical fiber has been providing tremendous paybacks in our hybrid fiber coaxial (HFC) access networks for a few decades now, recently offering 1 Gbps Internet communications. When cable last year announced the 10G platform offering 10 Gbps connections, the technologies and architectures that would be used included several of the above.

The 10G platform is a partnership between CableLabs, SCTE•ISBE and NCTA. It offers increased reliability, lower latency, expanded capacity, better security and symmetrical networks. In addition, 10G edge computing allows processing at the aggregation node in the access network. For example, in PONs, 10G platforms are supported by ITU XGS-PON (10 Gbps GPON) and IEEE 10G-EPON. DAA networks may leverage 10G over a digital multiplexed fiber, or perhaps in the near future via a coherent digital fiber link.

New fiber optic technologies, fiber optic architectures and the 10G platform provide operators with options to deploy next-generation access networks (NGAN). NGANs allow operators to deploy best-in-class residential services over fiber optics, enabling rich Smart Home experiences and telemedicine connections. In addition, operators use fiber and NGANs to offer premium business broadband, private Ethernet, software defined wide area networks (SD-WAN) and mobile backhaul services.

These optical networks mentioned will require significant construction and support, using qualified labor. There are operational practices and industry standards that must be followed to optimize and prioritize network performance when it comes fiber technology. A Light Reading survey in 2019 cited a lack of skills, knowledge and abilities around emerging technologies like fiber optics. Proper education reduces network downtime/network degradation caused by human intervention. Understanding proper practices and implementation for maintaining key performance indicators (KPIs), optimizing automation (e.g., PNM), security management techniques and improving network uptime are critical in today 's networks.

At SCTE·ISBE, we have been strategic in staying ahead of the curve in terms of the ever-changing technical access networks requirements of telecommunication operations and the engineering workforce. Working with industry experts, SCTE•ISBE has developed a line-up of fiber optic courses that drive business results and reduce human error factor (HEF) in the network. In addition, SCTE•ISBE offers the top industry credentials globally, certifying the competencies of expert telecommunication professionals (SCTE.org/certification). The SCTE•ISBE standards (SCTE.org/standards) program is the only ANSI-accredited platform for developing technical specifications, along with driving return on investment (ROI) in our training and certification programs.

Figure #2: SCTE•ISBE Learning and Development VirtuLearn and SCTE•ISBE Explorer, a New Standards Activity

The SCTE•ISBE fiber optic education curriculum is a comprehensive solution of technical courses driving business results in the marketplace. SCTE•ISBE offers curricula that support each of the areas mentioned earlier, including Optical Construction and Fiber Splicer Specialist. The SCTE•ISBE Broadband Fiber Installation curriculum allows learners to become proficient in FD, PONs and ODNs. SCTE•ISBE 's Business Class Service Specialist (BCSS) addresses the industry requirement for workforce proficiency in private Ethernet/IP performance management and fault management. The Society's Broadband Transport Specialist (BTS) and Fiber Restoration courses allow support personal to gain the skills, knowledge and abilities to support and manage optics in an HFC. The BTS course prepares individuals for three professional certifications, while the DAA curriculum enables operators to easily migrate support personal from an HFC access network to a NGAN.

Among SCTE•ISBE offerings are certifications that recognize individuals as experts in telecommunications. The SCTE•ISBE Broadband Fiber Installer (SCTE.org/BFI) professional certification was designed to measure a person's skills, knowledge and abilities in FD, PONs and ODNs. For those who support business services, the SCTE•ISBE Business Class Service Specialist (SCTE.org/BCSS) professional certification is designed to measure expertise in private Ethernet solutions, VoIP and IP addressing over optical networks. Finally, the SCTE•ISBE Broadband Transport Specialist (SCTE.org/BTS) was recently updated with new industry recommended practices. Since our BTS course covers the competencies desired by several professional certification authorities, SCTE•ISBE simplifies earning credentials. The credentials are the SCTE•ISBE BTS, the Electronics Technicians Association (ETA) Fiber Optics Installer (FOI) and Fiber Optic Association (FOA) Certified Fiber Optic Technician (CFOT).
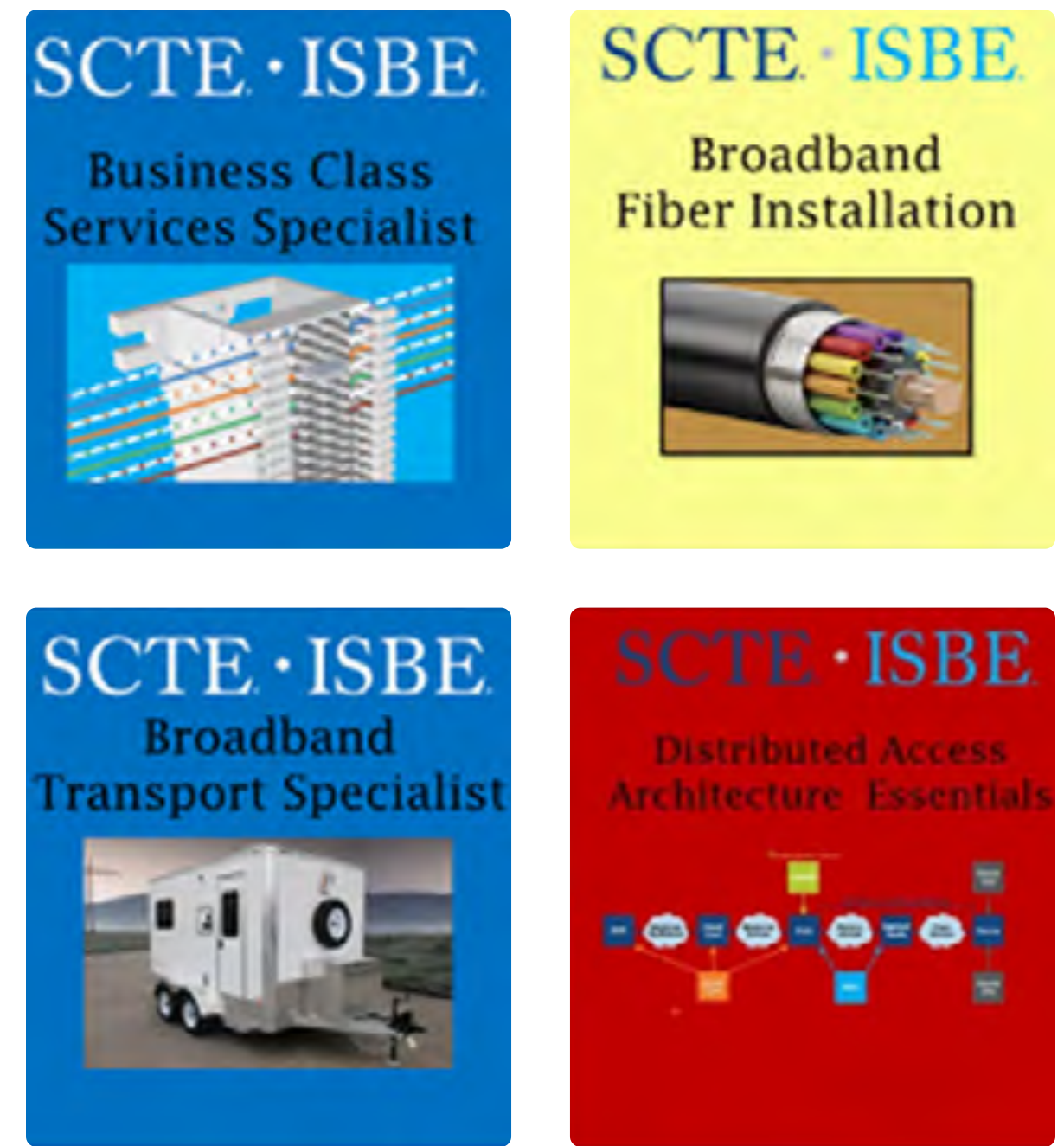
Figure #2: SCTE•ISBE Professional Certifications

Our SCTE•ISBE standards group was instrumental in early FTTH/FTTP networks with creation of SCTE 174, Radio Frequency over Glass (RFoG). Today our standards group is very active in defining the Generic Access Platform (GAP) standard, enabling an aggregation node of the future. SCTE•ISBE GAP defines common interfaces that supports plug-in modules within the aggregation node housing. The plug-in modules may be used for xPON, mobility, DAA or even Smart Cites under the SCTE•ISBE Explorer initiative, a new standards activity that is designed to work across industries to identify applications that can benefit from the 10G platform.

To learn more about the fiber optics and cable be sure to join us at SCTE•ISBE Cable-Tec Expo Virtual Experience (Expo. SCTE.org) Oct. 12-15. Also be on the lookout for 10G, optical construction best practices and vendors sharing the latest in optical testing!

Steve Harris
Executive Director, Technical Sales, Learning & Development
SCTE•ISBE

DAA/Converged Interconnect Network (CIN)

As they prepare for the not-so-distant future, cable technologists view DAA as a key piece of the puzzle. That's because DAA—an approach that shifts key electronics and functions out of the central cable headend and toward the edge of the HFC access network—offers a wide range of benefits to cablecos. These include greater network capacity, higher broadband speeds, more efficient use of space and power, better signal quality, easier plant maintenance, and potentially lower operating costs.

While relatively few cablecos have actually begun to deploy this next-gen technology so far, the momentum behind it is growing. For instance, major MSOs such as Comcast in the US, Shaw Communications in Canada, and Vodafone in Europe have started rolling out DAA to cable systems across their respective footprints.

But while DAA is clearly part of the industry's evolution plans for the next decade, there are still many questions about how the overall technology will be implemented. In particular, there are questions about how cablecos will leverage one of DAA's critical components, the converged interconnect network (CIN), which is a digital fiber link between the cable headend and the network fiber-optic nodes in a distributed HFC architecture. There are also questions about other related technologies, such as field aggregation, 10G PON, 5G, and automation. This section of the report tackles these types of questions, examining how cable operators aim to make the best use of both DAA and CIN technologies.

Key takeaways

- Slightly over one-quarter of respondents (26%) said the COVID-19 pandemic has either "somewhat" or "significantly" delayed their company's DAA rollout plans.

- But nearly one-third of respondents (31%) said the pandemic has either "somewhat" or "significantly" accelerated their company's plans to make the DAA shift.

- An overwhelming majority of respondents (87%) said their company intends to converge at least two types of services over a common CIN infrastructure.

- Close to one-half of survey participants (48%) said 5G is a key driver for their company's DAA and CIN rollout strategies.

Delving into DAA

Despite the strong appeal of DAA, most cablecos have still not rolled out remote PHY, remote MAC/PHY, or other flavors of the next-gen technology just yet. While several major MSOs

like Comcast, Shaw, and Vodafone are moving ahead with DAA deployments, most operators are still holding back and cautiously pondering their next-gen network options.

One new reason for this cautious approach could be the COVID-19 pandemic. In the Heavy Reading survey, slightly more than one-quarter of respondents (26%) said the pandemic has either "somewhat" or "significantly" delayed their company's DAA rollout plans. Thus, COVID-19 is proving to be a negative factor for a number of cablecos.

On the other hand, though, close to one-third of respondents (31%) said the pandemic has either "somewhat" or "significantly" accelerated their company's plans to make the DAA shift. Surprisingly, the pandemic is cutting both ways right now. The remaining 43% said COVID-19 has not affected their company's DAA strategy.

How has COVID-19 affected your plans to move to a Distributed Access Architecture (DAA) and extend fiber deeper? (N=127)
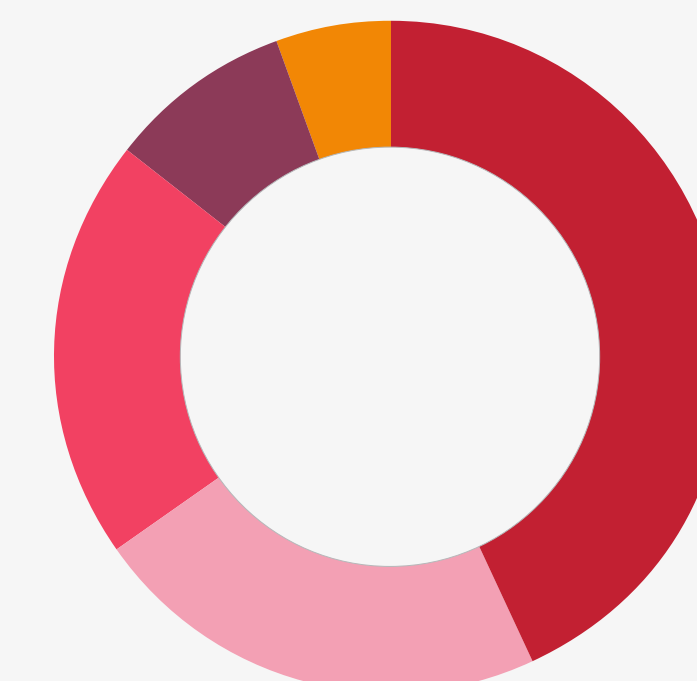
- **43.3%** | No change in DAA plans
- **22%** | DAA plans somewhat accelerated
- **20.5%** | DAA plans somewhat delayed
- **8.7%** | DAA plans significantly accelerated
- **5.5%** | DAA plans significantly delayed

Source: Heavy Reading

A key element of cable's DAA plans is the CIN. As part of their DAA implementation, cable operators are looking at how best to leverage the CIN and what they will use it to do. Asked about plans to converge multiple services over a common CIN infrastructure, an overwhelming majority of respondents (87%) said their company intends to converge at least two types of services that way. More than half (54%) said their company aims to converge at least three services, and a solid one-third (33%) indicated their company plans to converge four or more services over a common CIN.

Keeping the focus on the outside plant, Heavy Reading next inquired about operators' field aggregation strategies. Once again, an overwhelming majority of providers (87%) intend to do at least some type of field aggregation. More than two-fifths of respondents (44%) said their company is planning to carry out field aggregation in both its street cabinets and secure pole-mounted enclosures. Some 28% plan to do field aggregation just in their pole-mounted enclosures, while 16% plan to do it only in their street cabinets.

The study focused next on operators' plans to incorporate 10G PON in their DAA and CIN rollout strategies. Well over three-quarters of respondents (83%) said their company plans to leverage 10G PON in some way as they deploy DAA and CIN technologies. Slightly over one-third (34%) said their company intends to boost their use of 10G PON primarily through optical line terminals (OLTs) in both street cabinets and secure pole-mounted enclosures. About 19% said their company aims to increase the use of 10G PON only for secure pole-mounted enclosures. Just over 18% plan to use the technology primarily for OLTs in hub sites and nearly 13% plan to use it for OLTs in street cabinets.

How big a role is 5G mobile technology playing in operators' DAA and CIN strategies? Pretty big, according to the survey results. Close to one-half of survey participants (48%) said 5G is a key driver for their company's plans, either because of competitive threats or the c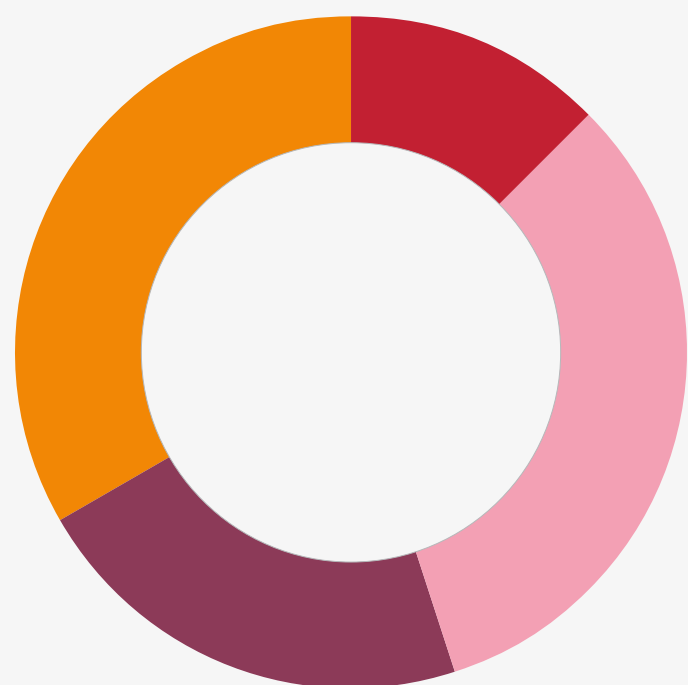ombination of competitive threats and new revenue opportunities. Nearly two-fifths (38%) called 5G "somewhat" of a driver for one or both reasons. Just 14% dismissed 5G as not much of a driver.

Is your company planning to converge multiple services over a common Converged Interconnect Network (CIN) infrastructure? (N=126)

- **12.7%** | No – we are planning to use CIN for just one type of service (e.g. residential or business services)
- **32.5%** | Yes – we are planning to use the CIN infrastructure for two services (e.g. residential and business services)
- **21.4%** | Yes – we are planning to use the CIN infrastructure for three services (e.g. residential, business, and fiber-to-the premise/PON services)
- **33.3%** | Yes – we are planning to use the CIN infrastructure for four services (e.g. residential, business, fiber-to-the-premise/PON, mobile services)

Source: Heavy Reading

Which field aggregation strategy (i.e. aggregation in the outside plant) best fits your network goals? (N=127)
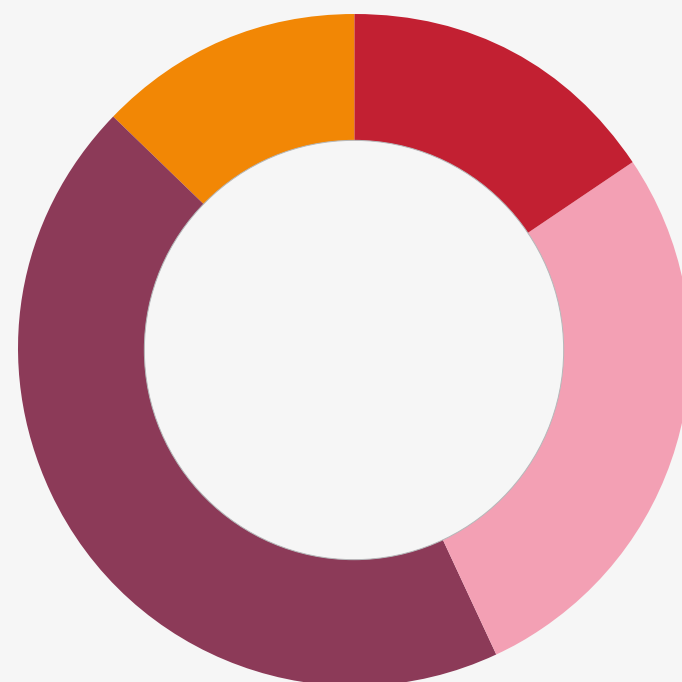
- **15.7%** | We are planning to do some field aggregation in street cabinets
- **27.6%** | We are planning to do some field aggregation in secure pole-mounted enclosures
- **44.1%** | We are planning to do some field aggregation in both street cabinets and secure pole mounted enclosures
- **12.6%** | Not planning field aggregation; all aggregation in hub sites and headends

Source: Heavy Reading

How is your company planning to include 10G PON in your DAA strategy and CIN rollout? (N=127)
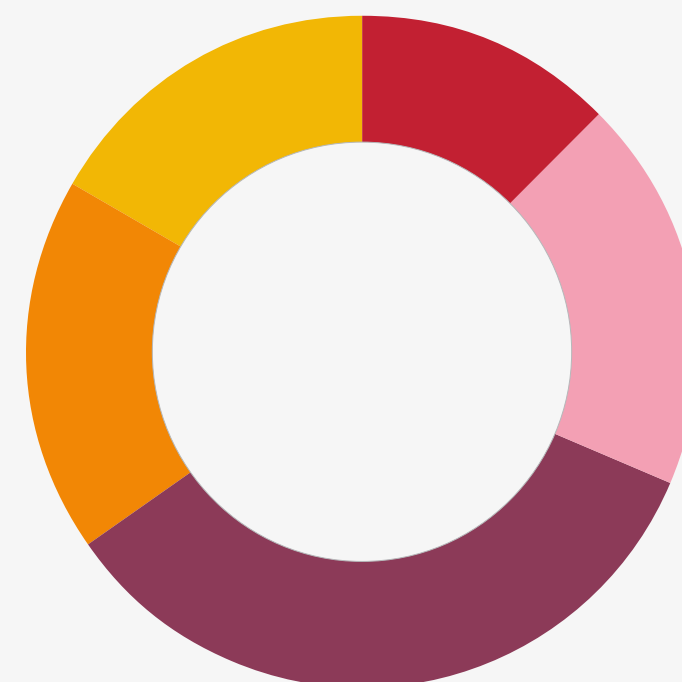
- **12.6%** | Increased use of 10G PON – primarily OLTs in street cabinets
- **18.9%** | Increased use of 10G PON – primarily OLTs in secure pole-mounted enclosures
- **33.9%** | Increased use of 10G PON – primarily OLTs in both street cabinets and secure pole mounted enclosures
- **18.1%** | Increased use of 10G PON – primarily OLTs in hub sites
- **16.5%** | No significant change in use of 10G PON

Source: Heavy Reading

How much does 5G contribute to your company's DAA strategy and CIN rollout, and why? (N=127)
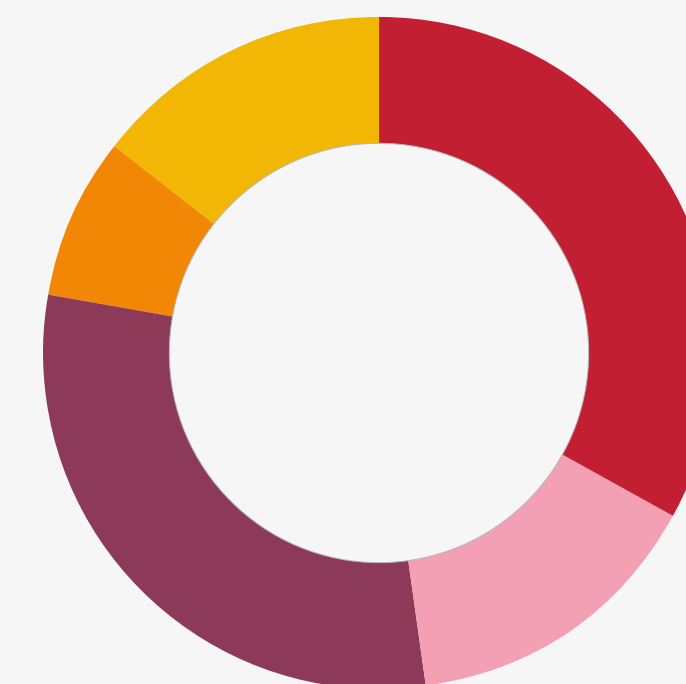
- **33.1%** | It's a key driver, due to competitive threats and new revenue opportunities
- **15.0%** | It's a key driver, due to competitive threats
- **29.9%** | It's somewhat of a driver, primarily due to competitive threats and new revenue opportunities
- **7.9%** | It's somewhat of a driver, primarily due to competitive threats
- **14.2%** | It's not a significant driver

Source: Heavy Reading

Next, Heavy Reading inquired about whether operators view fiber and wavelength management as a challenge or strength for their DAA and CIN strategies. Overwhelmingly, survey participants said they view it as a strength, with more than two-thirds (almost 69%) labeling such management as either a "significant strength" or "moderate strength." In contrast, only about 25% identified fiber and wavelength management as a "significant challenge" or "moderate challenge," while 6% said it is neither a strength nor a challenge.

The survey then asked providers about where they see the greatest need for more automation in their company's DAA and CIN plans. More than two-fifths of respondents (42%) said the greatest need is in "order to service: taking the customer request and converting it into service via the network, resources, and applications." More than one-quarter (28%) chose "plan to build: creation of the service-ready network able to support new services, including physical, logical, and virtual." And 18% picked "trouble to resolve: proactive monitoring of the service to handle events and faults and restore services to normal state."

Finally, the study sought to find out the resource or skills gap for services in support of operators' DAA and CIN rollouts. "Design: solution engineering for the CIN, implementation design, solution validation" ranked as the leading choice, drawing votes from slightly over 29% of respondents. "Implementation: site surveys, deployment and installation of the CIN, test and turn-up" came in a close second, attracting 27% of the votes. Operations, planning, and migration followed in third, fourth, and fifth places, respectively.

Do you identify fiber and wavelength management as a challenge or a strength for your company's DAA strategy and CIN rollout? (N=127)

- **23.6%** | Significant strength – excellent visibility and full automation
- **44.9%** | Moderate strength – good visibility and tracking is somewhat automated
- **18.1%** | Significant challenge – we do not have reliable visibility, any tracking is very manual
- **7.1%** | Moderate challenge – limited visibility and tracking is manual
- **6.3%** | Not identified as a challenge or strength

Source: Heavy Reading

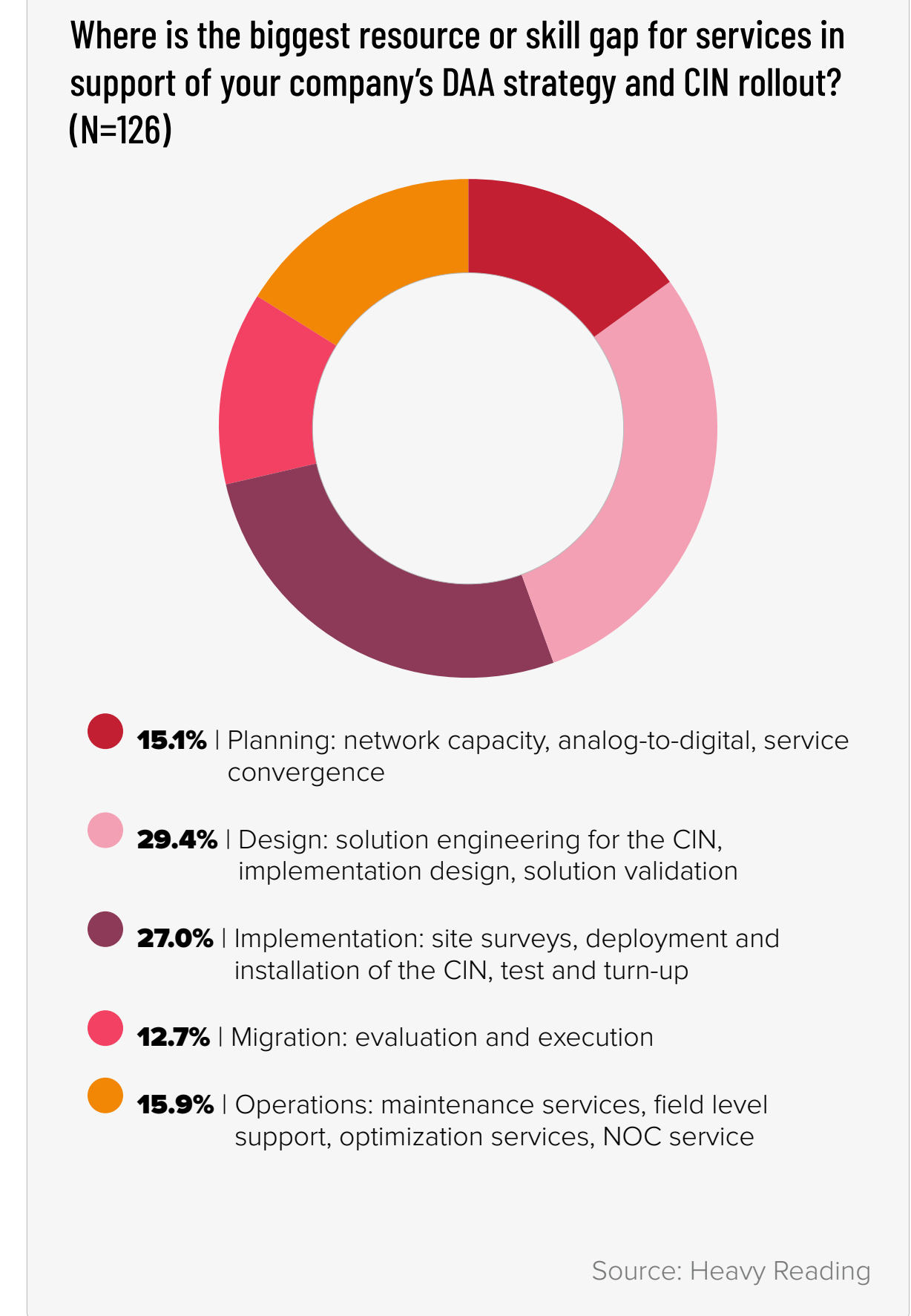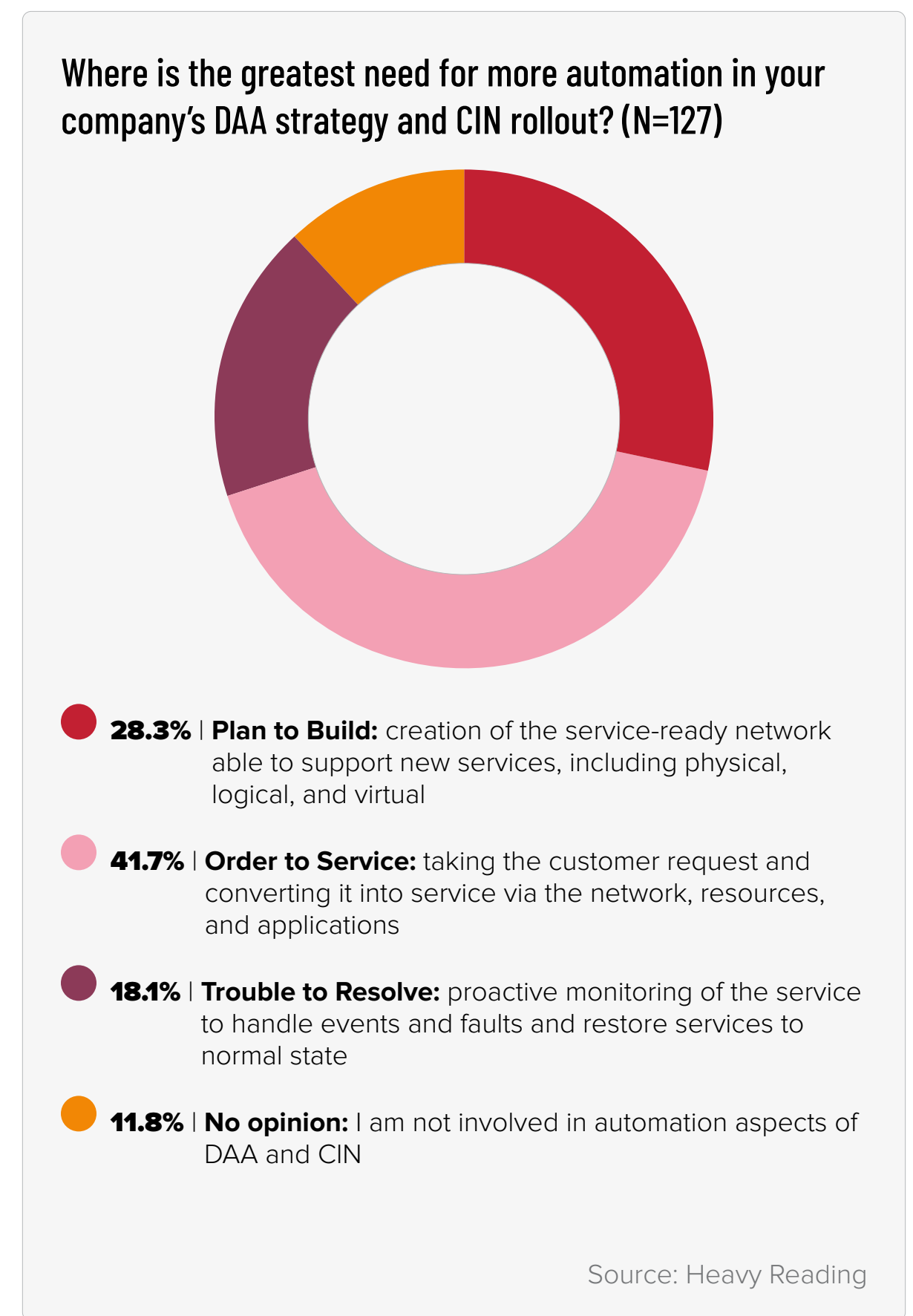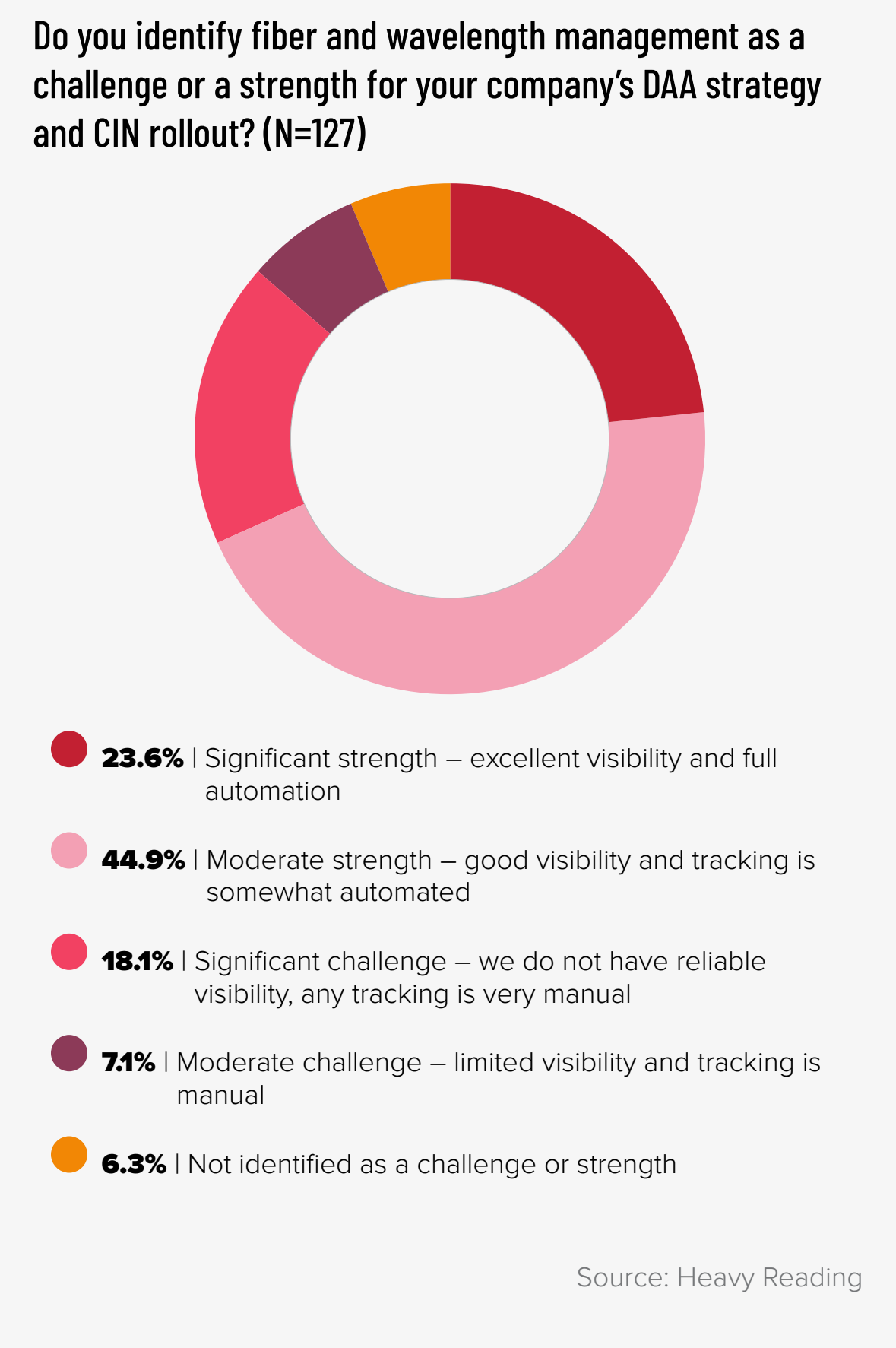### Where is the greatest need for more automation in your company's DAA strategy and CIN rollout? (N=127)

- **28.3%** | **Plan to Build:** creation of the service-ready network able to support new services, including physical, logical, and virtual
- **41.7%** | **Order to Service:** taking the customer request and converting it into service via the network, resources, and applications
- **18.1%** | **Trouble to Resolve:** proactive monitoring of the service to handle events and faults and restore services to normal state
- **11.8%** | **No opinion:** I am not involved in automation aspects of DAA and CIN

Source: Heavy Reading

Where is the biggest resource or skill gap for services in support of your company's DAA strategy and CIN rollout? (N=126)

- **15.1%** | Planning: network capacity, analog-to-digital, service convergence
- **29.4%** | Design: solution engineering for the CIN, implementation design, solution validation
- **27.0%** | Implementation: site surveys, deployment and installation of the CIN, test and turn-up
- **12.7%** | Migration: evaluation and execution
- **15.9%** | Operations: maintenance services, field level support, optimization services, NOC service

Source: Heavy Reading

ciena

Ciena is a networking systems, services and software company. We provide solutions that help our customers create the Adaptive Network™ in response to the constantly changing demands of their users. By delivering best-in-class networking technology through high-touch consultative relationships, we build the world's most agile networks with automation, openness, and scale.

Innovative services and applications — and changing usage patterns associated with remote working, learning, and entertainment — are placing new demands on cable networks including the need for symmetrical connectivity, low latency, and ever-increasing bandwidth. The cable industry announced its vision for delivering 10 Gigabit networks, or 10G — enabling new services, enhancing the customer experience and achieving operational efficiencies. MSOs will achieve 10G with a collection of architectures and technologies, including Distributed Access Architectures (DAA), Converged Interconnect Networks (CIN), and extending fiber deep. Network automation to support the scale of devices and services associated with the move to 10G will be extremely important.

Ciena builds the Adaptive Network for MSOs, enabling their journey to 10G with:

- DAA strategies, next-gen access, and service convergence with Ciena's **Fiber Deep solution for the Converged Interconnect Network** and **Universal Aggregation and Access over 10G PON Transceiver**

- New services and operational efficiencies with **Blue Planet**® network automation

- **Capacity scalability** with Ciena's industry leading optical networking products to meet ever-increasing customer demands

For updates on Ciena and the cable MSO industry, visit **www.ciena.com/insights/cable-mso**.

CORNING

Cable FTTx/ PON Plans

With the release of the new DOCSIS 4.0 specifications by CableLabs earlier this year and preliminary talk about a prospective DOCSIS 5.0 spec, there is no longer any question that the cable industry's basic HFC architecture still has a long life ahead of it. But a good part of the reason for this optimistic outlook is that cable operators are investing heavily in putting more fiber in their plant. They are extending that fiber ever further out in their access networks and ever closer to the customer to expand the bandwidth capacity of their entire plant.

Simultaneously, cablecos are increasingly deploying several different varieties of PON technology—either as a complement to or a replacement of the industry's homegrown DOCSIS technology—to deliver data, video, voice, and other services over their increasingly fiber-rich networks. As a consequence, operators are now relying on a wider range of networks and technologies than ever before to serve subscribers, mixing and matching HFC and FTTx networks as well as DOCSIS, PON, and wireless technologies.

This section looks at the different types of fiber-related network upgrades that operators are planning and executing, the drive toward more all-fiber deployments, and the new fiber-based services that operators are seeking to deliver. It also examines the challenges that operators are confronting as they make this historic shift and, of course, the impact that the COVID-19 pandemic is having on the network upgrade market.

Key takeaways

- More than one-half of survey respondents (nearly 54%) said their company plans to deploy fiber deep networks over the next five years, eliminating all, or nearly all, of the signal amplifiers in their HFC plant.

- At the same time, over two-fifths of survey participants (44%) said their company intends to build FTTH networks over the next five years.

- Nearly two-thirds of survey participants (64%) said their company aims to offer multi-gigabit data speeds over fiber lines, while the same number plan to offer 5G mobile backhaul, making those the top two intended services.

- Close to one-half (45%) of survey respondents rated a lack of "capacity for higher upstream demand" as the biggest network upgrade challenge that operators face because of the pandemic. Nearly two-fifths of respondents (38%) identified a "lack of available fiber" and almost as many (36%) named an "inability to install new fiber lines as fast" as they would like.

Feasting on Fiber

Cable operators plan to carry out a growing number of network upgrades and new builds over the next five years, including a mix of fiber to the premises (FTTP)-oriented, DAA-oriented, PON-oriented, DOCSIS-oriented, and fixed wireless-oriented deployments. The one common element in these various architectural and technological upgrade strategies is that they all depend on putting more fiber in the cable plant. What this means is that fiber will play an ever growing role in the industry's future and operators will use that fiber in a wide variety of ways.

How do these fiber deployment plans break down by type of network architecture and delivery technology? Like last year, the results are all over the board. But they all point in favor of operators using much more fiber.

For starters, more than one-half of survey respondents (nearly 54%) said their company plans to deploy fiber deep networks over the next five years, eliminating all, or nearly all, of the signal amplifiers in their HFC plant. That strategy, which has been embraced most vocally by Comcast, is one critical element for the deployment of DOCSIS 4.0, which will support broadband speeds as high as 10Gbps downstream and 6Gbps upstream.

At the same time, more than two-fifths of survey participants (44%) said their company intends to build FTTH networks over the next five years, similar to the strategy that Altice is pursuing in the US and Europe now. So, the cable industry appears headed down both fiber-rich tracks as it seeks to expand its bandwidth capacity and remain competitive with rivals.

With operators allowed to give multiple answers to this question, all the different versions of next-gen DOCSIS stand out as well. About one-third of respondents chose each of these options— DOCSIS 3.1, full duplex DOCSIS (FDX), and extended spectrum DOCSIS (ESD)—the last two of which are incorporated in the broad new DOCSIS 4.0 specs. About 31% selected DAA, 30% picked fixed wireless technology, and 23% chose low latency DOCSIS, which is another part of the new DOCSIS 4.0 specs.

Which types of network upgrades does your company plan to carry out over the next five years (by fall 2025)? (N=357)
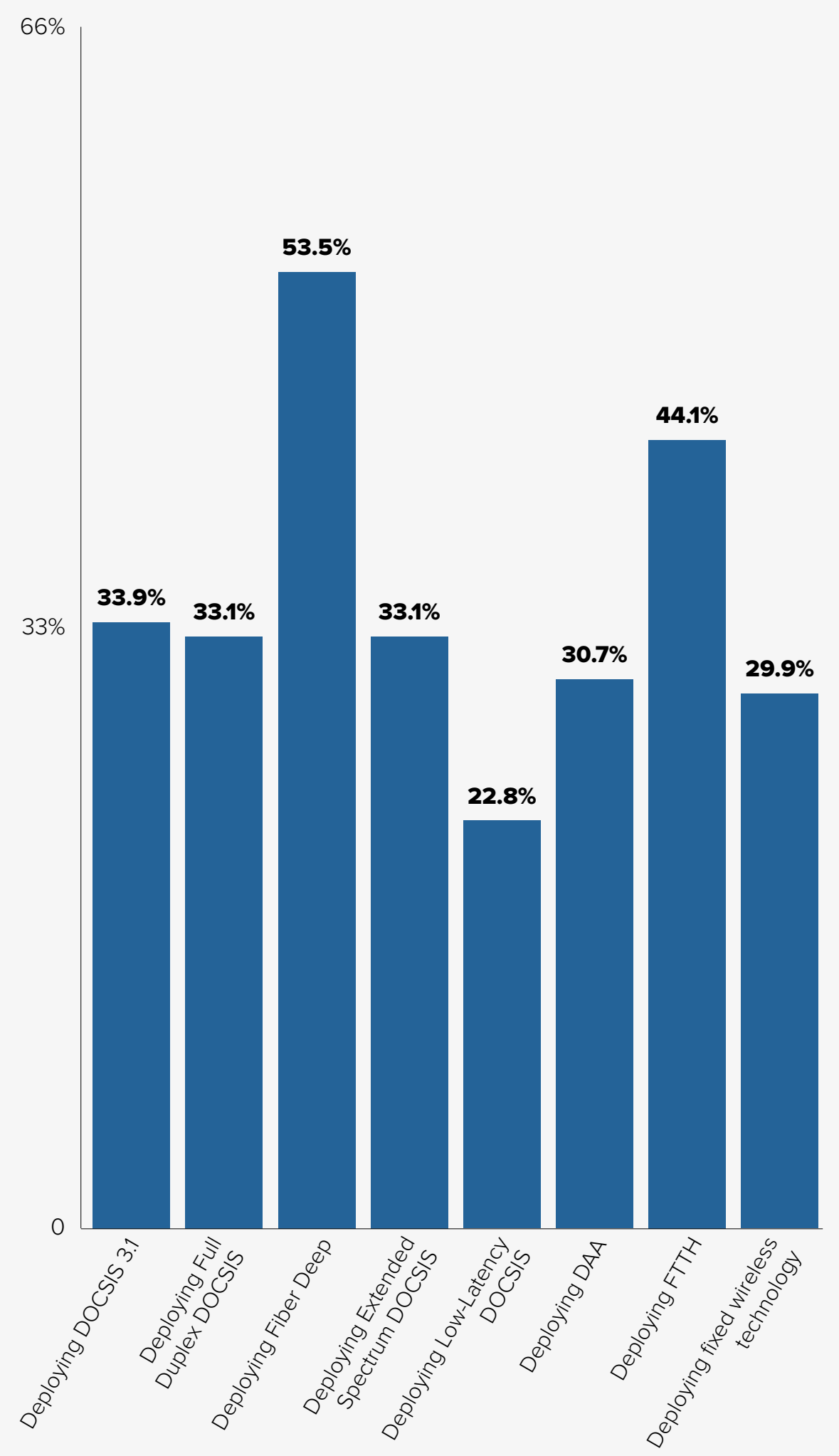
Source: Heavy Reading

Given that many operators are both upgrading their HFC plants and installing new FTTH networks, Heavy Reading sought to determine the top three factors driving the cable industry's installation of more fiber lines. The opportunity to "offer new revenue-generating services" topped the charts, with 51% of survey participants selecting that option. Close behind were the ability to "match or stay ahead of the competition," the desire to "address surging demand in growth," and the chance to "reduce network operating costs," all of which came in at roughly 50%. One more key driver was the opportunity to "reduce aging infrastructure," chosen by 45% of respondents.

Select the top three drivers for your company to install more FTTH lines rather than HFC? (N=375)
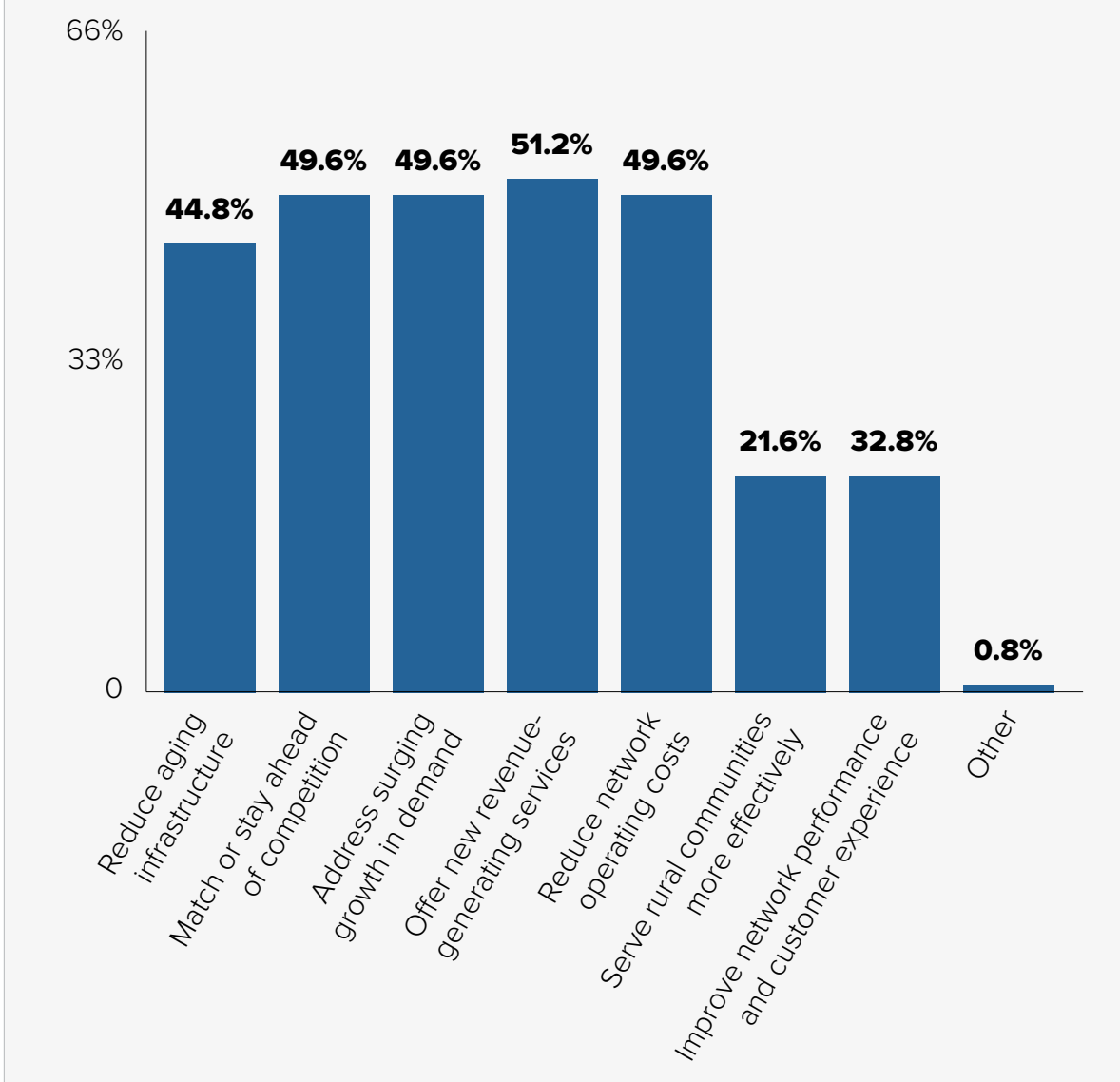
Source: Heavy Reading

With the industry's fiber drive only intensifying, the survey then asked participants how much of their company's footprint they expected to cover with FTTH lines over the next three years. More than two-fifths of respondents (43%) said they expect their company to cover more than 30% of their homes with FTTH by fall 2023, with 13% expecting to blanket more than 60%. Another 21% expect to cover between 21% and 30% of their territories with fiber lines, while 36% expect to cover 20% or less.

What percentage of homes in your company's footprint do you expect to pass with FTTH lines in three years (by fall 2023)? (N=126)
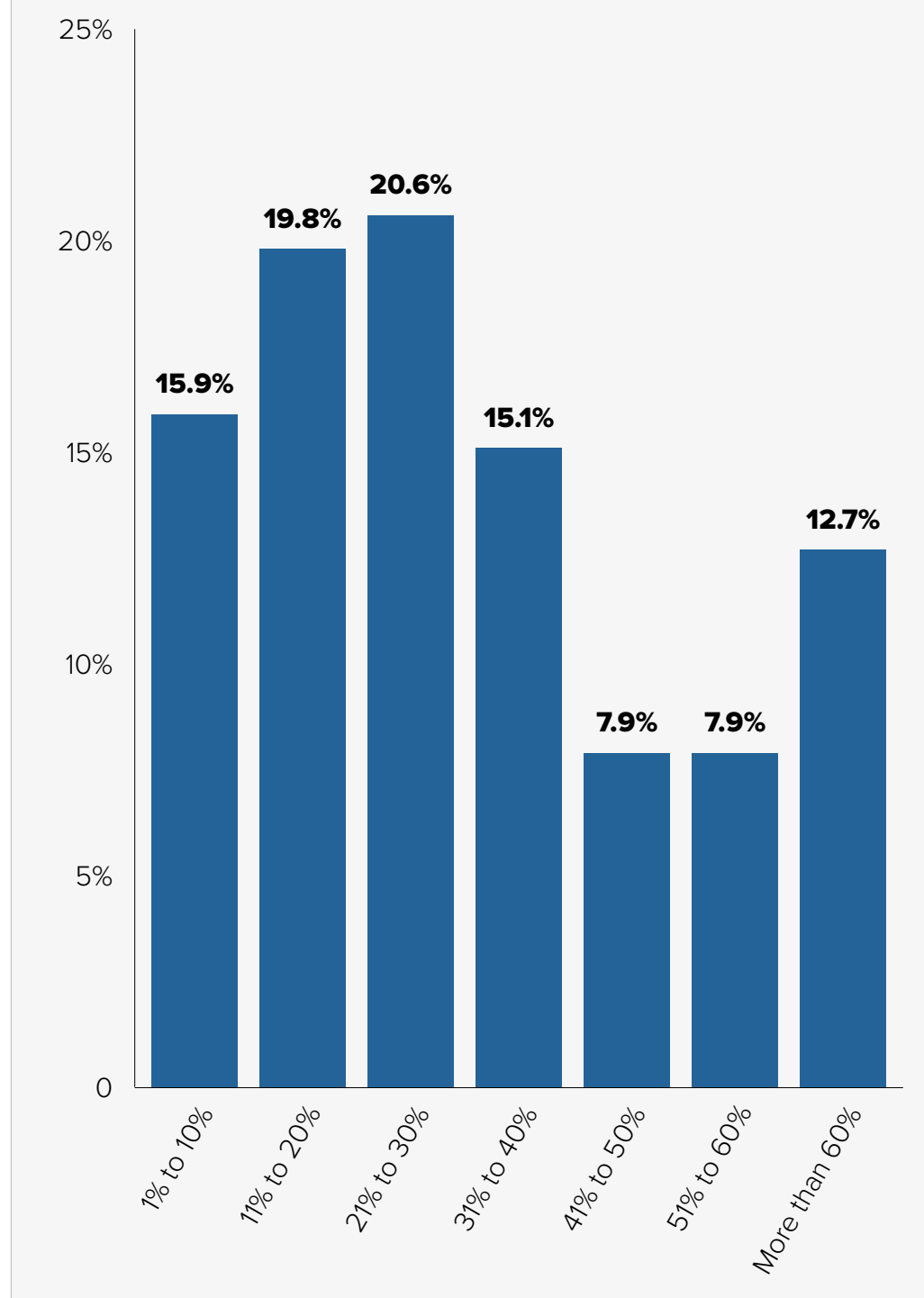
Source: Heavy Reading

Which new services are cablecos seeking to deliver over their new FTTH lines? Nearly two-thirds of survey participants (64%) said their company aims to offer multi-gigabit data speeds, making that one of the two top choices. The other top choice was 5G mobile backhaul, which was also picked by 64% of respondents. Streaming video, Internet of Things (IoT), and IPTV scored highly on the scale too, with each attracting support from close to half (46%) of respondents.

Which new services is your company looking to deliver over a FTTH architecture?
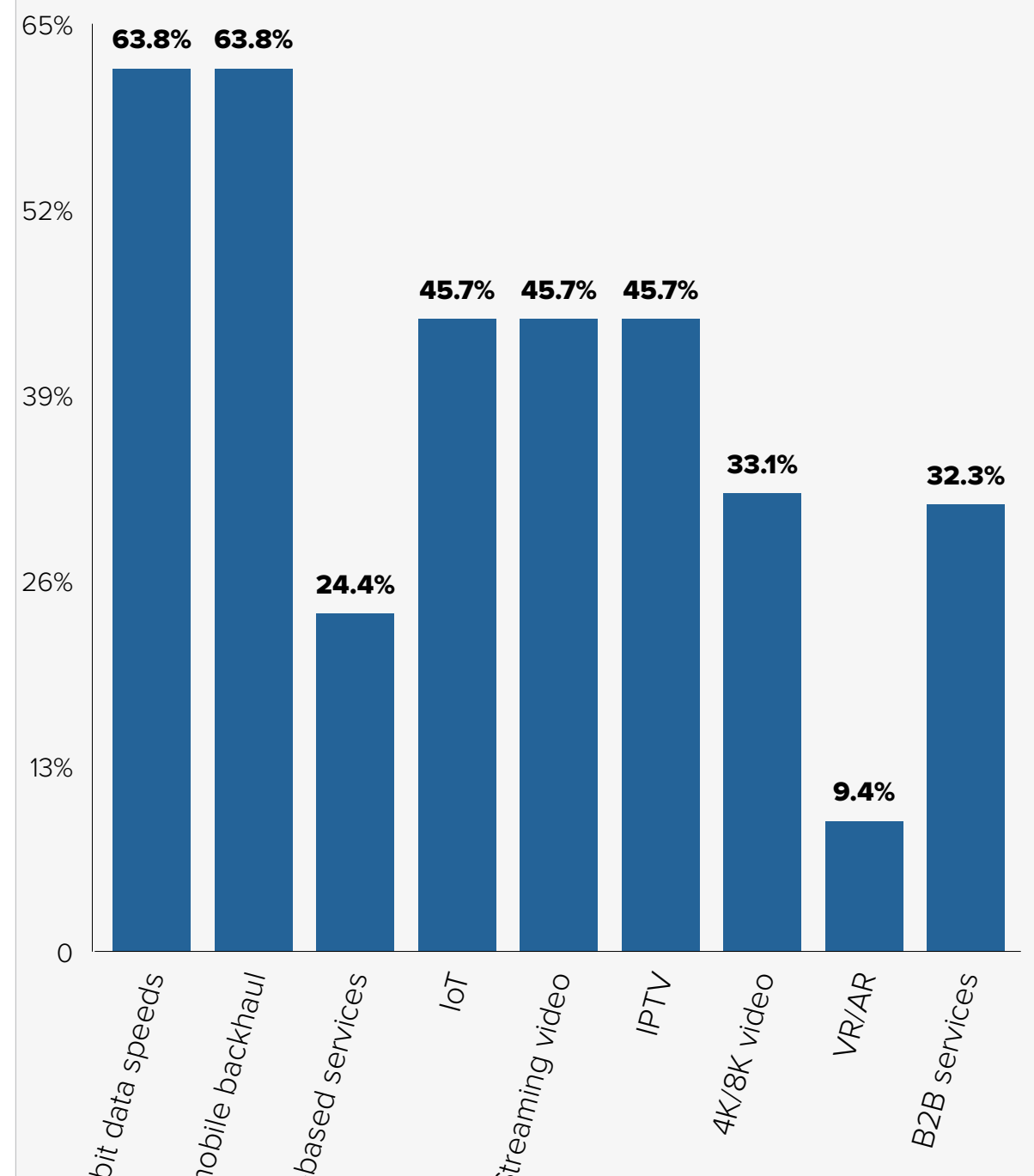
Source: Heavy Reading

With the prospect of 5G weighing heavily on their minds, how important are fiber network upgrades to operators' plans to support 5G and other new fixed wireless services? Very important, according to the survey results. A full three-quarters of respondents (75%) ranked fibers upgrades as "critical" or "important" to their plans. Only 5% rated those upgrades as "not important at all."

Staying with mobile service, Heavy Reading asked about the primary technologies that operators intend to use to support wireless small cells. Close to three-fifths of respondents (57%) said their company plans to deploy dense wavelength division multiplexing (DWDM) technology over fiber, making that the leading choice for the second straight year. Similar to last year, nearly one-half of survey participants (48%) said their company aims to rely on low latency DOCSIS, while the same number (48%) picked xPON technology.

As they look to migrate toward all-fiber networks, cable operators realize they face several major challenges. In the Heavy Reading survey, "fiber availability and expense" easily topped the list of challenges once again, with 71% of survey participants picking it. "Civil and real estate permitting," chosen by 60% of respondents, ranked as the second biggest challenge. "Education/training of contractors" (50%) and "digital fiber node costs" (49%) rounded out the top four challenges.

Last but far from least, Heavy Reading inquired about the biggest network upgrade challenge that operators are facing because of the COVID-19 pandemic. A lack of "capacity for higher upstream demand" led the way, with 45% of survey participants choosing that option. Nearly two-fifths of respondents (38%) identified a "lack of available fiber" and almost as many (36%) named an "inability to install new fiber lines as fast" as they would like, while 34% cited "higher fiber costs."
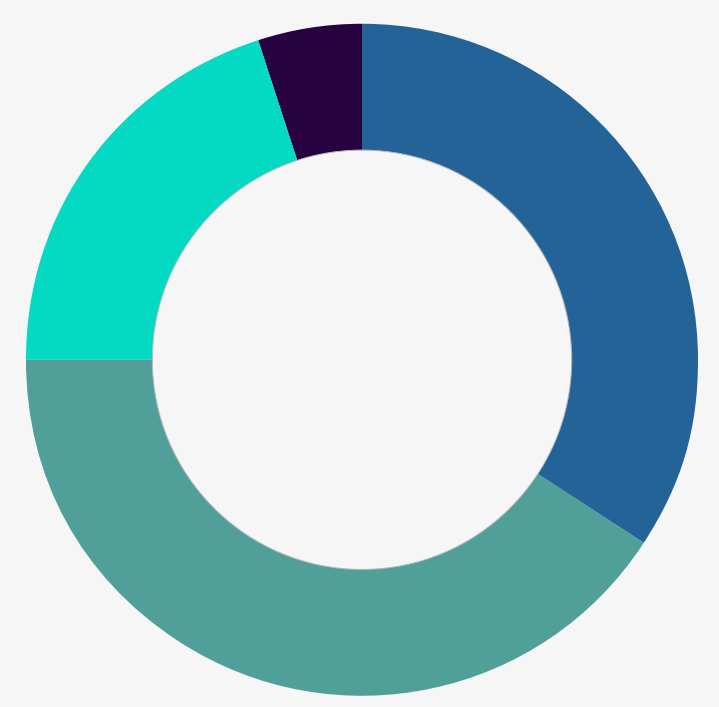
How important are fiber network upgrades to your company's plans to support 5G and other new fixed-wireless services?

- **12.7%** | Critical
- **32.5%** | Important
- **21.4%** | Somewhat important
- **33.3%** | Not important

Source: Heavy Reading

What are the primary technologies that your company plans to use to support wireless small cells?

DWDM over fiber	48.4%
X-PON technology	57.1%
Other	47.6%
Low-Latency DOCSIS (Low Latency X-Haul)	2.4%

Source: Heavy Reading

Please select the top three network challenges that your company faces in installing more FTTH lines? (N=381)

Education/training of own labor force	40.9%
Education/training of contractors	50.4%
Fiber availability and expense	70.9%
Civil and real estate permitting	59.8%
Digital fiber node costs	48.8%
Powering aspects	26.8%
Other	2.4%

Source: Heavy Reading

What are the biggest network upgrade challenges your company is facing because of the COVID-19 pandemic? (N=253)

Not enough capacity for higher downstream demand	24.0%
Not enough capacity for higher upstream demand	44.8%
Lack of available fiber	38.4%
Higher fiber costs	33.6%
Lack of trained fiber installation technicians	23.2%
Inability to install new fiber lines as fast as we would like	36.0%
Other	2.4%
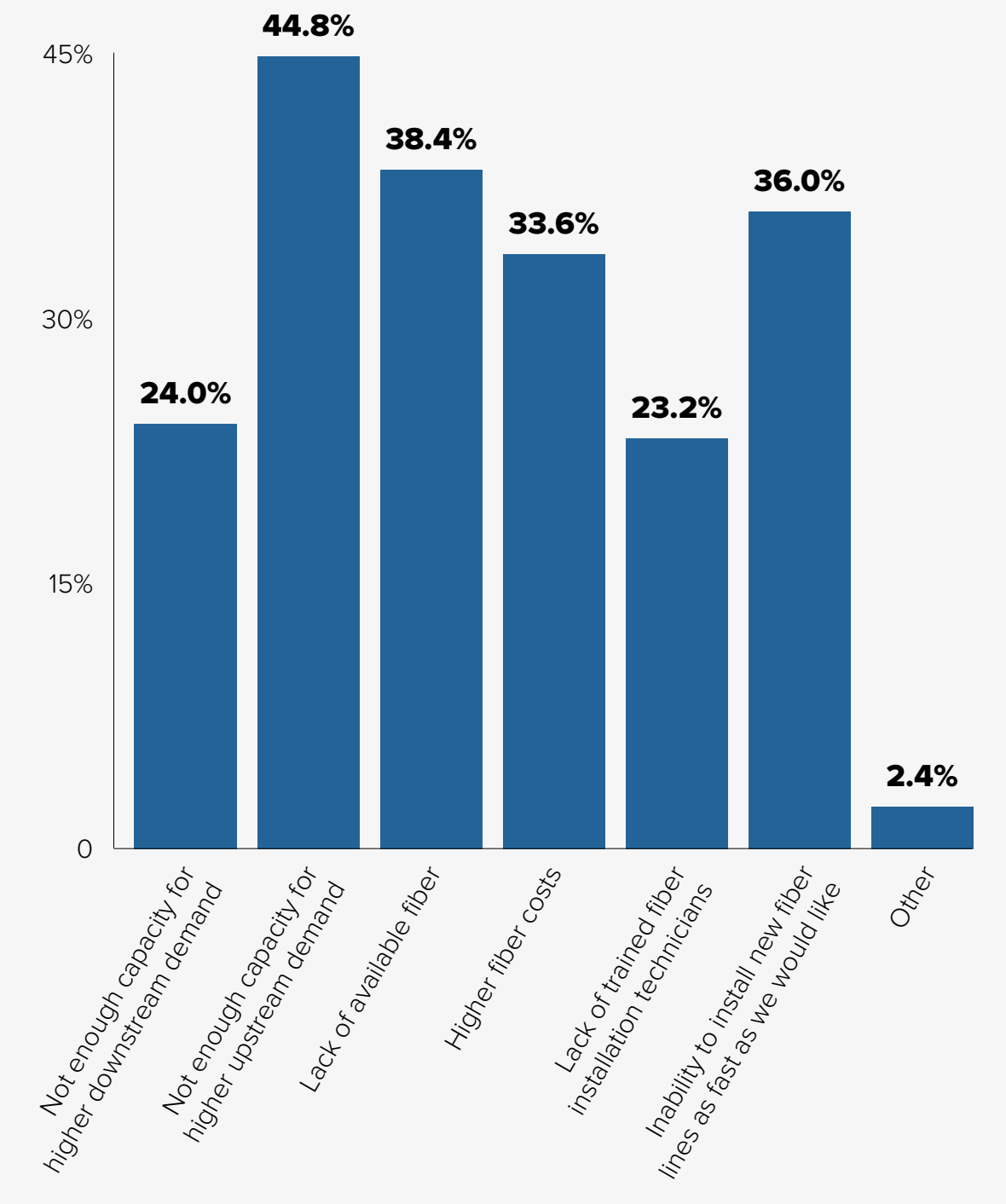
Source: Heavy Reading

CORNING

Corning is one of the world's leading innovators in materials science, with a 166-year track record of life-changing inventions. They apply unparalleled expertise in glass science, ceramic science and optical physics along with their deep manufacturing and engineering capabilities to develop category-defining products that transform industries and enhance people's lives.

Their Optical Communications segment delivers connectivity to every edge of the CATV network, from the headend to subscribers, and includes optical fiber, cable, hardware and equipment, as well as RF connectivity, to fully optimized solutions for high-speed communications networks. MSO networks are evolving, with fiber driving deeper into the network as operators move to a passive HFC network and utilize full fiber to the home deployment in greenfield builds. Corning is ready to help customers seize the opportunity in the next evolution of their networks, wherever they are on the road to 10G.

Fiber Monetization Plans

As detailed in the previous section, upgrading cable networks with more fiber certainly has its share of technical, logistical, and operational challenges. But these hurdles may all pale in comparison to an even bigger challenge for cable operators and other wireline service providers: monetizing their increasingly heavy investments in fiber.

Indeed, monetizing fiber is no simple matter. It requires upgrading existing or installing new business support systems (BSS) and operations support systems (OSS) to run, monitor, and bolster the new fiber-based services. Monetizing also requires collecting critical subscriber usage data, digging deeper into network traffic patterns and flows, integrating the billing of multiple services over multiple networks, and implementing new and improved network control policies, among other things. In other words, it requires operators to develop a new skill set for a new age.

In this section of the report, Heavy Reading examines the challenges of fiber monetization and looks at how cablecos are trying to surmount those obstacles. This section also looks at how new technologies such as DAA, network virtualization, automation, and others may affect the drive to monetize fiber.

Key takeaways

- Introducing "new service models to create more value for our customers" emerged as operators' greatest motivation for deploying fiber, with one-third of respondents (33%) citing it. Nearly one-quarter of respondents (24%) said their company's greatest motivation was to boost revenue.

- More than two-thirds of survey participants (71%) said their company needs "service diagnostics and proactive network maintenance (PNM)" from its fiber network, making that the top choice. "Capacity planning," picked by 62% of respondents, came in a strong second.

- Close to one-half (46%) of survey participants rated having multiple optical line terminal (OLT) and/or cable modem termination system (CMTS) network vendors to consider as a technical challenge for their company in monetizing its fiber network. Nearly two-fifths of respondents (38%) chose "B/OSS integration is complicated and time-consuming" as a challenge.

- Less than one-third of respondents (31%) said their company is ready to harness subscriber data from networks virtualized with technologies like DAA, vCMTS, and vOLT today. Some 30% said they are not ready because they need to "update our existing B/OSS to support virtualized networks," while 15% said they are not ready because they plan to "deploy standalone B/OSS functions to address virtualized networks."

Making Money on Fiber Builds

Now that cable operators and other providers have poured billions of dollars into fresh fiber networks, perhaps the biggest question is: How can they monetize that investment? Can they develop and deliver profitable enough new and advanced services to cover those huge network construction bills? Can they squeeze enough savings out of their operational budgets to make up for the sizable increases in capital expenditures? Can they run their new networks efficiently enough to boost their profit margins markedly on each product delivered and each customer served?

In this section of the survey, Heavy Reading started exploring the monetization issue by asking participants about their company's greatest motivation for deploying fiber. Notably, fully one-third of respondents (33%) ticked off introducing "new service models to create more value for our customers" as the biggest reason, making that the top choice. Nearly one-quarter (24%) said their company's greatest motivation was to "increase revenue," while 17% said the top aim was to gain a "competitive advantage" against their rivals.

### What is your company's greatest motivation for deploying fiber? (N=124)
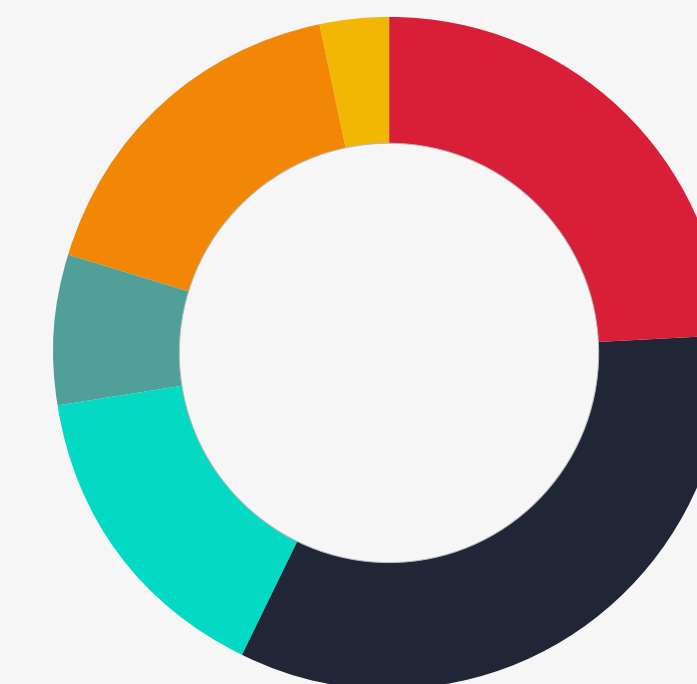
- **24.2%** | Increase revenue
- **33.1%** | Introduce new service models to create more value for our customers
- **15.3%** | Reduce customer churn
- **7.3%** | Monetize subscriber usage data from fiber network
- **16.9%** | Gain competitive advantage
- **3.2%** | Don't know/Not applicable
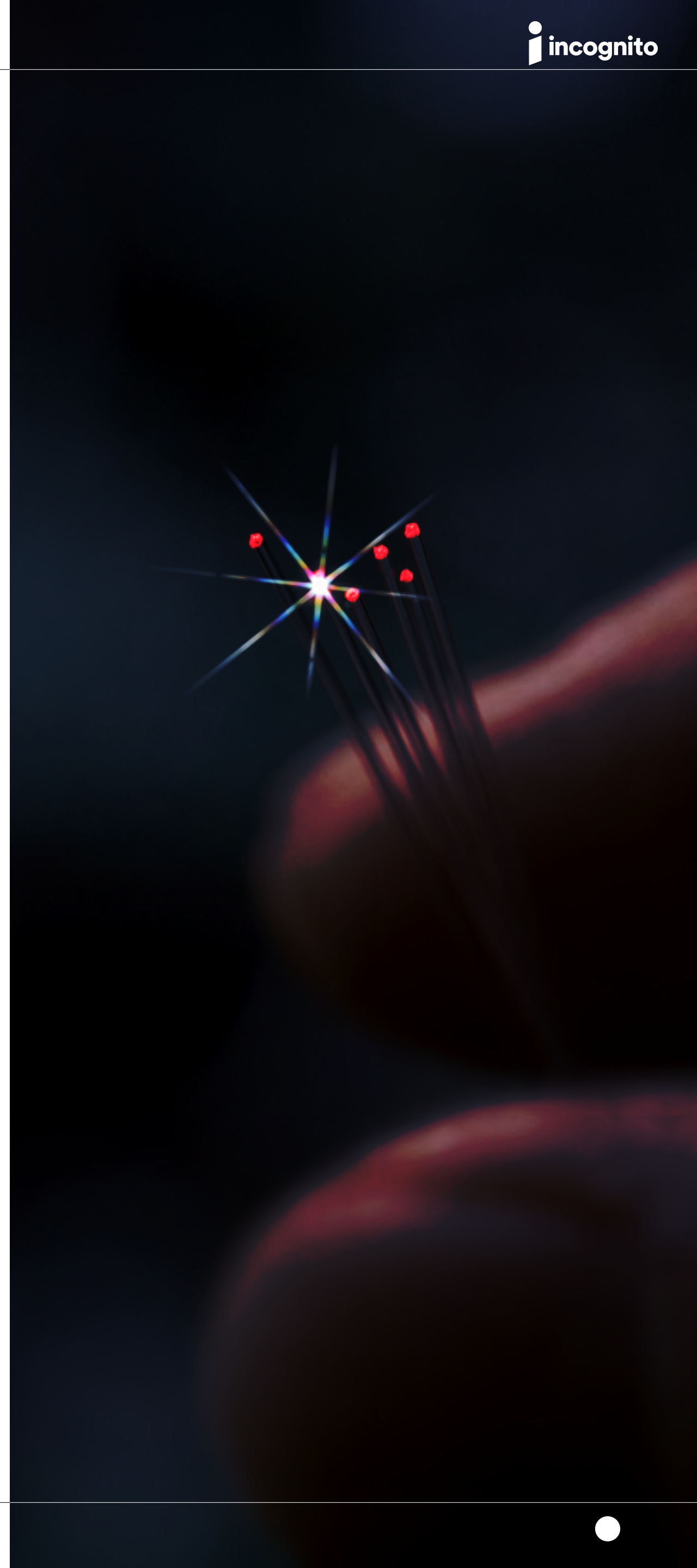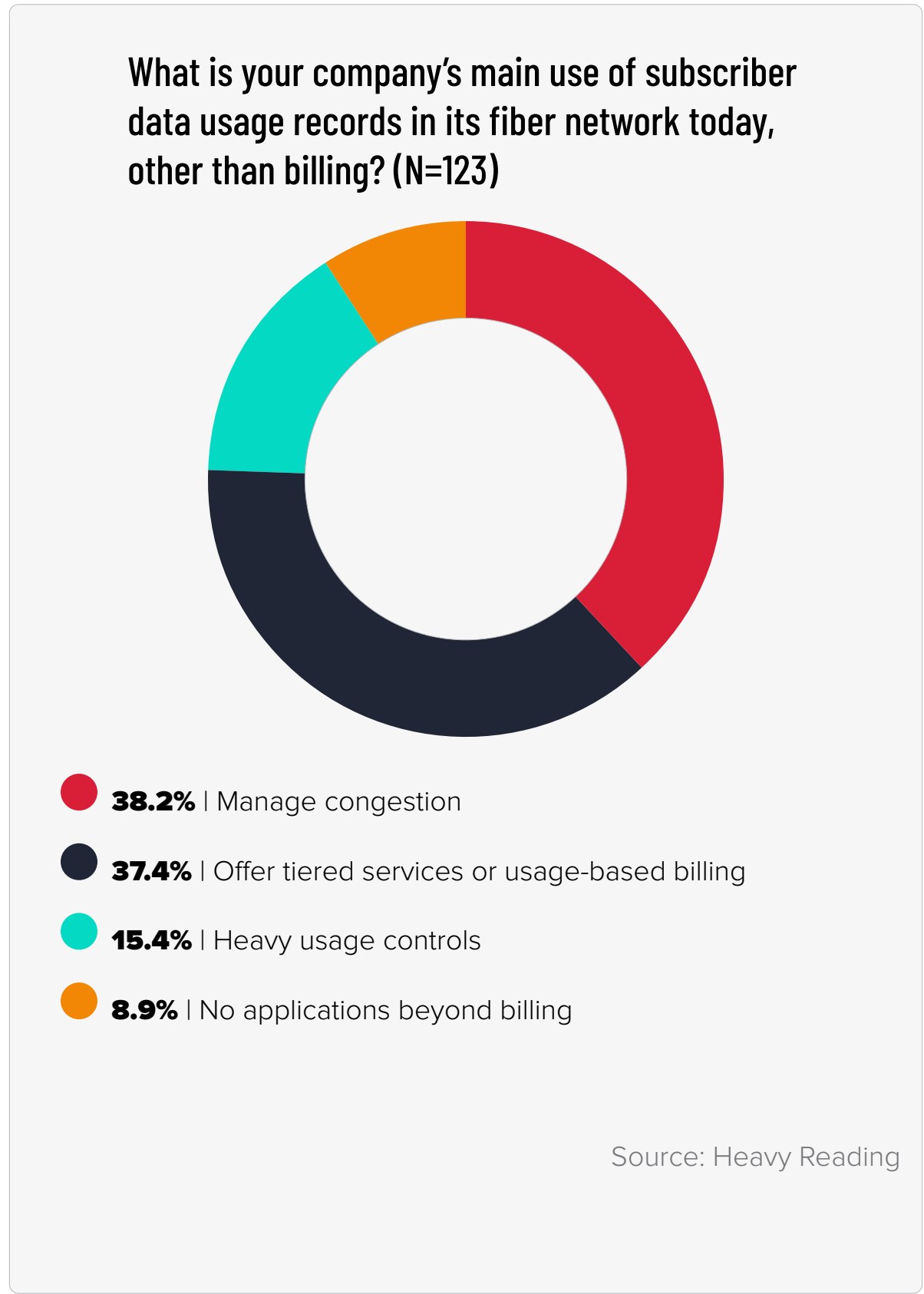
Source: Heavy Reading

With the construction of new fiber networks, operators are looking to learn more about their subscribers and their networks. Which insights do they need the most? More than two-thirds of survey participants (71%) said they need "service diagnostics and PNM," making that the top choice. "Capacity planning," picked by 62% of respondents, finished a strong second. Respondents also gave high scores to enforcing "traffic to conform to what subscribers have ordered" (49%) and uncovering "subscriber usage patterns" (40%).
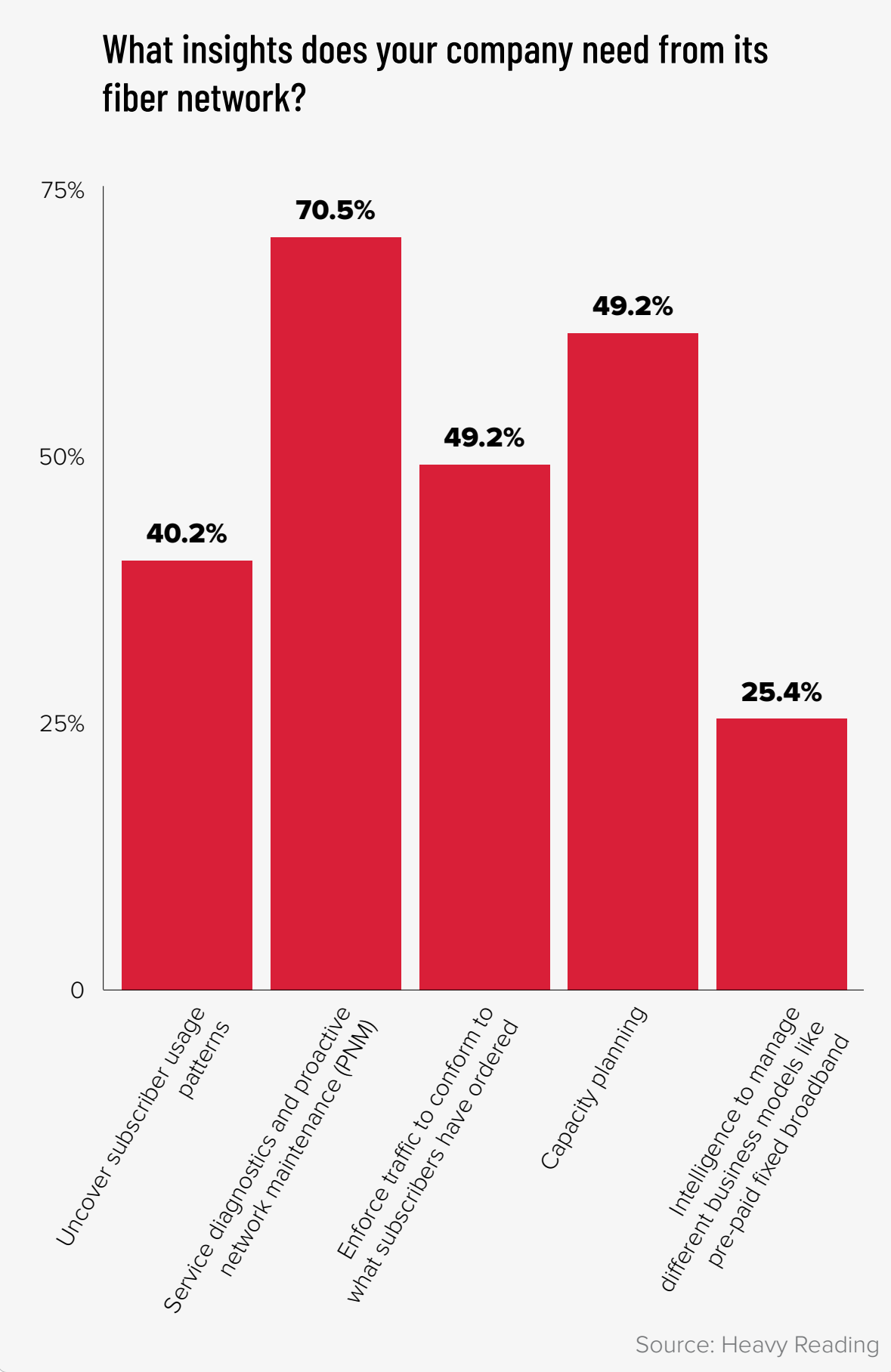
The study then focused on the technical challenges that operators face in monetizing their fiber networks. With multiple answers allowed, having "multiple OLT and/or CMTS network vendors to consider" emerged as the most commonly named challenge, with close to one-half (46%) of survey participants choosing it. Nearly two-fifths of respondents (38%) chose "B/OSS integration is complicated and time-consuming" as a challenge, while 35% picked "lack of automation" and 31% cited that they "have one subscriber data collection system for cable and a separate system for fiber."
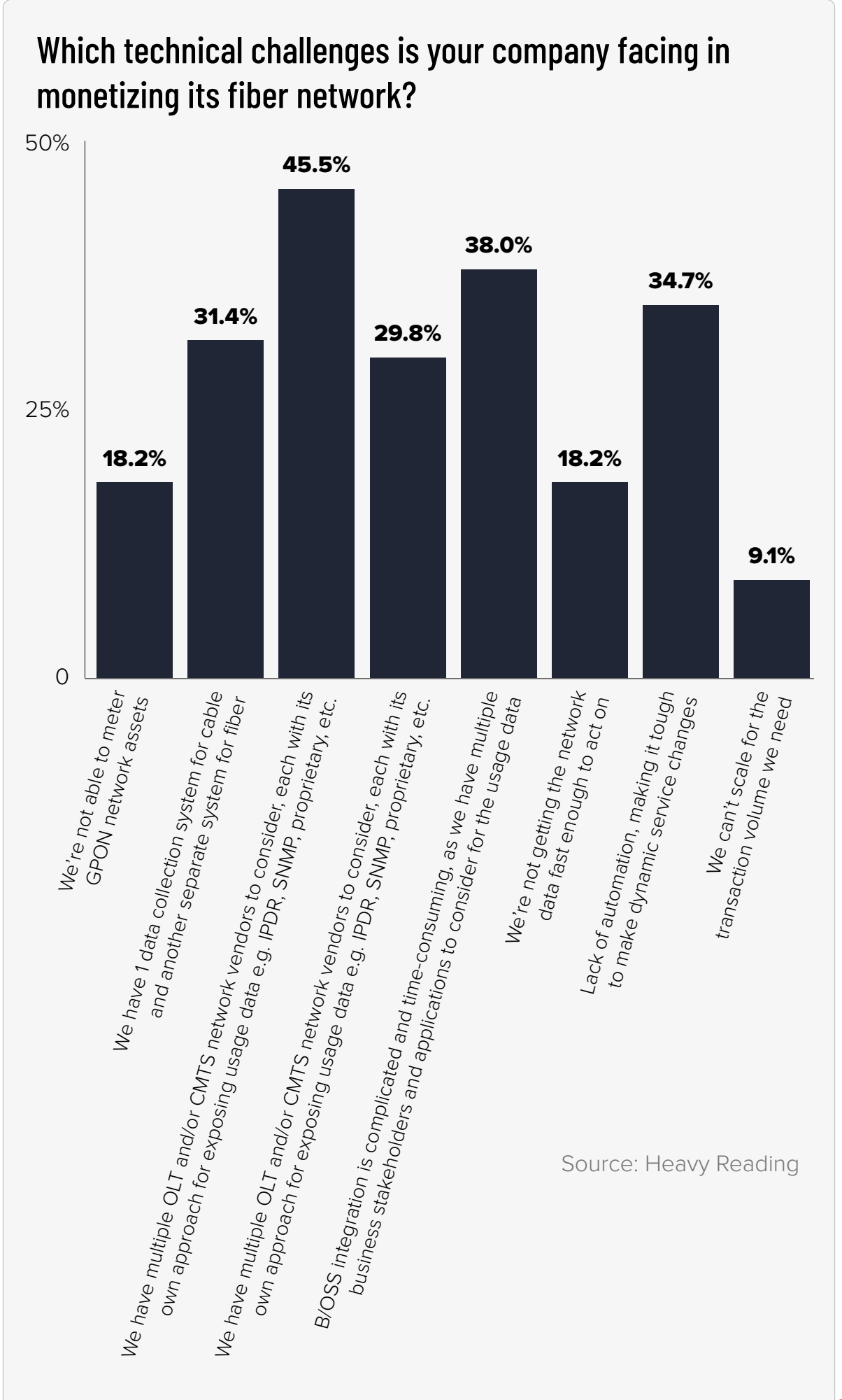
How are operators making use of subscriber data usage records in their fiber networks today? Close to two-fifths of respondents (38%) said their company's main use of subscriber data records is to "manage congestion." The ability to "offer tiered services or usage-based billing" came in a strong second, with 37% of respondents picking that choice. No other use cases came close.

What insights does your company need from its fiber network?

Category	Value
Uncover subscriber usage patterns	40.2%
Service diagnostics and proactive network maintenance (PNM)	70.5%
Enforce traffic to conform to what subscribers have ordered	49.2%
Capacity planning	49.2%
Intelligence to manage different business models like pre-paid fixed broadband	25.4%

Source: Heavy Reading

Which technical challenges is your company facing in monetizing its fiber network?

Category	Value
We're not able to meter GPON network assets	18.2%
We have 1 data collection system for cable and another separate system for fiber	31.4%
We have multiple OLT and/or CMTS network vendors to consider, each with its own approach for exposing usage data e.g. IPDR, SNMP, proprietary, etc.	45.5%
We have multiple OLT and/or CMTS network vendors to consider, each with its own approach for exposing usage data e.g. IPDR, SNMP, proprietary, etc.	29.8%
B/OSS integration is complicated and time-consuming, as we have multiple business stakeholders and applications to consider for the usage data	38.0%
We're not getting the network data fast enough to act on	18.2%
Lack of automation, making it tough to make dynamic service changes	34.7%
We can't scale for the transaction volume we need	9.1%

Source: Heavy Reading

What is your company's main use of subscriber data usage records in its fiber network today, other than billing? (N=123)

- **38.2%** | Manage congestion
- **37.4%** | Offer tiered services or usage-based billing
- **15.4%** | Heavy usage controls
- **8.9%** | No applications beyond billing

Source: Heavy Reading

Since operators are starting to enforce subscriber data caps for fixed broadband service again, the study asked participants what their companies need to do in that environment. Exactly one-half of respondents (50%) said they need to "understand the usage patterns of our subscribers so that we can deliver great value and quality of experience," making that overwhelmingly the top choice. Slightly over one-fifth of participants (21%) said they must "create new products quickly to address our subscribers' needs," while 17% said their company does not plan any changes right now.

Finally, with the cable industry now starting to shift to virtualized network architectures like DAA, vCMTS, and vOLT, the study sought to determine how ready operators are to harness subscriber data from these more advanced architectures. Not very, according to the survey results. Less than one-third of respondents (31%) said their company is ready to leverage that subscriber usage data today. In contrast, 30% said they are not ready because they need to "update our existing B/OSS to support virtualized networks." Another 15% said they are not ready because they plan to "deploy standalone B/OSS functions to address virtualized networks."

As operators resume enforcing subscriber data caps in fixed broadband, what does your company need to do? (N=124)

- **12.1%** | Make bulk network policy control changes
- **50.0%** | Understand the usage patterns of our subscribers so that we can deliver great value and quality of experience i.e. appropriate bandwidth for their usage
- **21.0%** | Create new products quickly to address our subscribers' needs
- **16.9%** | No changes at this time. We want to give our customers the bandwidth they need for business continuity

Source: Heavy Reading

Is your company ready to harness subscriber data from network architectures that use virtualized technologies like DAA, vCMTS or vOLT? (N=123)

- **30.9%** | Yes, we are ready
- **30.1%** | No, we need to update our B/OSS that currently manages physical assets to support virtualized networks
- **14.6%** | No, we will deploy standalone B/OSS functions to address virtualized networks
- **7.3%** | No, we need IPFix capabilities to gain further insights
- **7.3%** | No, as we are concerned about bottlenecks and performance when collecting granular data from a single software application that aggregates data from the nodes
- **9.8%** | We haven't deployed network virtualization nor have plans to do so

Source: Heavy Reading

incognito

Incognito Software Systems provides service orchestration software and services that help digital service providers manage the next-generation broadband experience. Over 300 customers worldwide, including Claro, Cox, Digicel, Globe and Orange, leverage Incognito solutions to fast-track the introduction of innovative broadband services over fiber, cable, fixed wireless technologies, while delivering a great customer experience.

VIAVI

5G xHaul

Cable operators have been delivering cell tower backhaul services for 3G and 4G wireless networks for years, typically through their business services divisions. But now, with the telcos starting to roll out mobile 5G technology around the globe, cablecos see promising new revenue growth opportunities, primarily from offering 5G backhaul, midhaul, and fronthaul services to mobile network operators. To a lesser degree, cable providers are also looking to offer some 5G services to subscribers themselves.

Perhaps the biggest hurdle for the cable industry, though, is that 5G support will require a major HFC network overhaul—particularly in extending fiber connectivity out to 5G macro sites and new small cells. This section covers the 5G opportunities and challenges for cable, focusing on the backhaul, midhaul, and fronthaul technology issues that operators face.

Key takeaways

- Only 12% of survey respondents said their company has upgraded its backhaul network to support 5G so far, but 45% expect to upgrade their backhaul network within the next two years.

- More than two-fifths of operators (42%) plan to converge their fronthaul and backhaul segments in a single physical network, while 36% aim to converge their legacy and next-gen fronthaul protocols, Common Public Radio Interface (CPRI) and enhanced CPRI (eCPRI), respectively, over a single physical network.

- Nearly two-thirds of operators (63%) plan to deploy network slicing in their transport networks. 40% intend to use slicing to provide the full suite of 5G use cases.

- More than one-half of operators (56%) expect to deploy some flavor of new PON technology for 5G midhaul and backhaul networks, while nearly one-half (48%) will leverage wavelength-division multiplexing (WDM) wavelengths.

Gearing up for hauling 5G

Although 5G technology has arrived throughout the world, only 12% of survey respondents said their company has already upgraded its backhaul network to support 5G, a number that is actually down from 15% in last year's survey. But with the clock ticking relentlessly, more than two-fifths of respondents (45%) expect their company to upgrade its backhaul network within the next two years. Another 27% expect the upgrade to happen in two to four years, while 10% said they do not know when it will occur.

As noted in last year's report, the relatively tight two-year window for upgrading backhaul networks maps closely to overall industry expectations for 5G advanced use case rollouts of massive machine-type communication (mMTC) and ultra-reliable low latency communication (URLLC) services, both of which will likely require significant backhaul upgrades to meet stringent performance requirements. Cable operators—like their telecom counterparts—appear to be planning their networks with these advanced 5G use cases in mind.

### When will your company upgrade its backhaul network to support 5G? (N=119)
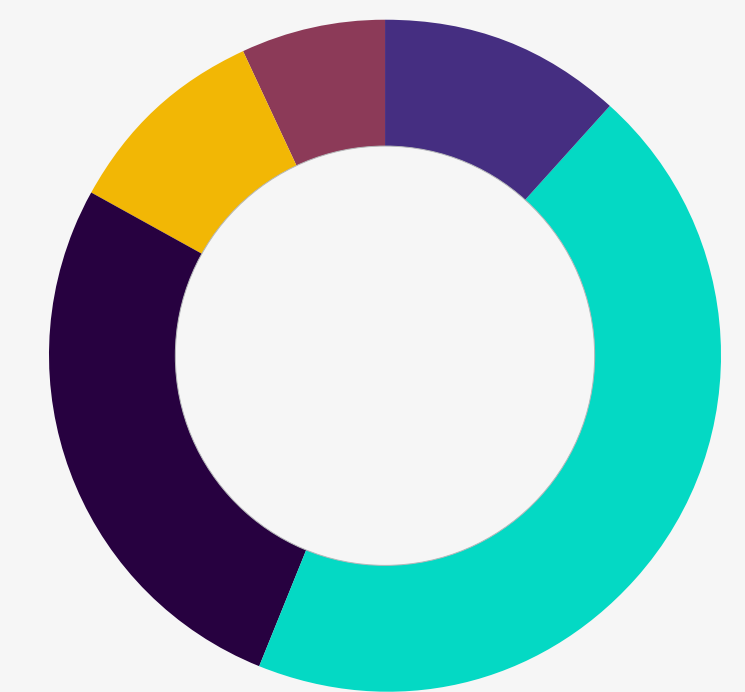
- **11.8%** | Already completed
- **44.5%** | In less than 2 years
- **26.9%** | 2-4 years
- **10.1%** | Unknown
- **6.7%** | Backhaul network doesn't need an upgrade for 5G

Source: Heavy Reading

Cable operators and other wireline service providers see great potential in network convergence because it promises to bring lower costs and simplified operations. In the Heavy Reading survey, more than two-fifths of respondents (42%) reported that they plan to converge their fronthaul and backhaul segments in a single physical network, down from the 53% reported in last year's study but still a significant number. Another 36% said their company plans to converge its legacy and next-gen fronthaul protocols (CPRI and eCPRI, respectively) over a single physical network, down again from 44% the previous year but still high.

At the same time, slightly over one-third of operators (34%) expect to keep their CPRI and eCPRI fronthaul networks separate, up from 28% a year earlier. Fewer still (just 20%) expect to maintain "separate 4G and 5G backhaul networks," slightly up from the year before.
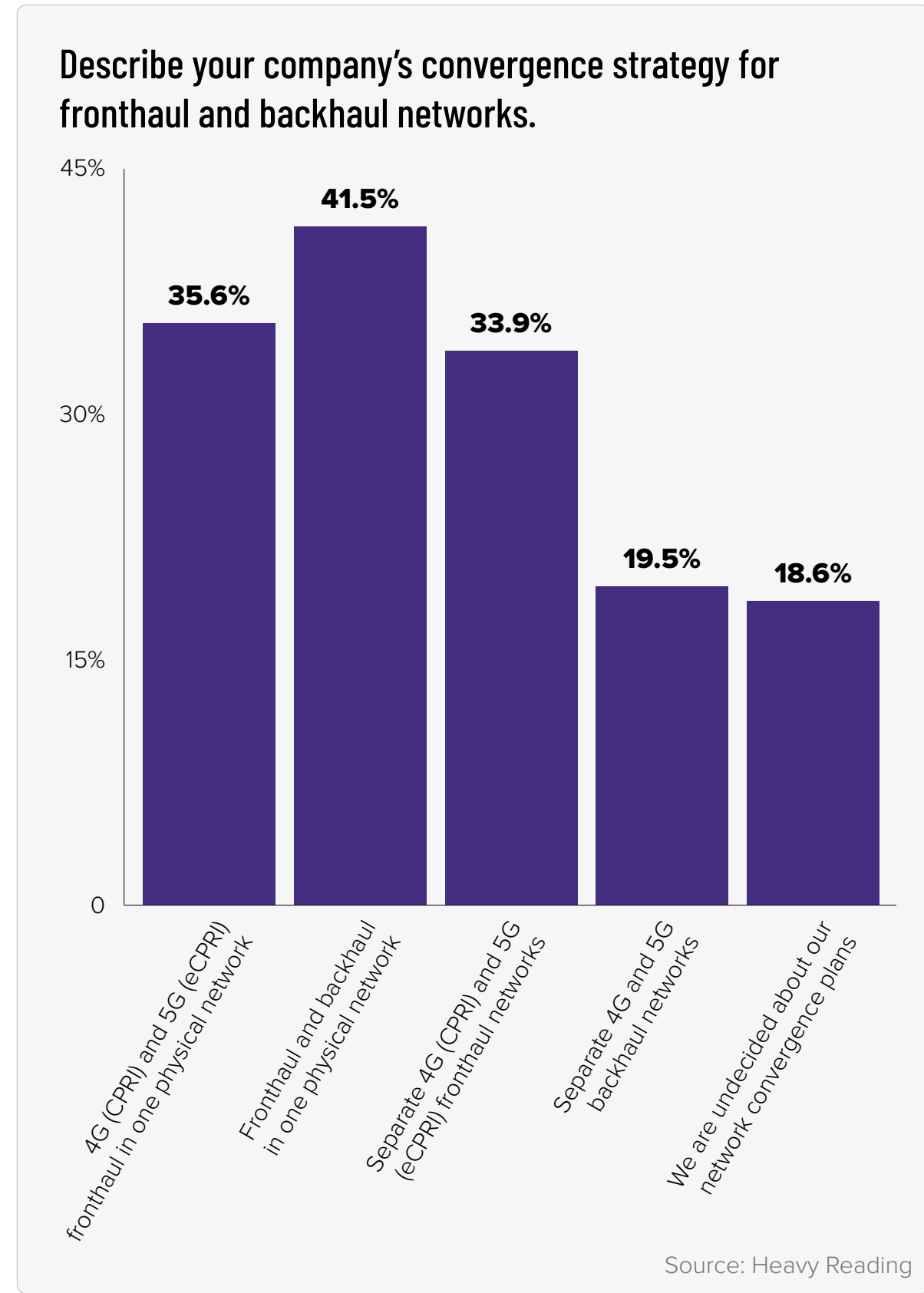
The beauty of network slicing is that it creates multiple logical networks within a single physical network, each with different quality-of-service and performance attributes. Not surprisingly, then, cable operators view network slicing as a critical technology enabler for delivering multiple types of 5G services without the need for multiple physical networks. Nearly two-thirds of operators surveyed (63%) reported that they plan to deploy network slicing in their transport networks, slightly down from 67% last year.

Some 40% of respondents said their company will use network slicing to provide the full suite of 5G use cases: enhanced mobile broadband (eMBB), URLLC, and mMTC, about the same number as in last year's survey. Another 23% said network slicing will enable them to partition transport networks to address eMBB and URLLC applications (excluding IoT-centric mMTC). Just 18% have "no plans for network slicing," while an additional 20% are still weighing their options.
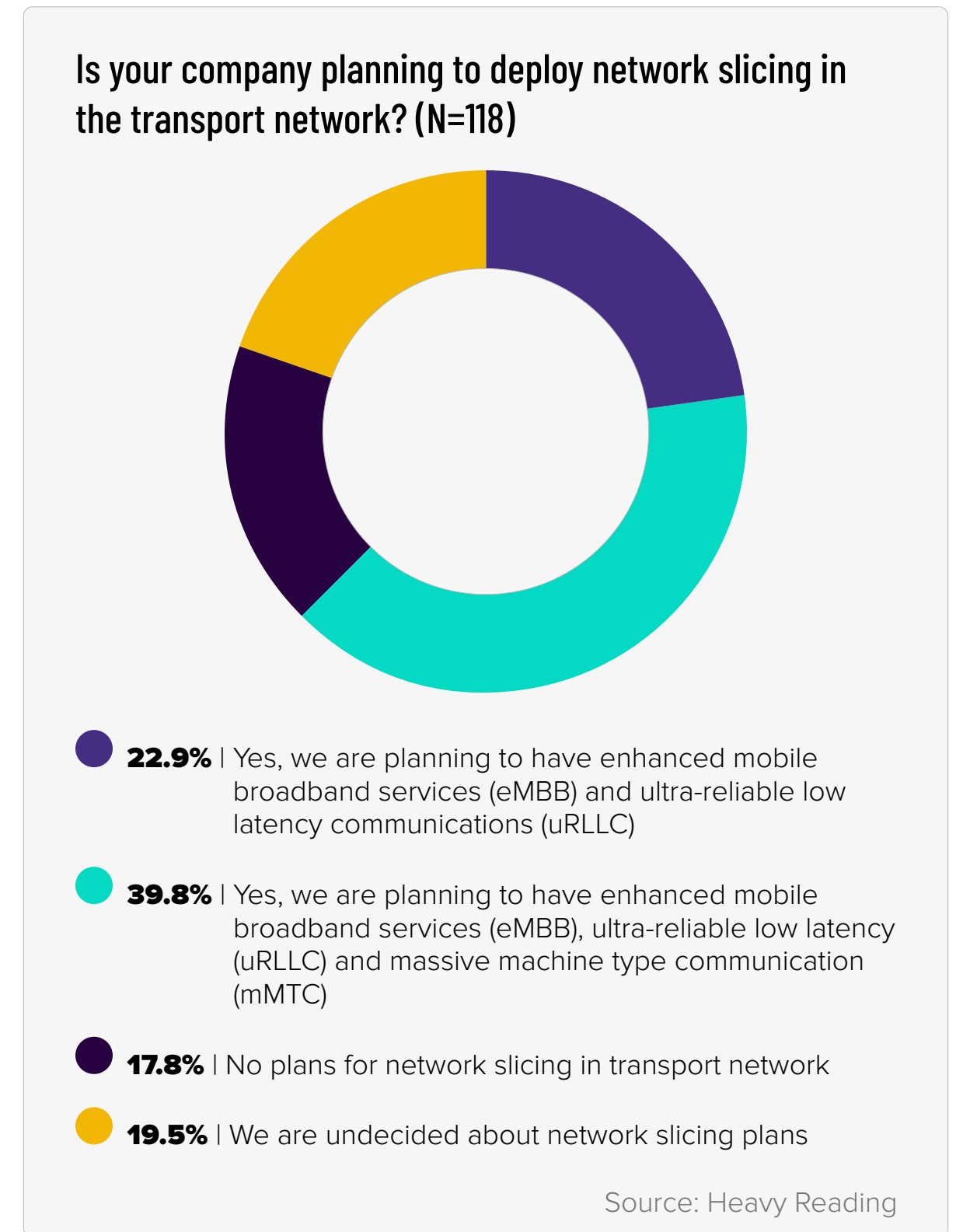
Fronthaul protocols connecting radio unit (RU) and centralized baseband unit (BBU) processing have high bandwidth requirements. Industry experts expect to see multiple 10Gbps and 25Gbps per RU for 5G, even with the bandwidth efficiency of eCPRI considered. Given these considerations, operators view fiber as the clear choice for physical connectivity, with multiple fiber options possible.
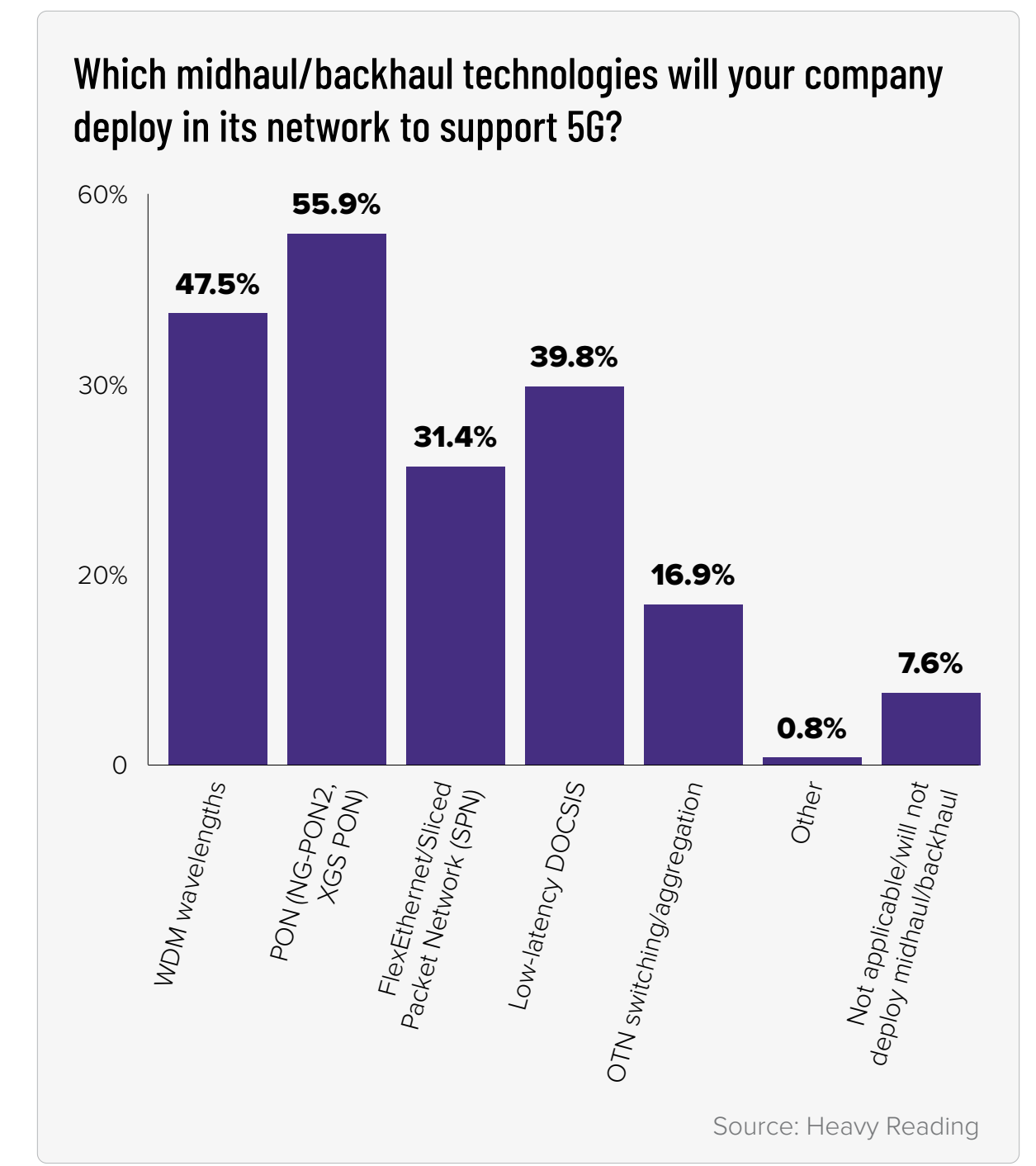
Nearly one-half of survey participants (47%) said their company will deploy standard 1310/1550nm wavelengths to support 5G fronthaul, making that the top choice. With multiple answers allowed, 40% of operators plan to leverage WDM wavelengths, while 37% intend to use standard 850/1300nm wavelengths and an equal number (37%) aim to use PON (NG-PON2 and/or XGS PON). In addition, 26% plan to use passive WDM pluggables in the radio.
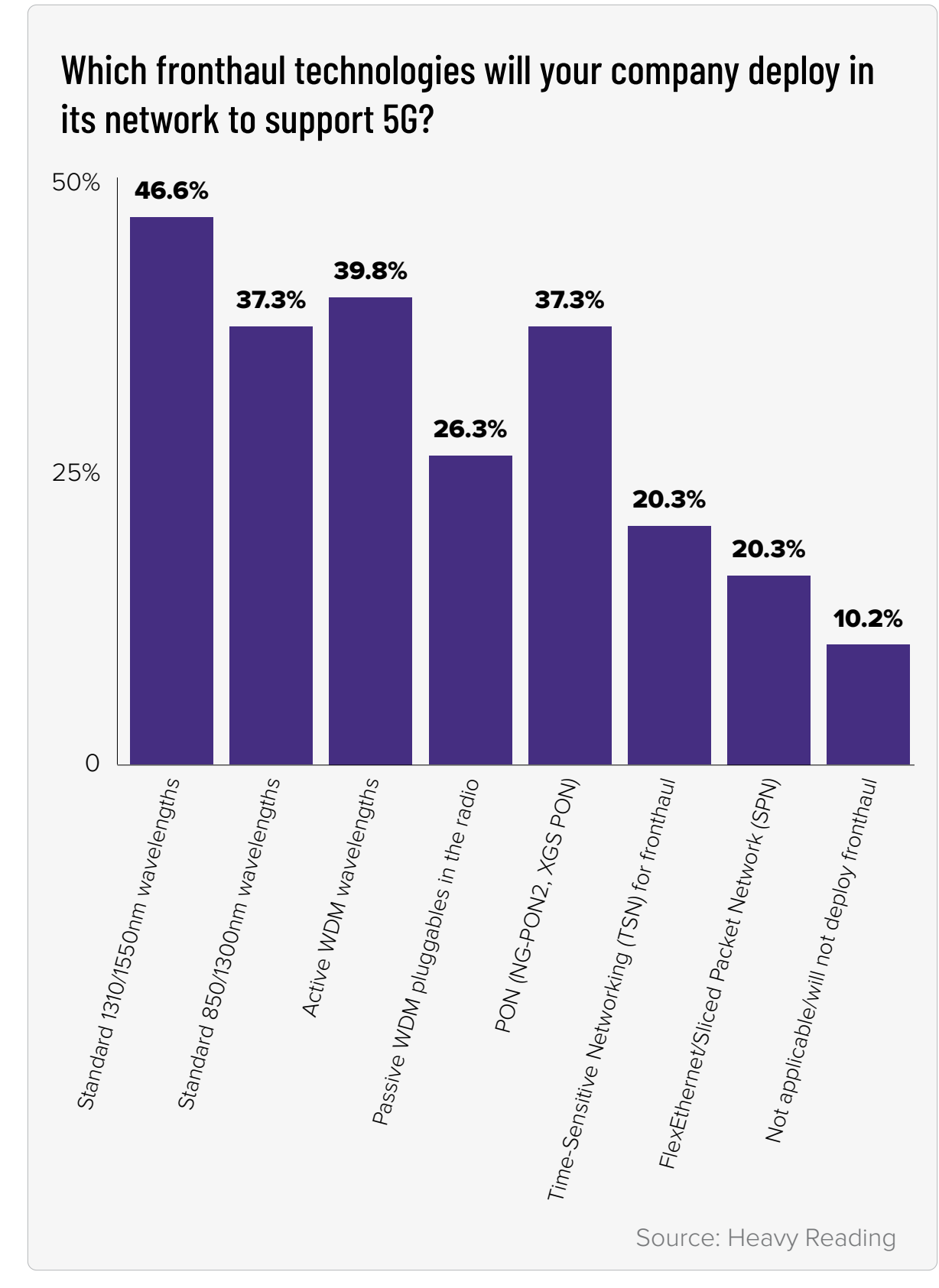
Turning to the midhaul and backhaul segments of the network, the latency and bandwidth requirements are clearly more relaxed than in the fronthaul segment. Yet, 5G still imposes greater demands on these segments than 4G technology does. As a result, network upgrades will be needed for midhaul/backhaul as well.

More than one-half of the surveyed operators (56%) expect to deploy some flavor of new PON technology, whether it is NG-PON2 or XGS PON. Nearly one-half (48%) said their company will leverage WDM wavelengths. Both represent even stronger showings than last year, when PON and WDM also led the way. Notably, low latency DOCSIS surged in popularity, rising from just 11% last year to 40% this year as the cable industry prepares to roll out its latest DOCSIS specs, DOCSIS 4.0, which incorporate low latency features.

With CableLabs and industry vendors working hard to develop and promote ways to upgrade coax to support 5G requirements, this last finding is heartening for HFC advocates. But the overall findings here still suggest that fiber-based 5G transport remains the favorite.

Describe your company's convergence strategy for fronthaul and backhaul networks.

- 4G (CPRI) and 5G (eCPRI) fronthaul in one physical network — 35.6%
- Fronthaul and backhaul in one physical network — 41.5%
- Separate 4G (CPRI) and 5G (eCPRI) fronthaul networks — 33.9%
- Separate 4G and 5G backhaul networks — 19.5%
- We are undecided about our network convergence plans — 18.6%

Source: Heavy Reading

Is your company planning to deploy network slicing in the transport network? (N=118)

- **22.9%** | Yes, we are planning to have enhanced mobile broadband services (eMBB) and ultra-reliable low latency communications (uRLLC)
- **39.8%** | Yes, we are planning to have enhanced mobile broadband services (eMBB), ultra-reliable low latency (uRLLC) and massive machine type communication (mMTC)
- **17.8%** | No plans for network slicing in transport network
- **19.5%** | We are undecided about network slicing plans

Source: Heavy Reading

Which fronthaul technologies will your company deploy in its network to support 5G?

- Standard 1310/1550nm wavelengths — 46.6%
- Standard 850/1300nm wavelengths — 37.3%
- Active WDM wavelengths — 39.8%
- Passive WDM pluggables in the radio — 26.3%
- PON (NG-PON2, XGS PON) — 37.3%
- Time-Sensitive Networking (TSN) for fronthaul — 20.3%
- FlexEthernet/Sliced Packet Network (SPN) — 20.3%
- Not applicable/will not deploy fronthaul — 10.2%

Source: Heavy Reading

Which midhaul/backhaul technologies will your company deploy in its network to support 5G?

- WDM wavelengths — 47.5%
- PON (NG-PON2, XGS PON) — 55.9%
- FlexEthernet/Sliced Packet Network (SPN) — 31.4%
- Low-latency DOCSIS — 39.8%
- OTN switching/aggregation — 16.9%
- Other — 0.8%
- Not applicable/will not deploy midhaul/backhaul — 7.6%

Source: Heavy Reading

Which optical line rates do operators expect to deploy in their 5G midhaul/backhaul networks? Slightly over one-half of providers (51%) expect to roll out 100Gbps Ethernet data rates, up from 43% a year ago. Nearly two-fifths (38%) expect to deploy 50Gbps line rates, up slightly from 35% the year before, while 35% expect to deploy 25Gbps rates, about even with last year.

Notably, 36% of survey respondents expect to deploy 10Gbps line rates, markedly down from 54% in the prior year. Thus, operators are clearly looking for even faster speeds than before as the industry upgrades from 4G mobile networks, where the typical line rate for backhaul today is just 1Gbps, to more capable 5G networks.
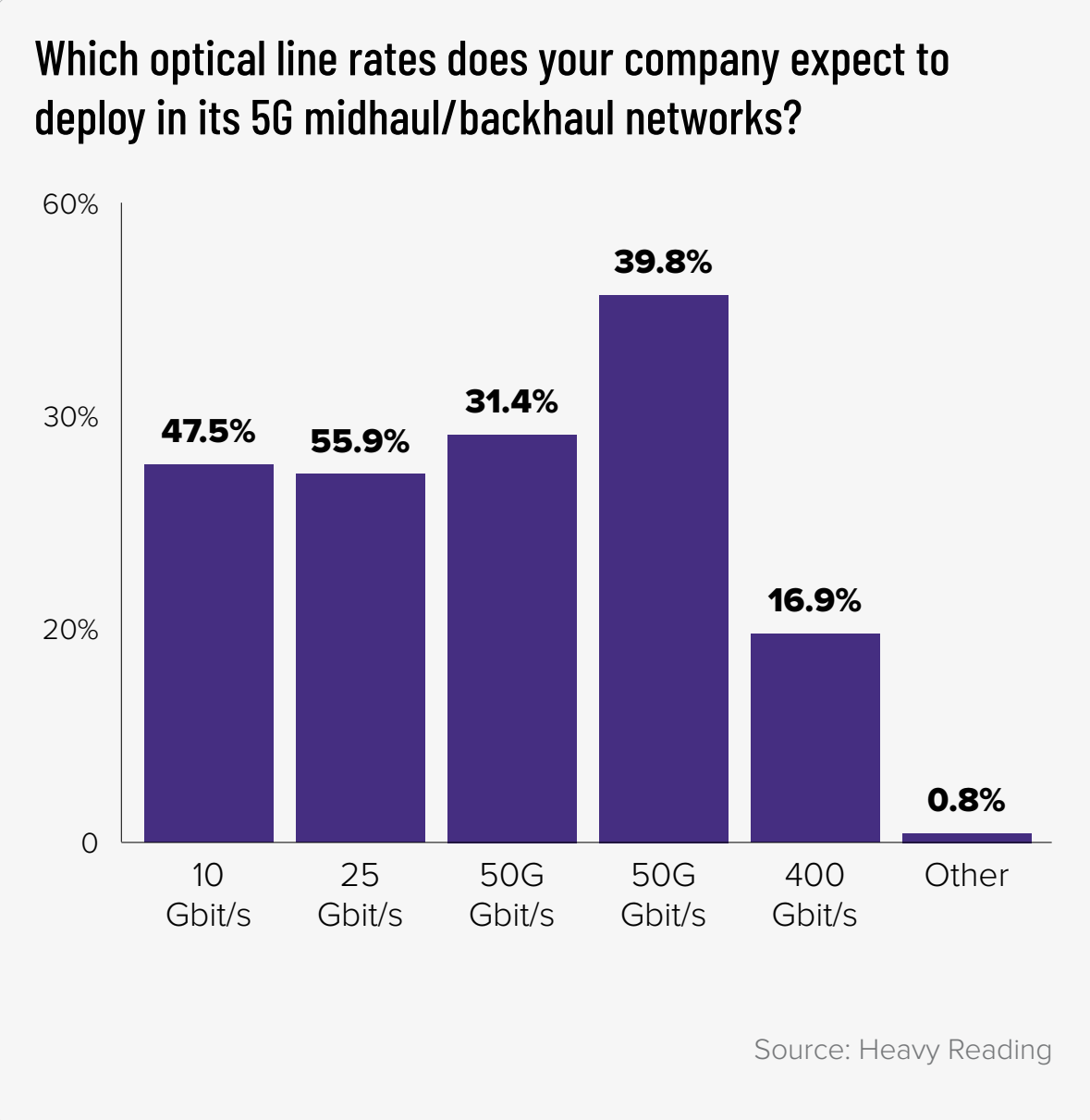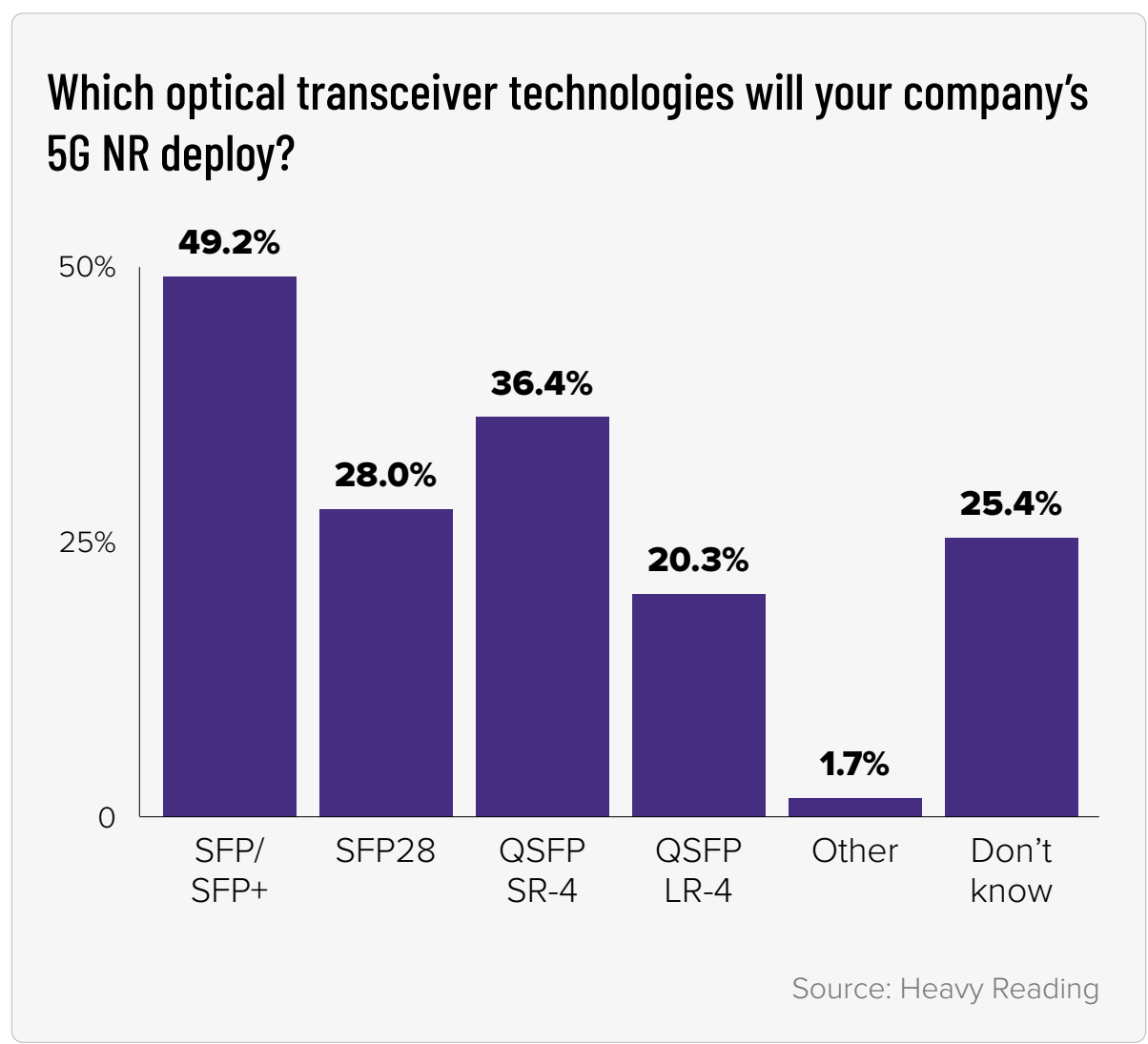
Distance is a crucial consideration in fronthaul architectures, as the timing requirements between the RUs and the BBUs also place hard limits on how far these elements can be physically separated. Although timing requirements cap maximum fronthaul distances at 20km, the surveyed operators anticipate their fronthaul distance requirements will be much less.

In fact, slightly more than one-half of survey participants (52%) expect fronthaul fiber lengths of no more than 1km, with the lion's share of that portion (35%) expecting lengths of 500 meters to 1km. Another 36% expect distances from 1km to 20km. In both cases, the results are very similar to last year's survey.
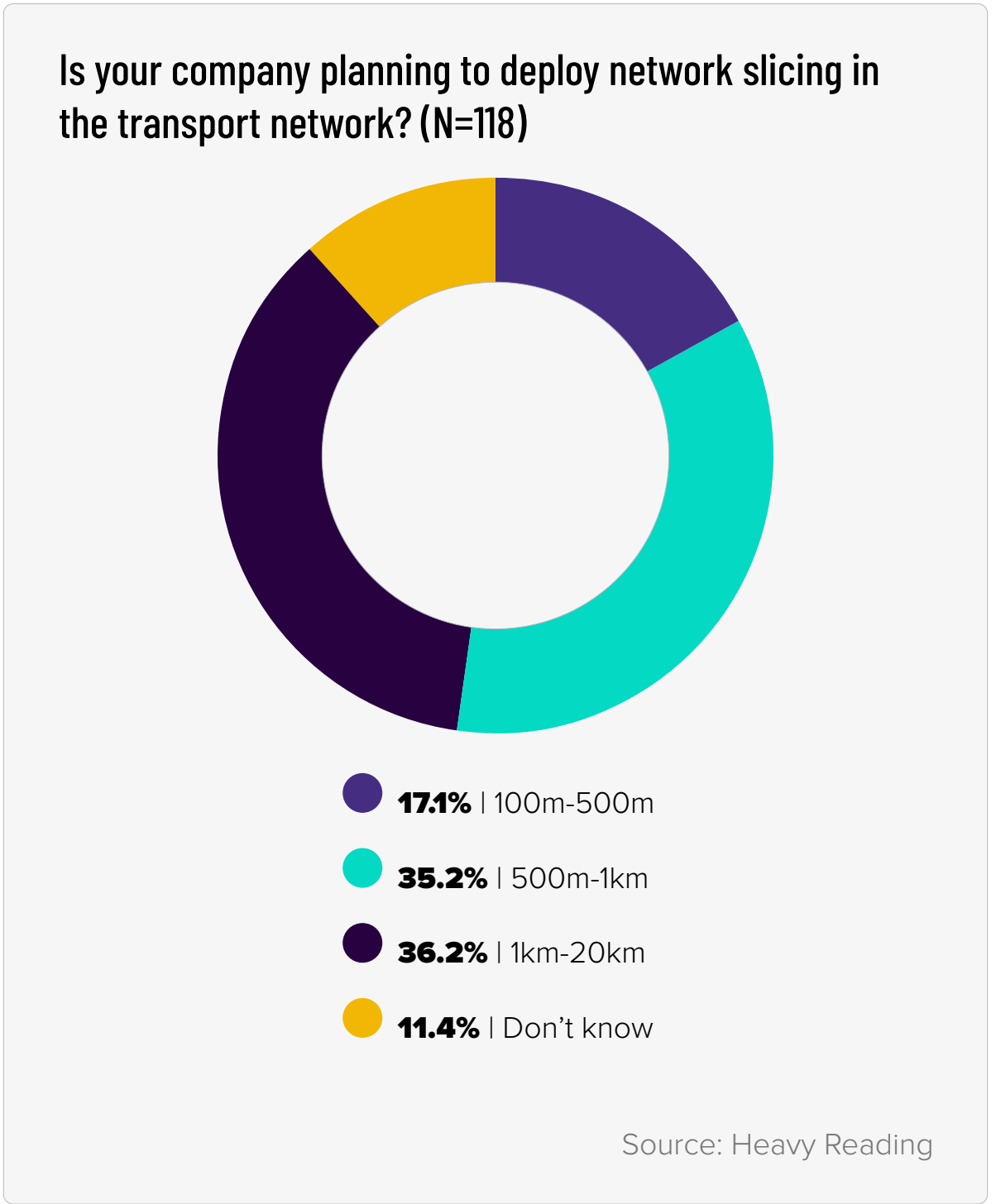
The final 5G backhaul question in the survey focused on optical transceiver technologies, seeking to determine which transceiver form factors will be most important in 5G New Radio (NR). As it did in 2019, SFP/SFP+ emerged as the convincing winner, corralling votes from 49% of operators (about the same number as last year). QSPF SR-4, selected by 36% of respondents, came in second again, followed by SFP28 (28%) and QSFP LR-4 (20%).

Which optical line rates does your company expect to deploy in its 5G midhaul/backhaul networks?

Source: Heavy Reading

Is your company planning to deploy network slicing in the transport network? (N=118)

- **17.1%** | 100m-500m
- **35.2%** | 500m-1km
- **36.2%** | 1km-20km
- **11.4%** | Don't know

Source: Heavy Reading

Which optical transceiver technologies will your company's 5G NR deploy?

Source: Heavy Reading

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Providers looking to win in 5G development, deployment, optimization and beyond should look to VIAVI to take command of the 5G network. Since 2013, VIAVI has been a driving force in 5G, partnering with the world's top communication providers and network equipment manufacturers and delivering industry-leading solutions, including the TM500, TeraVM, CellAdvisor, OneAdvisor and T-BERD/MTS brands.

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Fiber Testing

By now, it is crystal clear that cable operators will keep installing more and more fiber in their HFC plants to support their new and advanced video, broadband, voice, wireless, smart home, and business services, as well as 5G. But such an ambitious fiber expansion strategy means that operators must be able to conduct proper fiber testing, which is no easy matter. Indeed, cablecos may well lack the critical fiber testing expertise they need.

Thus, cable technicians trained and experienced in installing coax will increasingly have to learn how to work with fibers. Even those with some training in fibers will need to migrate from lower speeds to 100Gbps coherent optics and beyond. This section covers key testing issues related to fiber expansion, including installation, service turn-up, and troubleshooting. It looks at both the technical and operational issues associated with fiber testing.

Key takeaways

- Cable operators rely in nearly equal measure on in-house technicians and outside contractors to handle their fiber installations. Nearly two-fifths of survey respondents (37%) reported that an even mix of staff technicians and outside contractors perform the majority of their fiber install, while 30% said most installations are performed by their in-house staff and an equal number said most are done by outside contractors.

- Slightly over one-quarter of respondents (27%) said they feel "very confident" that their company's technicians are properly trained to handle, install, turn up, and troubleshoot fiber networks, while 50% said they are "confident."

- Although cost is a major factor in selecting fiber test equipment, it is not the biggest factor. As it did in 2019, reliability topped the list this year, with slightly over two-thirds of operators (69%) ranking it as "very important," while durability came in second.

- Asked which kinds of fiber testing they will implement as they start deploying remote PHY and other DAA networks, one-half of respondents (50%) chose "bidirectional fiber testing for all main feeder segments." Right behind it at 49% was "end-to-end testing with a DWDM OTDR before turn-up."

Testing for Fiber Success

As in previous years, cable operators rely in nearly equal measure on in-house technicians and outside contractors to handle their fiber installations. In the Heavy Reading survey, nearly two-fifths of respondents (37%) reported that an even mix of in-house technicians and outside contractors perform the majority of their fiber installs. Some 30% said most installations are performed by their in-house staff, while an equal number said most are done by outside contractors.

Who performs the majority of fiber installations at your company? (N=118)
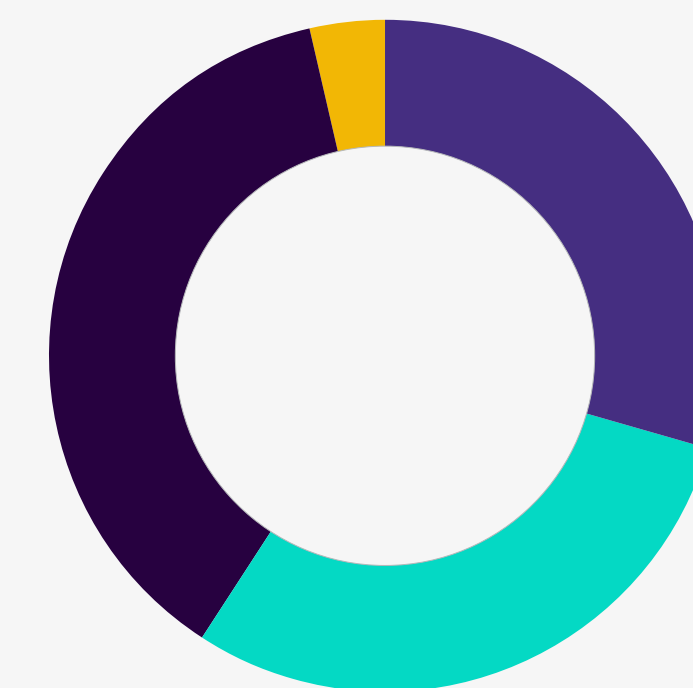
- **29.7%** | In-house technicians
- **29.7%** | Outside contractors
- **37.3%** | We use an equal mix of in-house technicians and outside contractors
- **3.4%** | Don't know/Not applicable

Source: Heavy Reading

While operators often depend on contractors to do the job, they still tend to have confidence in their own technicians' abilities to get the installation work done. In the survey, slightly over one-quarter of respondents (27%) said they feel "confident" that their company's technicians are properly trained to handle, install, turn up, and troubleshoot fiber networks, while 50% said they are "very confident." The remaining 23% described themselves as "somewhat confident." These numbers represent a marked improvement in confidence from last year's results.
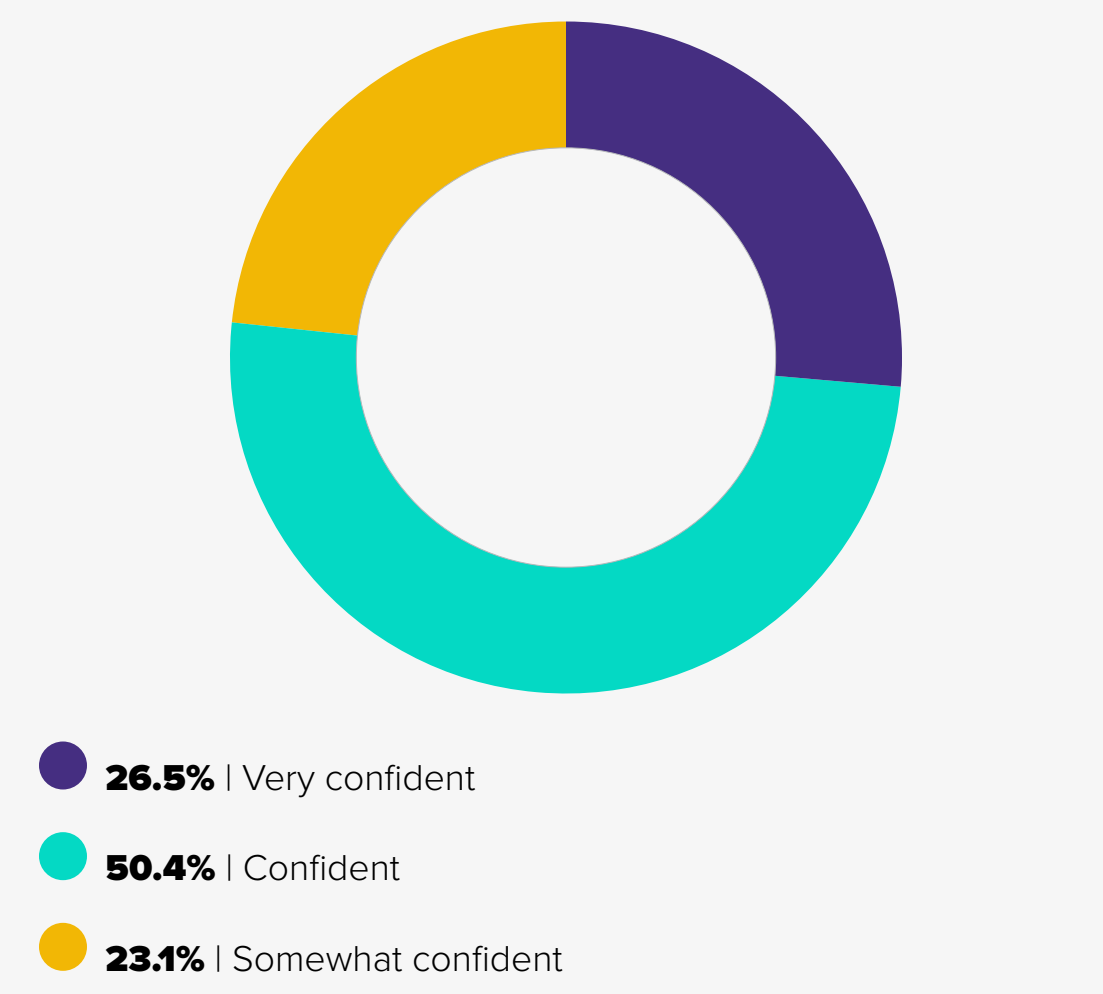
Ease of setup and analysis of optical time-domain reflectometer (OTDR) fiber test results is also "important" to nearly all cable operators and a "critical" function for some. In Heavy Reading's survey, 82% rated ease of setup and analysis as at least "important," with 21% of the group reporting these functions are "critical." These results are similar to last year's figures. As it was last year, the main driver for ease of setup and analysis is the lack of OTDR expertise among cable technicians.

Although cost is a major factor in selecting fiber test equipment, it is not the biggest factor. Indeed, cost ranked third on a list of six important factors for fiber test equipment in Heavy Reading's survey. As it did in 2019, reliability topped the list this year, with slightly over two-thirds of operators (69%) ranking it as "very important."

Like last year as well, durability came in second, with 56% rating it as "very important." Cost followed closely behind, with 55% calling it "very important," and ease of operation came in a strong fourth at 53%. As they did last time around, multipurpose testing solutions (ranked fifth) and automated workflow and reporting (ranked last) brought up the rear.

Similar to other service providers, cable operators are seeking to leverage automation technology to improve operations and boost service performance while also cutting costs. Given this trend, Heavy Reading asked operators to name up to three of the most important elements of test process automation they would pick for introducing more automation to their test processes and procedures.
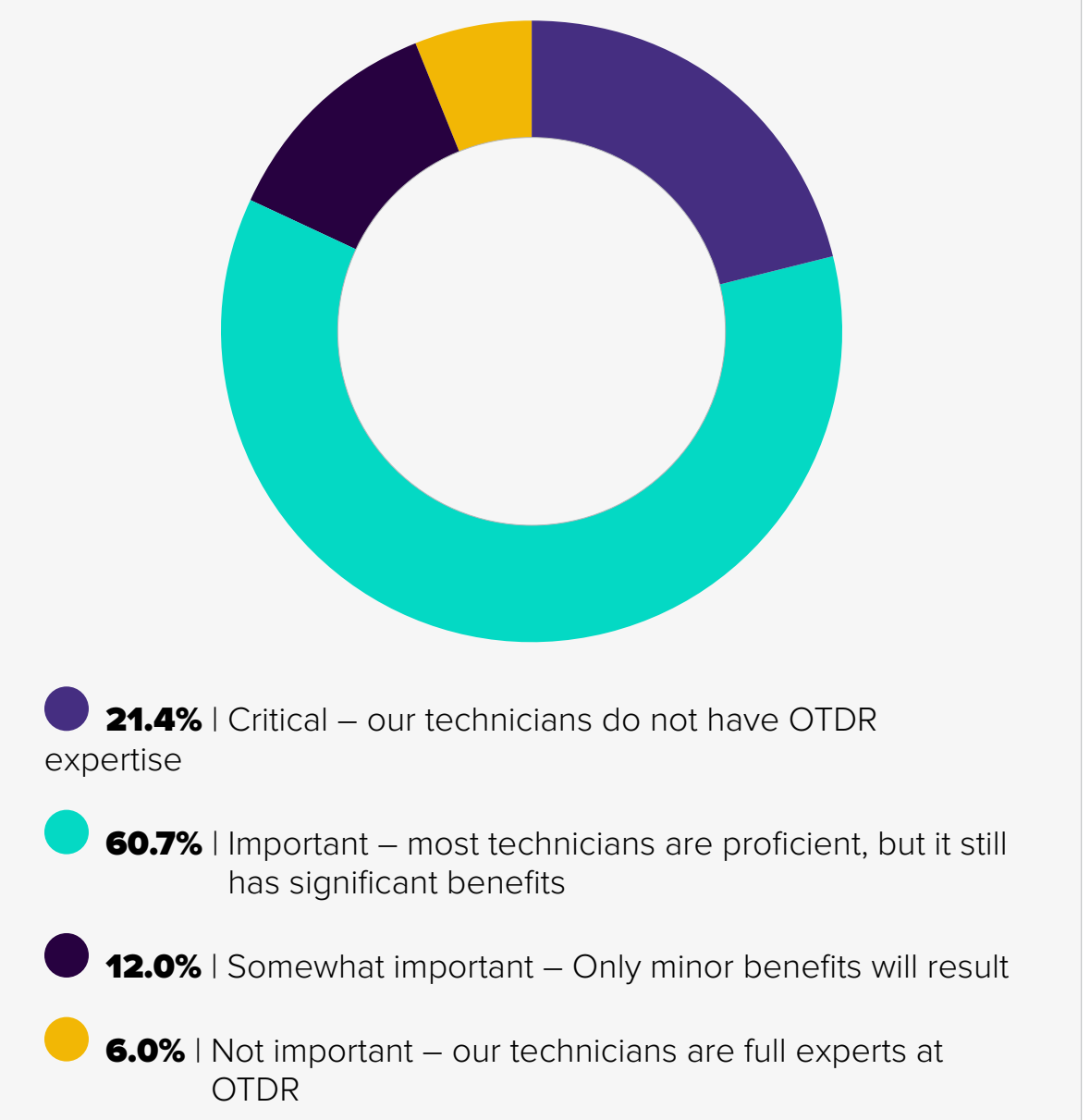
In this case, an "instrument-based guide to step techs through tests, ensuring compliance to methods of procedure (MOP)" scored highest on the scale, with nearly three-fifths of survey participants (59%) choosing it. "A centralized management tool for both in-house techs and contractors" came in a close second, with 55% selecting it. "Creating job/task lists with all supporting configs delivered direct to an instrument" rounded out the top three, with 51% picking it.

How confident are you that your company's technicians are properly trained to handle install, turn up, and troubleshoot fiber networks? (N=117)
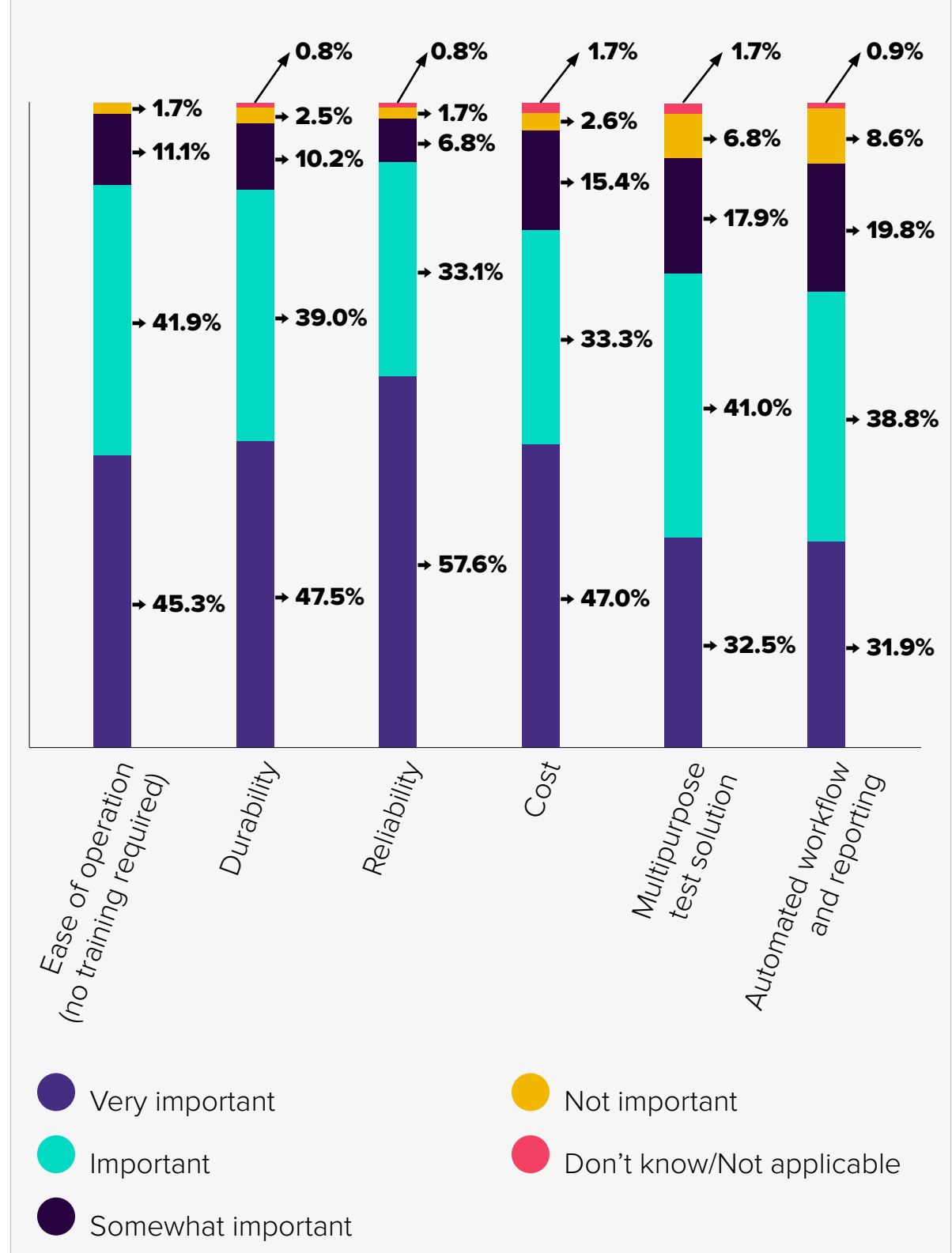

- **26.5%** | Very confident
- **50.4%** | Confident
- **23.1%** | Somewhat confident

Source: Heavy Reading

How important is ease of setup and analysis of OTDR fiber test results? (N=117)

- **21.4%** | Critical – our technicians do not have OTDR expertise
- **60.7%** | Important – most technicians are proficient, but it still has significant benefits
- **12.0%** | Somewhat important – Only minor benefits will result
- **6.0%** | Not important – our technicians are full experts at OTDR
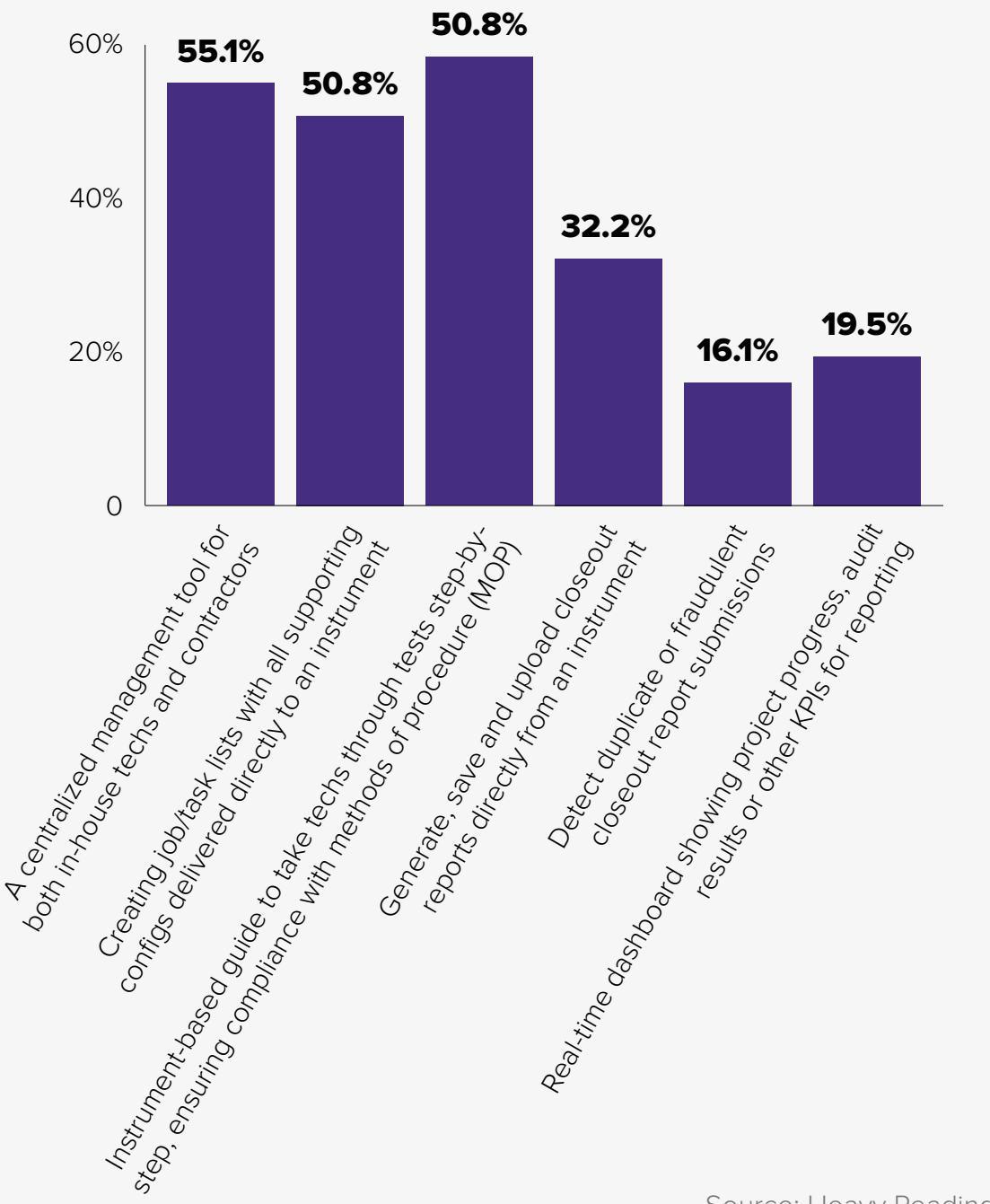
Source: Heavy Reading

Which optical line rates does your company expect to deploy in its 5G midhaul/backhaul networks?

	Ease of operation (no training required)	Durability	Reliability	Cost	Multipurpose test solution	Automated workflow and reporting
Don't know/Not applicable		0.8%	0.8%	1.7%	1.7%	0.9%
Not important	1.7%	2.5%	1.7%	2.6%	6.8%	8.6%
Somewhat important	11.1%	10.2%	6.8%	15.4%	17.9%	19.8%
Important	41.9%	39.0%	33.1%	33.3%	41.0%	38.8%
Very important	45.3%	47.5%	57.6%	47.0%	32.5%	31.9%

- Very important
- Important
- Somewhat important
- Not important
- Don't know/Not applicable
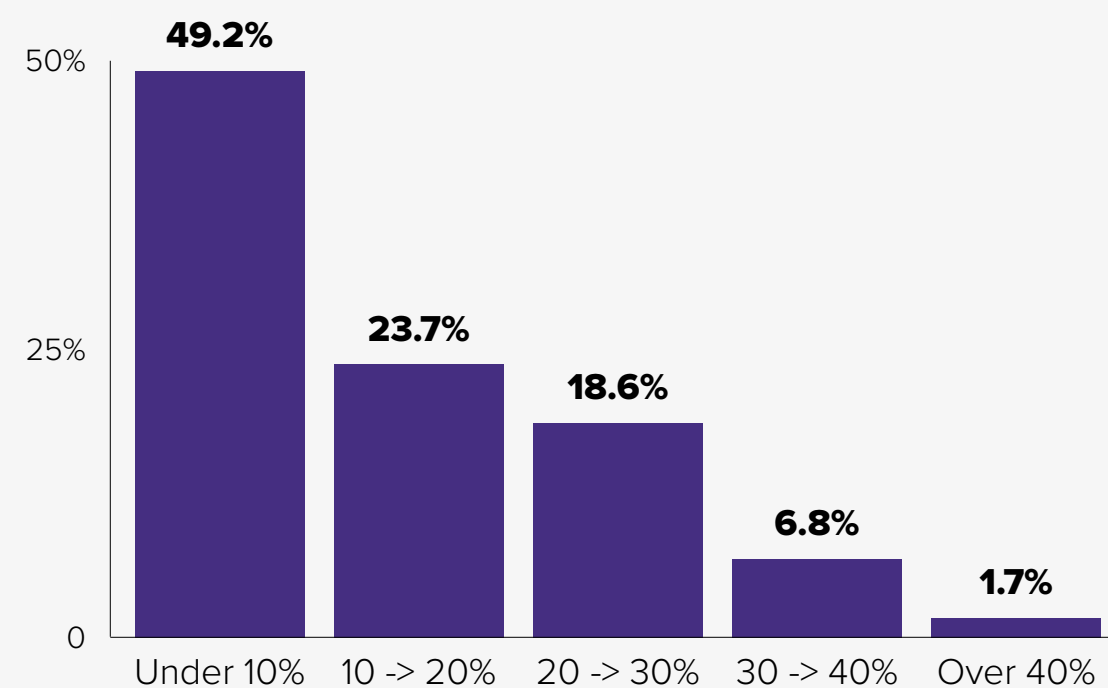
Source: Heavy Reading

If your company could introduce more automation to its test processes and procedures, which element(s) of test process automation would be most important?

Element	%
A centralized management tool for both in-house techs and contractors	55.1%
Creating job/task lists with all supporting configs delivered directly to an instrument	50.8%
Instrument-based guide to take techs through tests step-by-step, ensuring compliance with methods of procedure (MOP)	50.8%
Generate, save and upload closeout reports directly from an instrument	32.2%
Detect duplicate or fraudulent closeout report submissions	16.1%
Real-time dashboard showing project progress, audit results or other KPIs for reporting	19.5%

Source: Heavy Reading

Shifting the focus to FTTH/PON, the survey asked operators about the typical rate of first-time install failures for these services. Almost one-half of respondents (49%) reported low install failure rates of less than 10%, making that the lead choice. Nearly one-quarter (24%) pegged the install failure rates at 10–20%, while 19% ranked the failure rates between 20% and 30%.

What is your company's typical rate of first-time install failures for FTTH/PON services? (N=118)

Source: Heavy Reading

With the rising adoption of DWDM in access networks, Heavy Reading sought to uncover the biggest challenge that operators are encountering with the technology. "Faulty SFP/SFP+ or incorrect SFP/SFP+" led the pack, with nearly one-third of survey participants (31%) selecting it. "Identifying/verifying channel(s) passed or faulty MUX/DeMUX ports" was a close second, with 27% of participants choosing it. "Testing, certifying, or troubleshooting specific wavelength routes" ranked as the third biggest challenge, attracting votes from 17% of respondents.

With the rising adoption of DWDM in access networks, what is the biggest challenge your company is encountering with DWDM? (N=117)
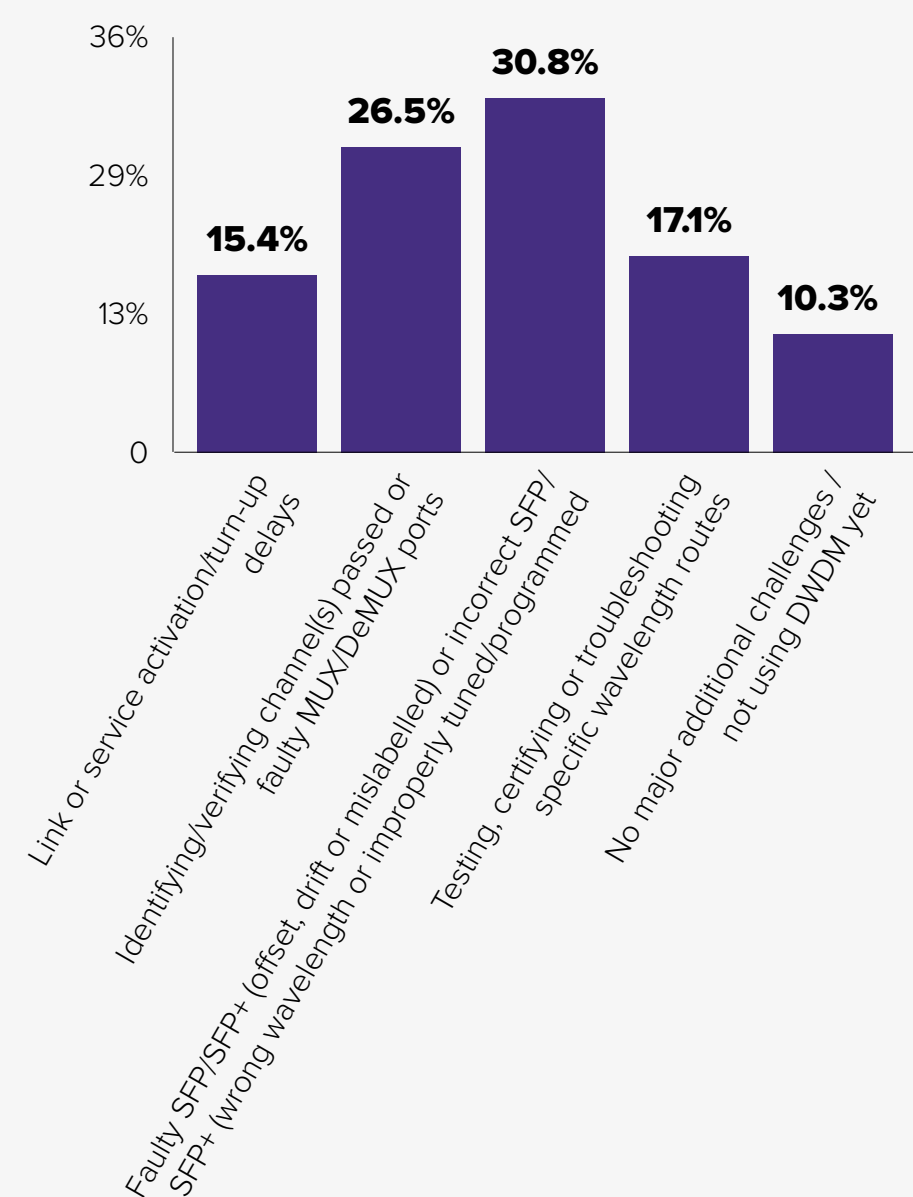

Source: Heavy Reading

The last question of this section focused on the kinds of fiber testing operators will implement as they start deploying remote PHY and other varieties of DAA networks. With survey participants allowed to choose multiple answers, "bidirectional fiber testing for all main feeder segments" scored highest, as one-half of respondents (50%) chose it. Right behind it was "end-to-end testing with a DWDM OTDR before turn-up," which was selected by 49%. One-third of survey participants (33%) picked "unidirectional fiber testing for all main feeder segments." 31% chose "timing tests (PTP/1588) to ensure clock distribution to the nodes" and 27% selected "verification of correct DWDM channel and power level when installing the remote PHY device (RPD)."

As your company begins deploying Remote PHY and DAA networks, which kinds of fiber testing will you implement?
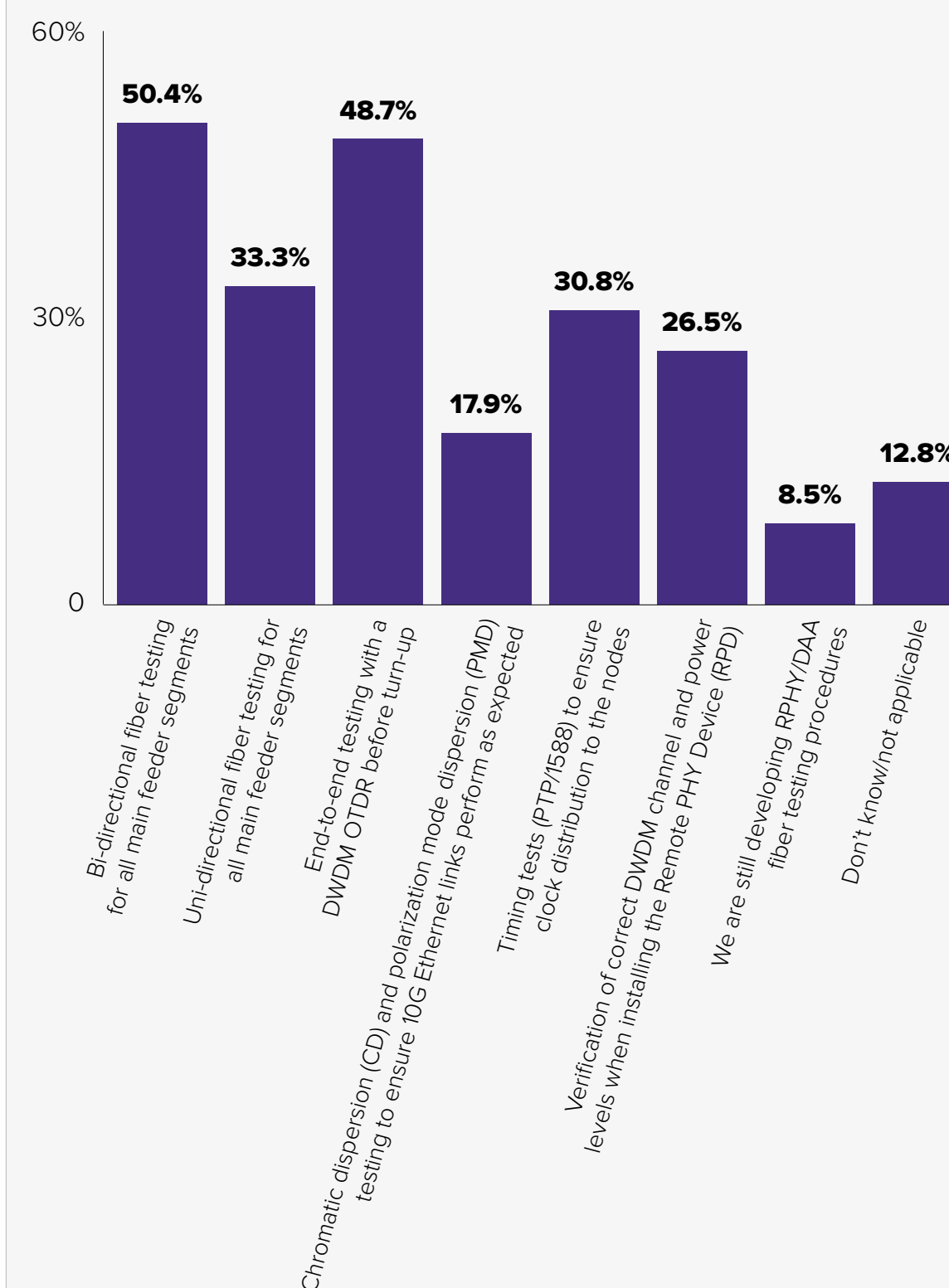
Source: Heavy Reading
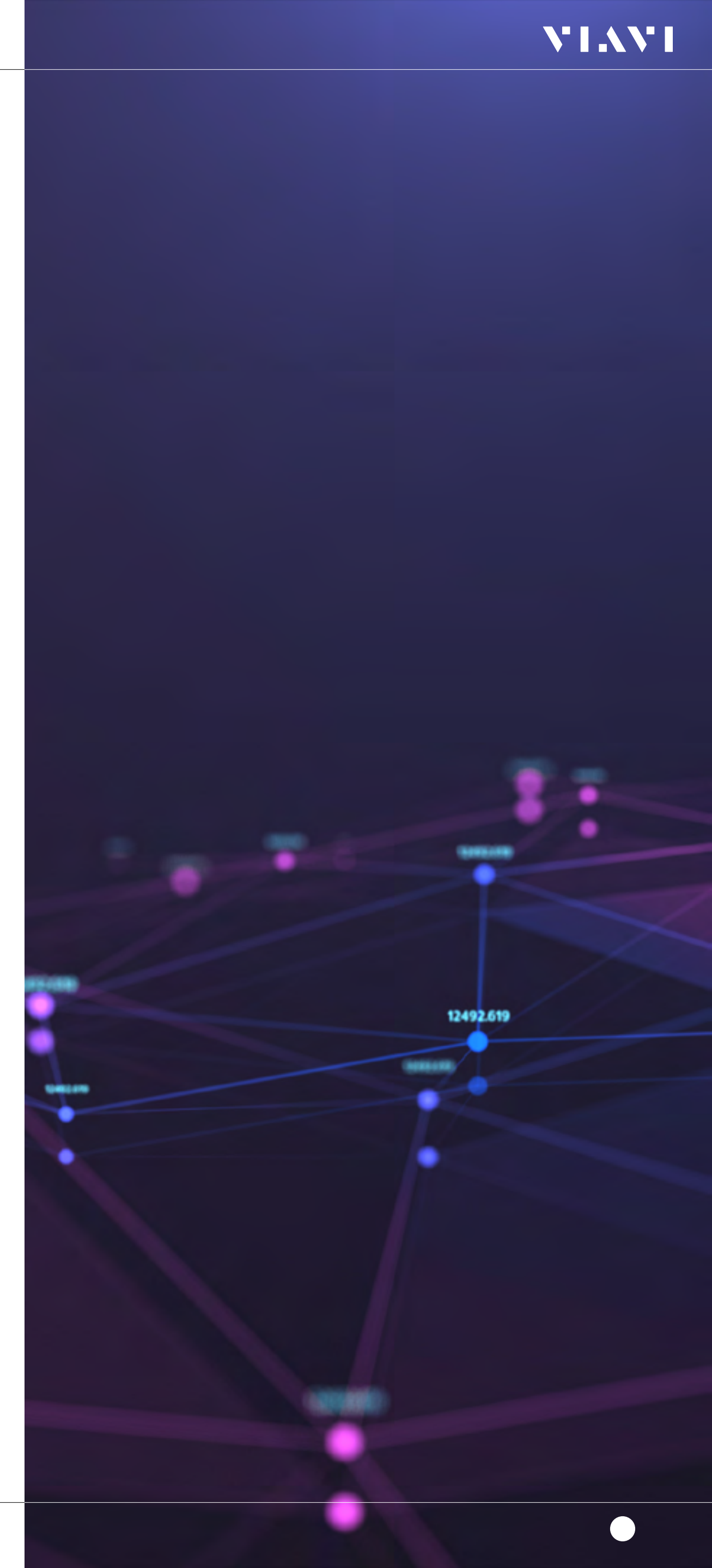
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