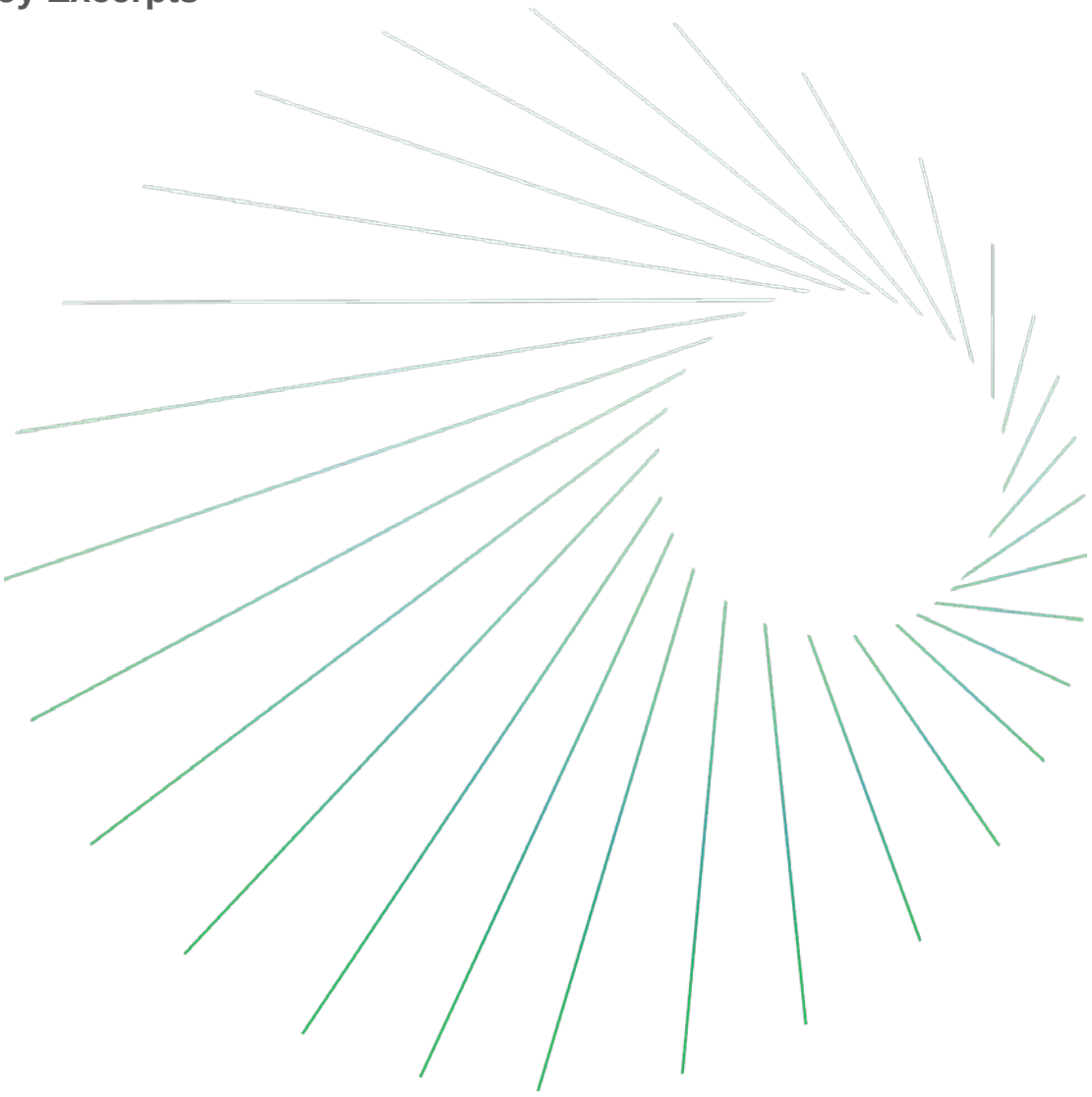
Optical Equipment Vendor Leadership

Service Provider Survey Excerpts

15 March 2019



Heidi Adams
Senior Research Director,
IP & Optical Networks

IHS Markit Technology | **Survey**

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Market background

Industry conferences, news websites, panel discussions, and message boards add tremendous noise to what is really the critical issue: what does the customer think? Our annual optical leadership survey is an attempt to quantify the opinions of service providers. We gather their perceptions of optical networking equipment company leadership, and we measure the decision criteria hierarchy service providers use when making vendor decisions.

This document is an excerpt; please contact IHS Markit for the full report.

Methodology and demographics overview

In November through December 2018, using online, telephone, and in-person survey methods, we interviewed 26 service providers who have detailed knowledge of and purchase influence for optical transmission and switching equipment. 77% of respondents are either the primary decision-maker or have a lot of influence. These operators controlled 14% of the world's 2017 telecom capex.

Of note in this year's survey: our respondents were primarily focused in EMEA, CALA, and North America. CALA had an especially high participation rate, representing 31% of respondents this year while only representing approximately 5% of global optical equipment spending in 2018. Asia Pacific by contrast had a much lower participation rate with only 4% of respondents from the region, which accounted for close to 50% of global optical equipment spending in 2018. As such, please consider the results in this survey to be more indicative of vendor perception in EMEA and the Americas.

Please also note that for this edition of our survey, we are considering Infinera and Coriant as separate entities due to the timing of the acquisition and its closing date with respect to when the interviews were conducted for this survey. Moving forward into the 2019 edition, we will combine the companies and their results.

Vendors installed and under evaluation

As a starting point, it is important to understand the composition of the installed base among our respondents. This provides a baseline for the assessment in this survey and ties feedback on key evaluation criteria to actual experience with the different vendors. We add to this a view of which vendors are being evaluated for future deployments. This provides an indication of potential future performance and represents in itself a view of vendor perception in the market.

Rather than choosing names from a list of specific companies, respondents answered an open-ended question, naming the vendors of optical transmission and switching equipment currently installed in their networks and those they are evaluating (including installed and/or new vendors) for equipment to be added to their networks by year-end 2019.

Huawei, Nokia, and Ciena were the top three installed vendors with this year's respondents, consistent with what we observed in our 2016 and 2017 surveys. This result is also aligned with positioning in the global optical network hardware market in the first three quarters of 2018, where Huawei, Ciena, and Nokia were ranked as the top three vendors by market share in this period. Of note is that Infinera punched above its weight in installed base versus market share; this is likely in part due to the high distribution of respondents in EMEA and North America, markets where Infinera has presence. Likewise, ZTE came out lower on this list—in large part as a significant part of its business is in China and emerging countries, where we had lower representation in this survey.

For vendors under evaluation, Ciena jumped to the top of the list this year with 38% of vendors citing it as being under evaluation for new builds to be deployed before 2019. Ciena was followed by Nokia at 23%, Infinera at 19%, and Huawei at 15%. These same vendors were also cited in our 2017 survey as being under evaluation by the most operators.

Exhibit 1 Optical transmission and switching vendors installed and under evaluation
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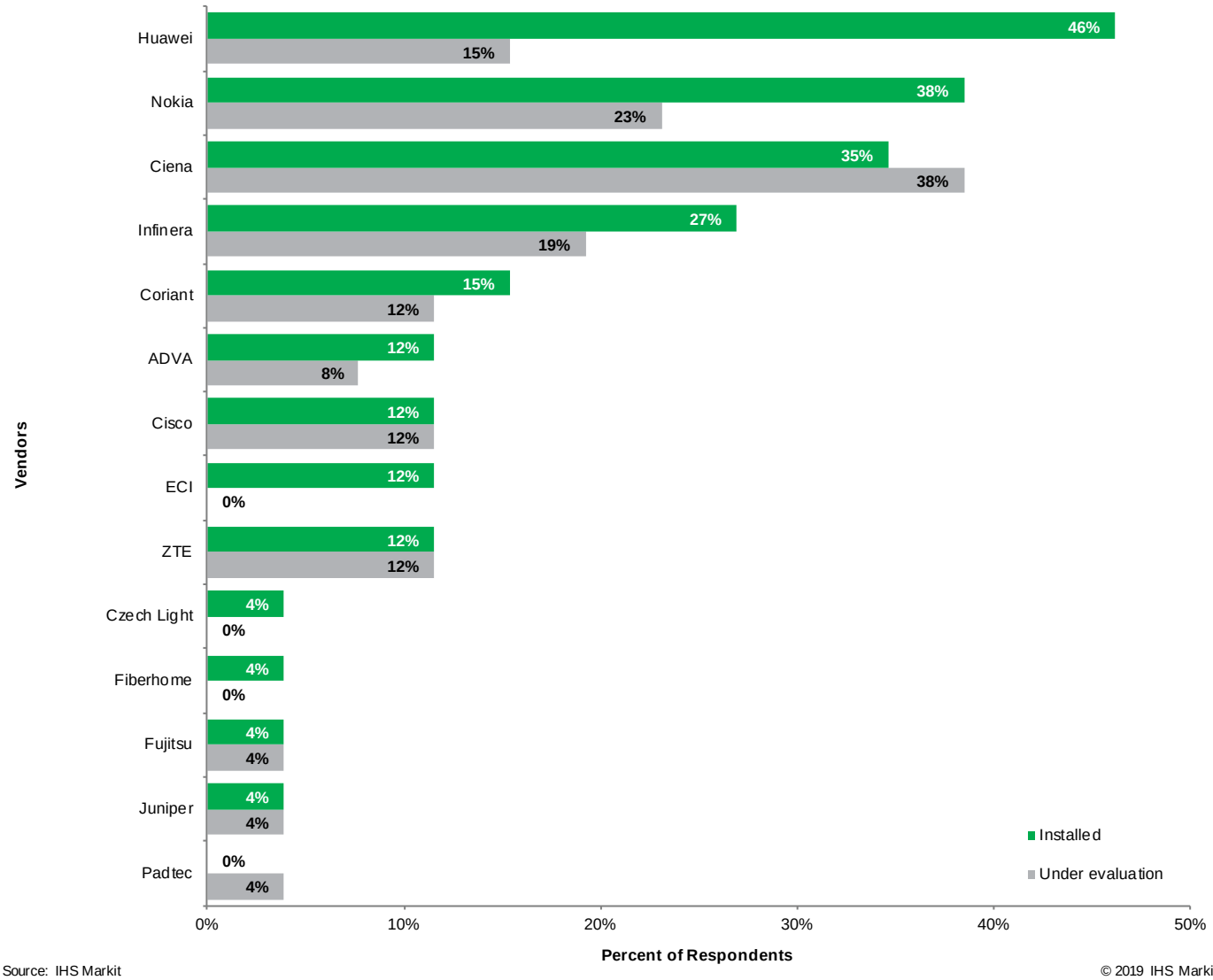


Source: IHS Markit

Respondents name top vendors

In open-ended questions, we asked respondents whom they consider to be the top three equipment vendors in several categories, a measure called unaided brand awareness, which provides a good view of overall brand strength. Typically, the larger a vendor (e.g., broad product portfolio) and the more familiar respondents are with the company (see Exhibit 2), the better it fares in this question.

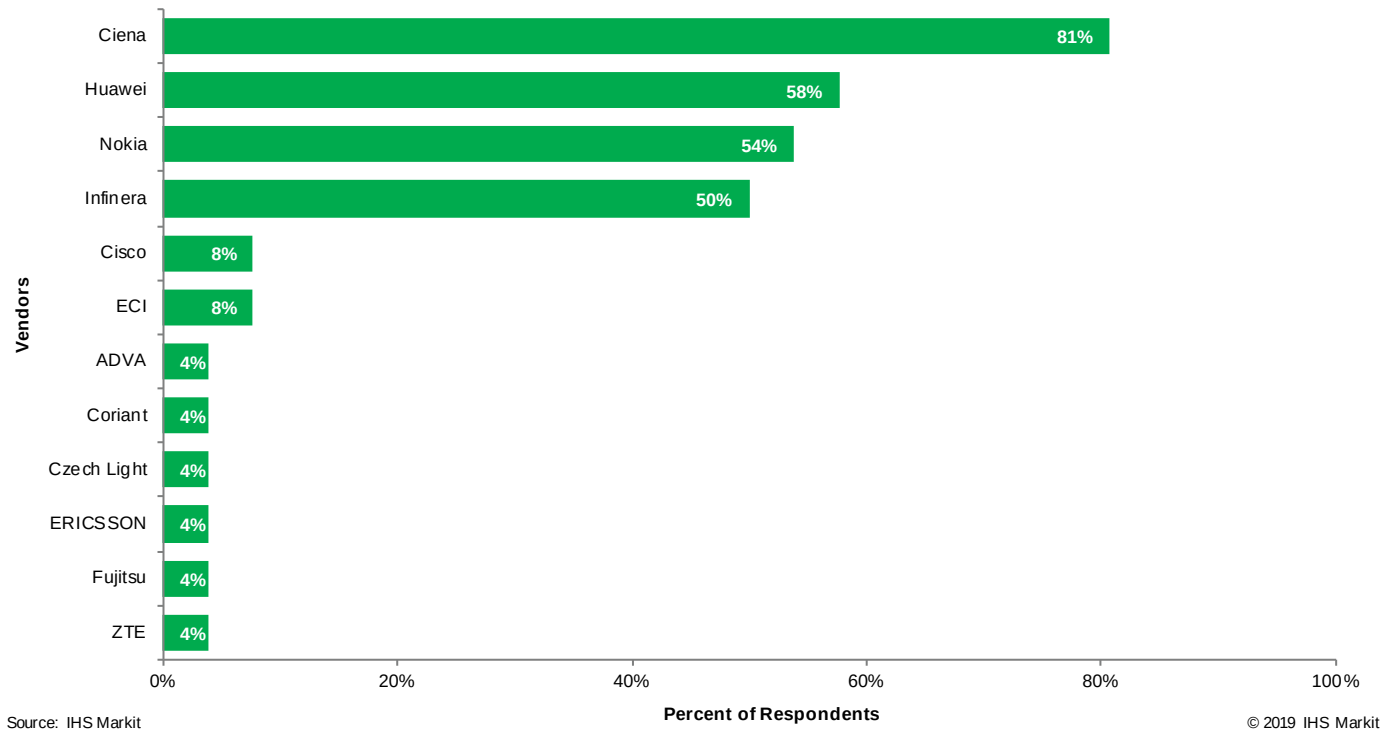
In past years, we focused the survey on packet-optical, OTN switching, and 100G technologies. With these areas now more mature, we decided to focus on some of the emerging areas that are considered hot topics within the industry. We asked our service provider respondents to list whom they consider to be the top three vendors in optical data center interconnect (DCI), disaggregated optical equipment, and ROADM/line systems. Although disaggregation in optical systems is still in very early days in the context of service provider networks, we believe the results provide a view of where vendors are putting their marketing effort and, in turn, which vendors service providers are engaging for discussions in these areas.

Consistent with previous years, we also asked for feedback in an open-ended question on service provider perception of the top three overall optical transmission and switching equipment vendors.

Top overall optical transmission and switching equipment vendors

We asked respondents to name the top three overall optical transmission and switching vendors in an open-ended question. Ciena was again the #1 vendor, followed by Huawei at #2, Nokia at #3, and Infinera at #4. The top three vendors and their relative rankings remained unchanged from last year. Of note, in the current survey results, there is a distinct separation between the top four vendors, who each have 50% or more of survey respondents citing them as a top-three player, and the rest of the pack with results all below 10%.

Exhibit 2 Top three optical transmission and switching equipment vendors
n=26



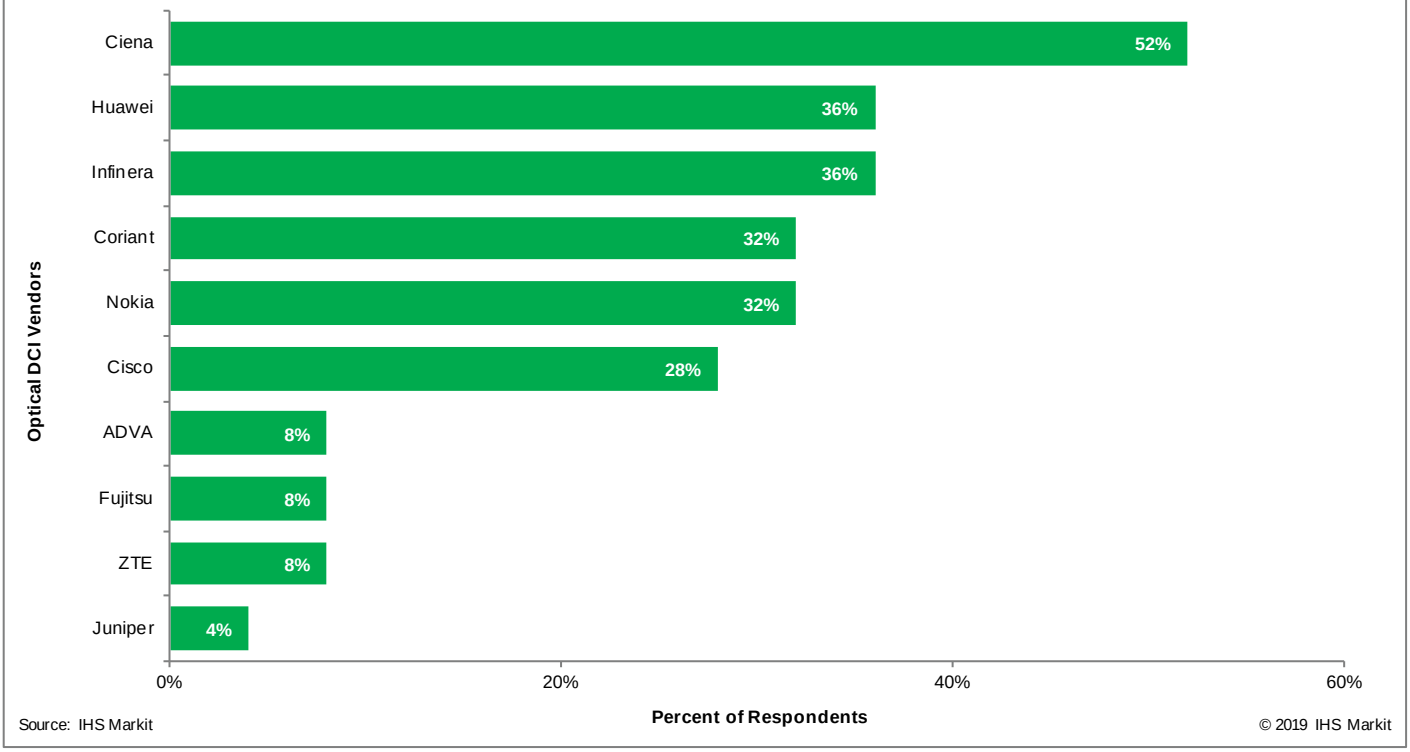
Top DCI equipment vendors

DCI continues to be a key growth segment for optical networking equipment, driving $1.4B in sales in 1H18, up 19% YoY according to the IHS Markit *DCI, Packet-Optical & OTN Equipment Market Tracker*. IHS Markit expects DCI will represent 22% of total WDM optical equipment sales in 2018, growing to close to 30% of sales by 2022. With DCI such a hot segment for optical equipment, we thought it would be useful to explore service provider perceptions of vendors in this area. We asked service providers to name whom they consider to be the top three leaders in this area.

Once again, Ciena leads the pack as the most frequently cited leader in optical DCI. This is no big surprise as the company was the #1 vendor worldwide in optical DCI in 1H18 with 25% market share. Based on this year's survey results, Ciena has been successful in further enhancing its reputation in this market. In 2017, 39% of our survey respondents cited the company as a leader in optical DCI. In 2018, that number increased to 52%, which also represents a significant lead over its next closest competitor.

Huawei and Infinera tied for second place in this year's survey with Huawei making a significant jump from its fifth place ranking in 2017. Third place honors go to Coriant and Nokia, which tied with 32% of respondents citing these companies as being leaders in DCI. Cisco rounds out the top five, dropping from #2 in 2017.

Exhibit 3 Top optical data center interconnect (DCI) vendors
n=25



Top disaggregated optical equipment vendors

The disaggregation of optical transport systems was first seen in the subsea market as wavelengths from third-party transponders were carried over existing line systems, enabling new SLTE vendors to enter the market and facilitate system upgrades to 100G technologies. Optical disaggregation took a further step forward into the mainstream as web scale ICPs demanded a separation between line system and transponder equipment to enable more flexibility in network deployments and evolution (e.g., new generations of transponders come out faster than new generations of line systems) and to create a more flexible and competitive vendor environment.

Another important aspect of optical disaggregation is on the software side. The increasing availability of open APIs and SDN control and orchestration solutions provides a framework for the delivery of a wide range of software-based features and functions that have traditionally been fully integrated with a given vendor's equipment. For some, the ultimate realization of this direction for disaggregation would be in the emergence of a vibrant optical white box market. For most others, the more pragmatic end goal is to improve optical equipment interoperability and reduce reliance on a single optical equipment vendor.

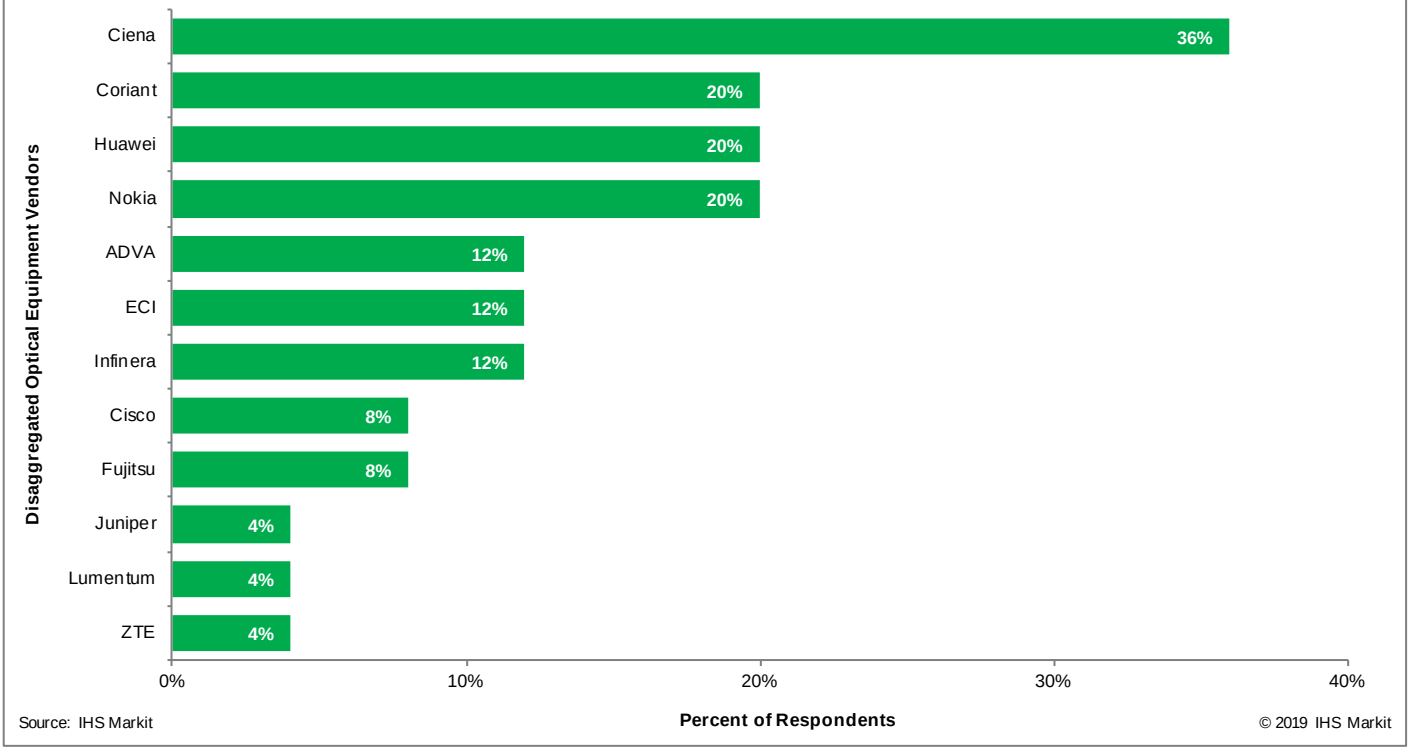
Within this broad context and understanding that disaggregated optical solutions may mean different things to different parties, we asked our service provider respondents to identify whom they consider to be the top three equipment vendors for disaggregated optical equipment in the market.

Ciena made significant strides this year, moving from #3 in our 2017 survey to the #1 position in 2018 with 36% of respondents citing the company as a leader in optical disaggregation. We believe Ciena's efforts in promoting its Blue Planet software portfolio and Waveserver disaggregated DCI platforms helped increase its perception as a leader in this area among service providers.

Coriant, Huawei, and Nokia all tied for second place with 20% of respondents citing each company as a leader in disaggregation. We believe Coriant's success is based on positive perception of its Groove G30 portfolio that includes disaggregated transponders and open line systems platforms. The company has also actively promoted its pluggable optical layer, which can also be considered an aspect of disaggregation, and its Transcend software suite. Huawei and Nokia also offer DC-optimized disaggregated transponder platforms (Huawei OSN902 and Nokia 1830 PSI) and extensive SDN and software capabilities.

Of note, one of our 2017 survey co-leaders, Fujitsu, dropped down to seventh in the rankings for 2018, tied with Cisco. Fujitsu has been a strong advocate for a deeper vision of disaggregation through its 1Finity disaggregated equipment portfolio and Virtuora software platform; however, its offer has been more targeted to the US and Japan markets with less visibility to the EMEA and CALA providers participating in this survey.

Exhibit 4 Top vendors for disaggregated optical equipment n=25



Top ROADM and line systems vendors

Several factors are driving the evolution of ROADM infrastructure. Increasing video consumption continues to be a primary driver of bandwidth demand on fixed and mobile networks. 5G and AR/VR applications are also expected to drive demand and more stringent network requirements on latency. To meet this demand, optical networks will be required to support a mix of existing and higher speed coherent interfaces including 400G+ and super-channels for longer reach applications. ROADM infrastructure as a result will require a shift from traditional 50 GHz fixed-grid allocated spectrum to ITU G694.1 flex-grid spectrum. New mechanisms for managing and automating spectrum allocation will also become critical as ROADM networks become more complex and transport increasing amounts of traffic.

As a result, we believe that ROADM infrastructure will see increased attention over the next few years, and we wanted to gain some insight into which optical equipment vendors are perceived as well positioned to intercept the coming wave of ROADM investment.

In an open-ended question, we asked respondents to name the top three overall ROADM and line systems vendors. Ciena topped the list with 76% of respondents citing the company as a leader in ROADM networks. Nokia and Huawei rounded out the top three with 52% and 48%, respectively, of respondents naming them leaders in this segment.

Exhibit 5 Top ROADM and line systems vendors
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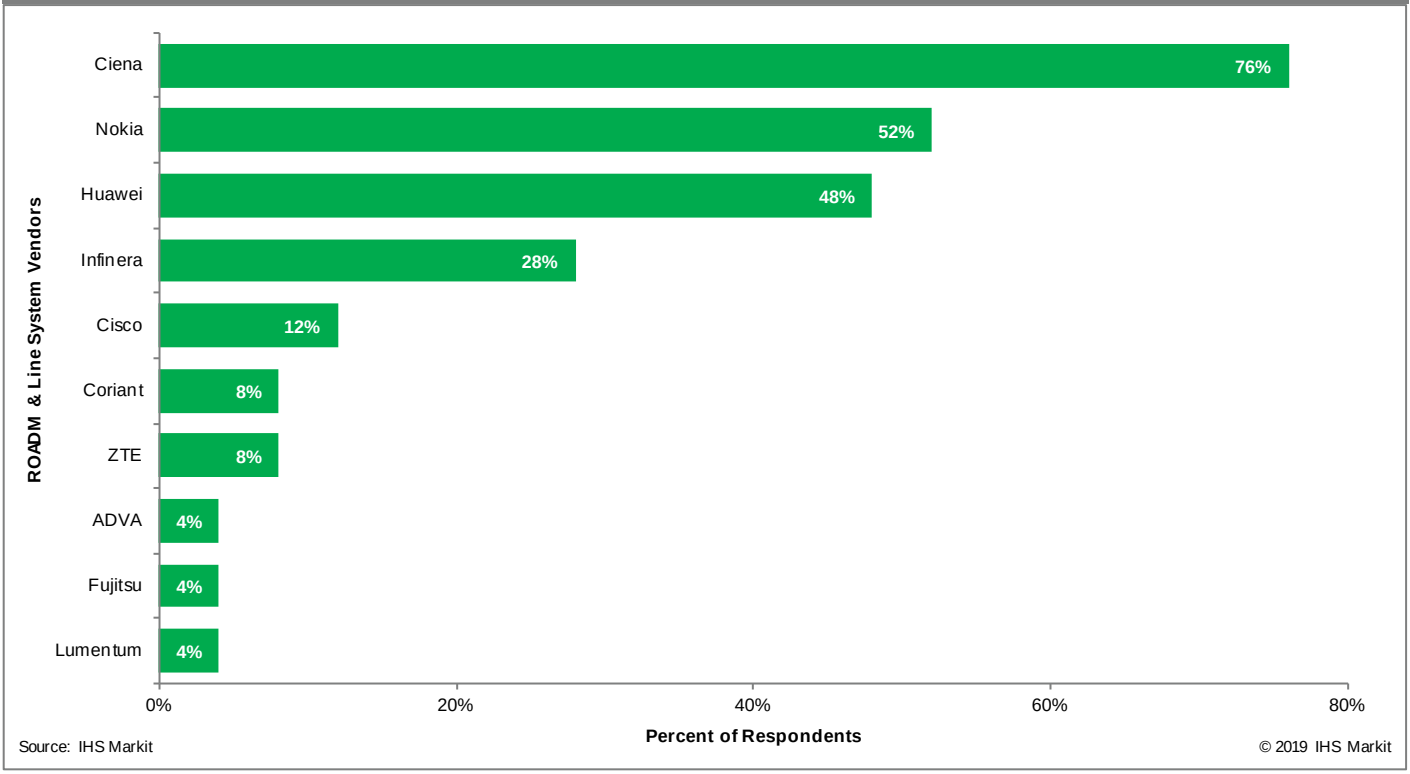

Source: IHS Markit

Vendor leadership in optical equipment selection criterion

We asked our respondents to name individual leaders for several optical equipment vendor selection criteria. This was a prompted question—respondents could choose up to three vendors for each criterion from a provided list of vendors. The three choices were given in no particular order or ranking. The following charts show the percentage of respondents naming each vendor as a leader for each criterion.

Because this type of question tends to favor well-known vendors, and to eliminate sample bias, we adjusted the percentage of respondents based on how familiar our sample is with each vendor.

Vendor leadership: Product reliability

Respondents identified product reliability as the top optical equipment vendor selection criterion in 2018. High product reliability drives improved customer satisfaction by enabling the service provider to meet or exceed service level agreements on network services. It also drives lower operational expenses through less time and effort spent on qualifying equipment and software for network deployment and in troubleshooting and resolving issues associated with product failures and/or network outages.

In this year's survey, Ciena came out on top as the vendor perceived to have the highest reliability, with 30% of respondents considering the company to be a leader in this area. Nokia and Infinera also performed well with 22% and 20%, respectively, of respondents considering these companies to deliver reliable products.

Exhibit 6 Vendor leadership: Product reliability
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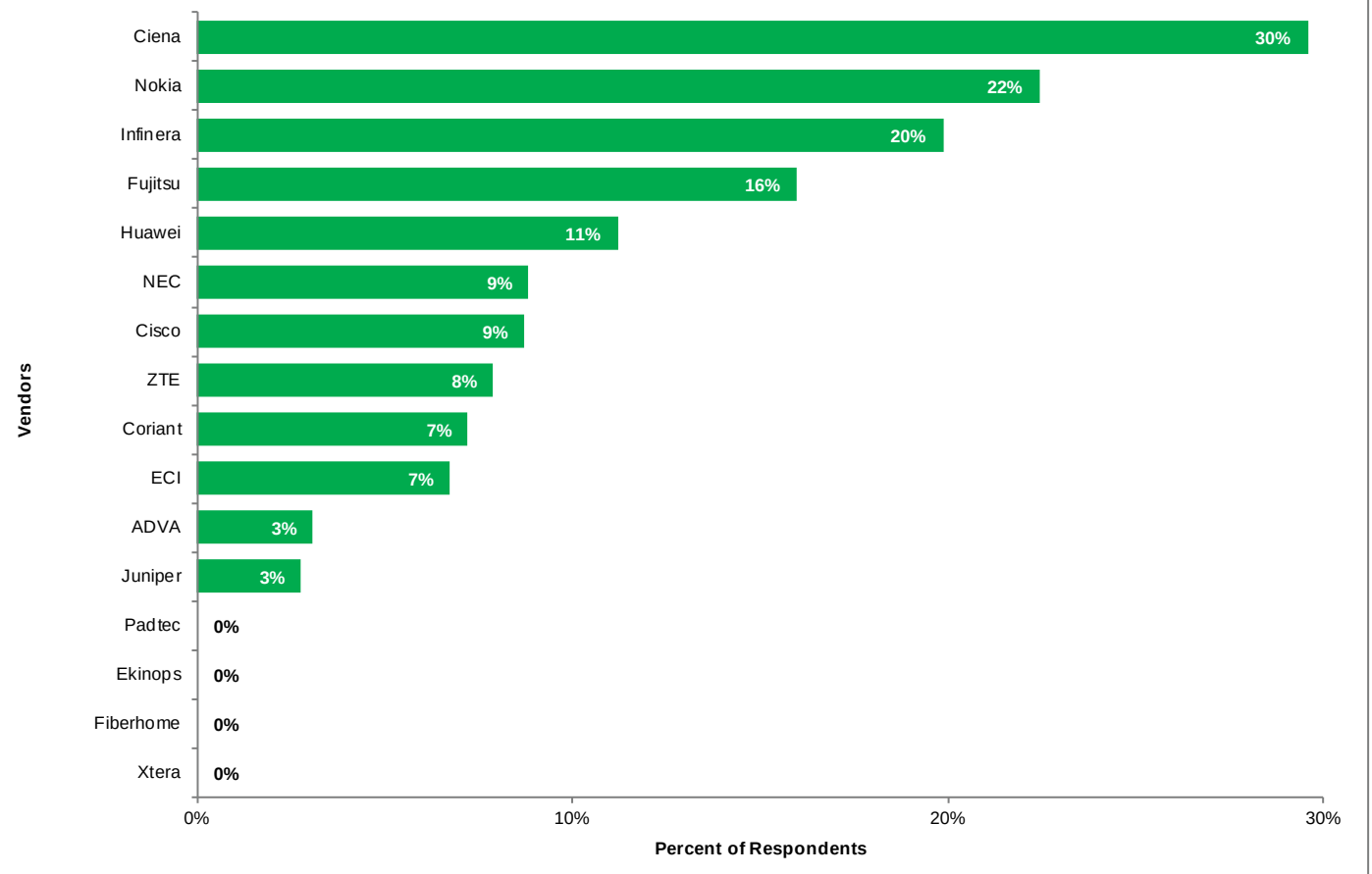

Source: IHS Markit

Vendor leadership: Technology innovation

Technology innovation was rated as the fourth most important criterion for purchasing decisions in 2018. In optical infrastructure, especially for longer reach applications, every extra dB of margin that can be squeezed out of the network can mean higher network utilization, lower cost in line system equipment for amplifiers and/or repeaters, additional revenue, or a longer lifespan for the network. Competition for innovation in optical networks continues to be intense, especially as the industry pushes against basic physical boundaries (e.g., Shannon's limit) and as improvements in capacity and efficiency become more incremental with each successive generation of coherent optical technology.

In this year's survey, Ciena stands out as the vendor most frequently cited by our respondents (37%) as a leader in technology innovation. Infinera was ranked #2 with votes from 24% of our respondents. Nokia and Huawei were tied for third with 20% of the votes.

Exhibit 7 Vendor leadership: Technology innovation
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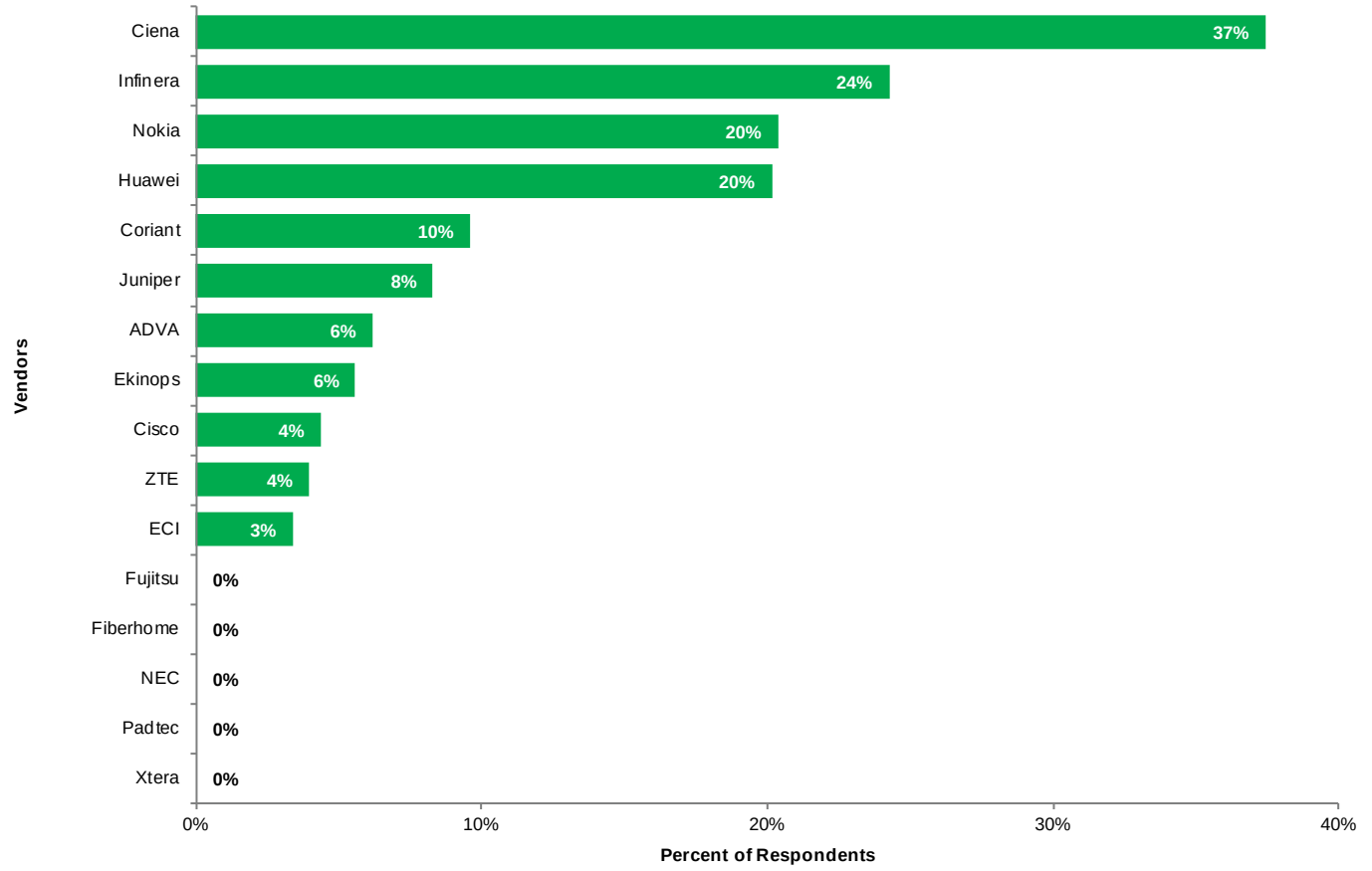

Source: IHS Markit

Vendor leadership: Service and support

Service and support was rated as the fifth most important purchasing criterion in 2018. Service and support consists of many areas, from a customer's experience working with a vendor from the first engagement through product selection, network design and planning, deployment, and eventually production operation. A large component is also in post-production—support for network upgrades, enhancements, and expansion. Additionally, should an outage hit the network once it is in production, the vendor's ability to support the network operator to quickly identify and resolve the problem becomes critical.

Nokia tops the list as the vendor most frequently cited as a leader in service and support in our 2018 survey with votes from 22% of our respondents. Ciena is a close second with 20% of respondents considering the company to be a leader in service and support, followed by Huawei in third with 16%.

Exhibit 8 Vendor leadership: Service and support
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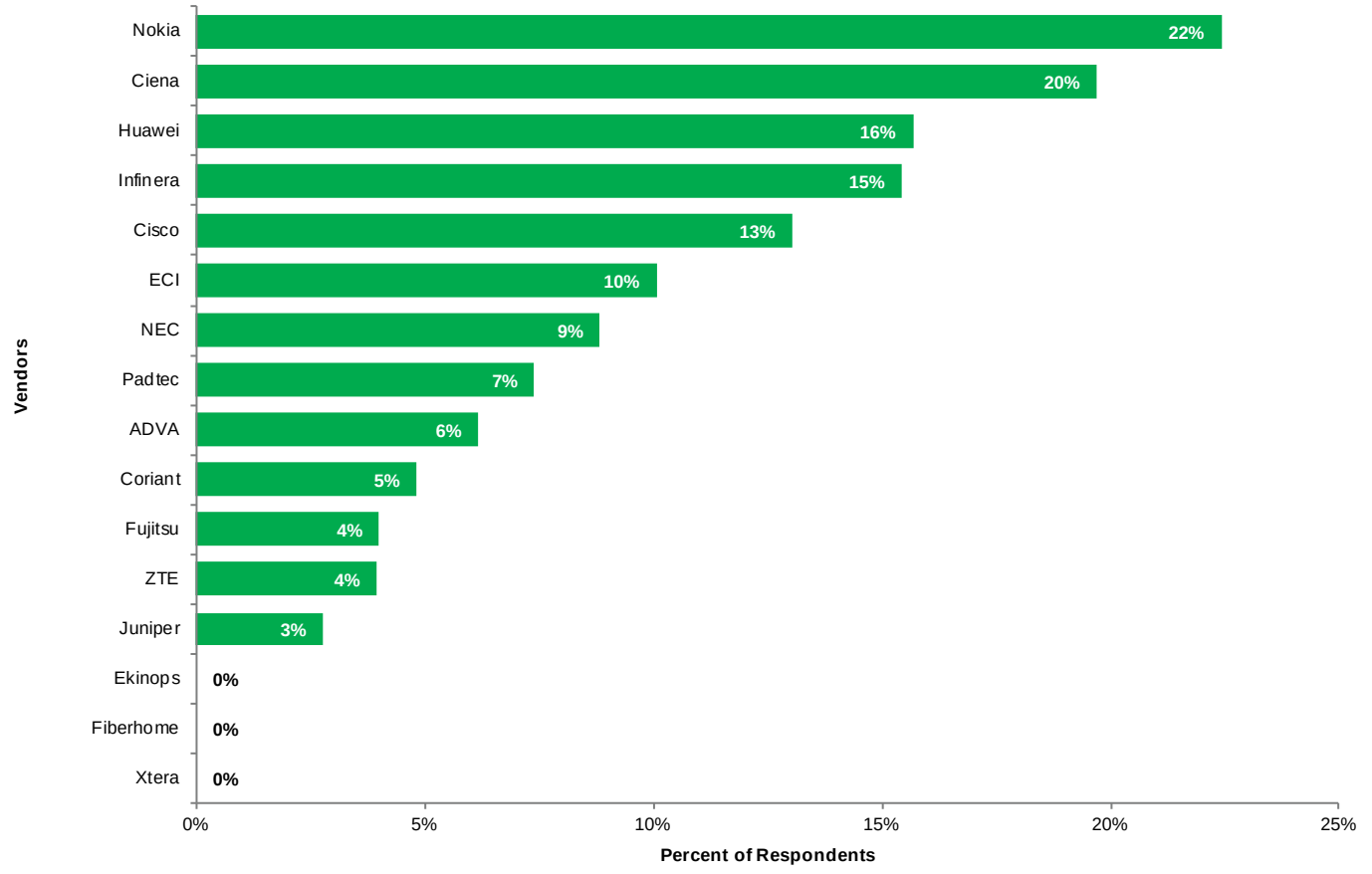

Source: IHS Markit

Vendor leadership: Management software

Management software is included in our list of purchasing criteria as an increasingly important aspect of network operations—especially in the context of the introduction of SDN into optical networks and service provider interest in adding more network automation to manage scale and reduce overall opex. However, one of the benefits associated with SDN and the growing pervasiveness of open APIs is that management software no longer needs to be purchased from the equipment vendor. This would explain why this factor is rated as only the sixth most important purchasing criterion for optical networks in our 2018 survey.

With strong market awareness of its Blue Planet software, automation, and management suite, Ciena is the leader in this year's management software category with 32% of respondents rating the company a leader in this area. Nokia follows in second place, having a solid reputation with its installed base for its NSP SDN and management software suite (and its predecessors, 5620 SAM and 1350 OMS). Huawei rounds out the top three in this year's survey.

Exhibit 9 Vendor leadership: Management software
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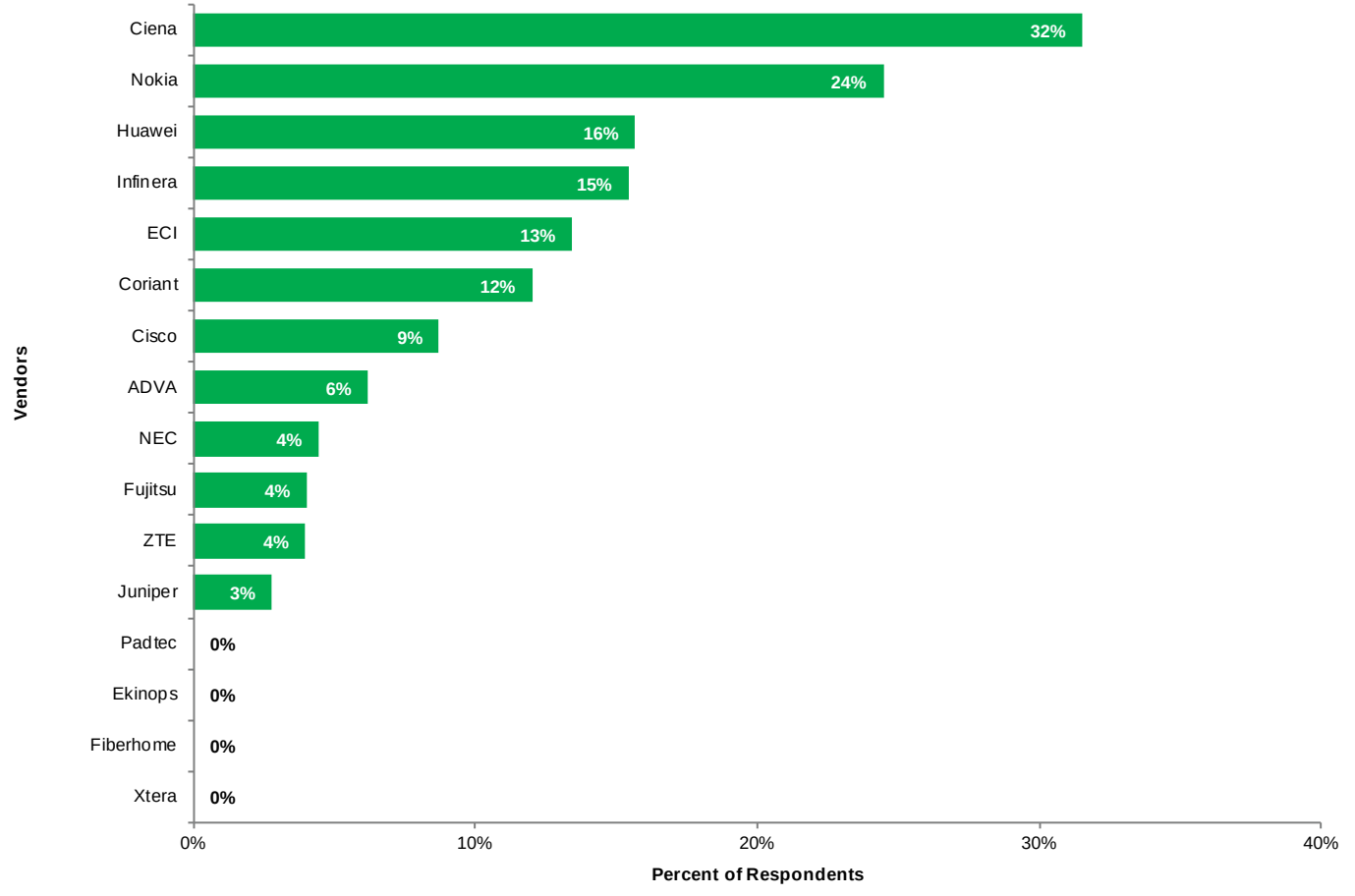

Source: IHS Markit

Vendor leadership: Financial stability

The financial stability of a network equipment and solutions vendor partner is important for ensuring continuing support and ability to evolve and enhance the network once it has been deployed. Financial stability is always a requirement, as are all of our nine buyer selection criteria—and because they are each a requirement, we asked operators to *rank* the nine critical selection criteria in order to discern their relative importance. Our respondents identified financial stability of the equipment vendor as the eighth most important criterion for vendor selection.

Huawei and Ciena are tied as the vendors perceived as having the strongest financial stability with 34% of our service provider respondents rating them a leader in this area. Cisco was rated the third highest with 20% of respondents rating it a leader in financial stability.

Exhibit 10 Vendor leadership: Financial stability
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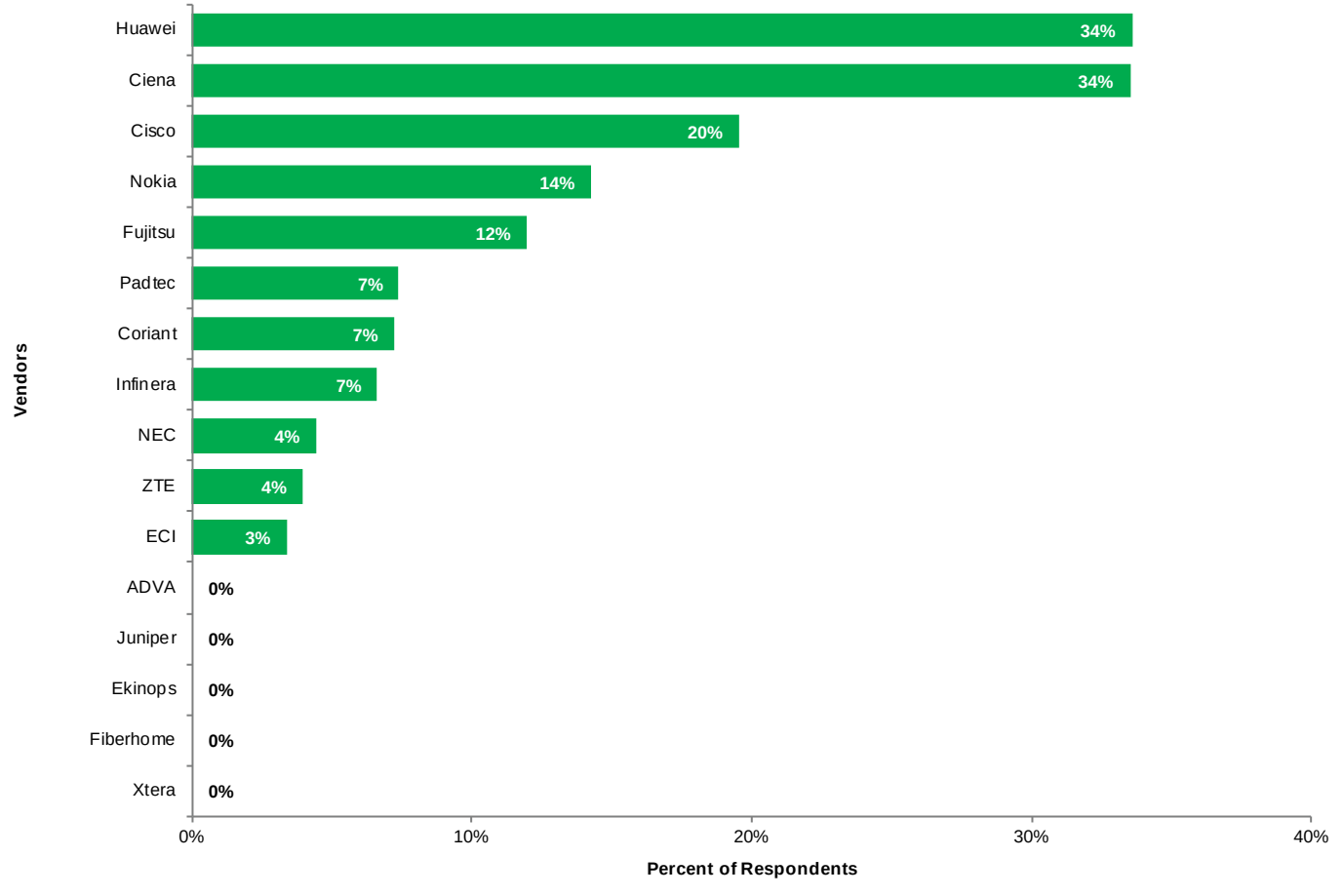

Source: IHS Markit

Vendor leadership: R&D investment

Given the importance of technology innovation as a buying criterion, it may come as a surprise that R&D investment was rated as the least important purchasing criterion among the nine identified purchasing criteria for optical networks in 2018. One might expect that innovation is directly proportional to the investment accorded to developing it. However, it is clear from these results that although buyers want to see innovation, they are less inclined to consider the cost and investment to achieve it. Ciena was the leader in perception of R&D investment in this year's survey, followed by Huawei and Infinera.

Exhibit 11 Vendor leadership: R&D investment
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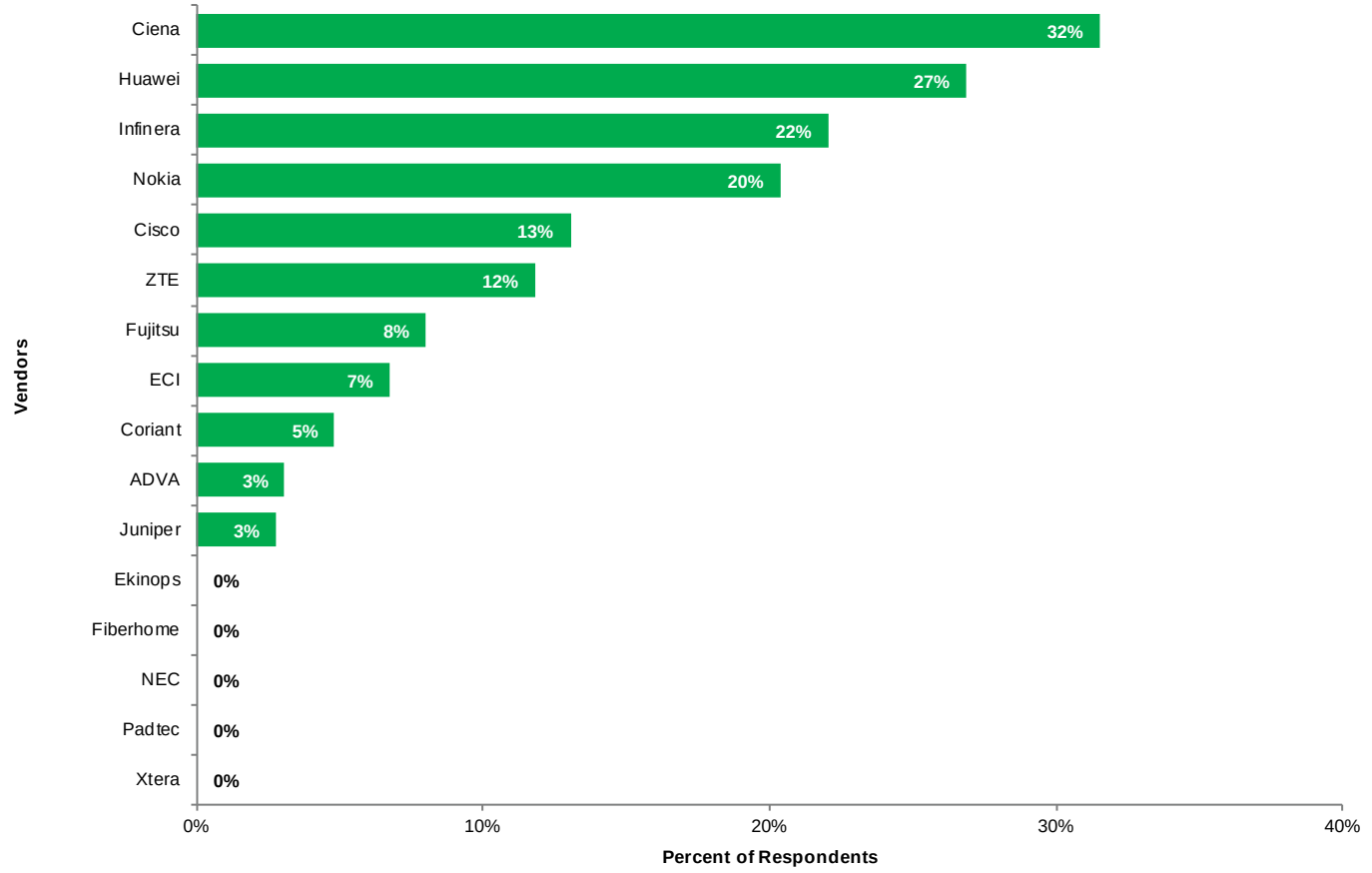

Source: IHS Markit

Contacts

Heidi Adams
Senior Research Director,
IP & Optical Networks
+1 408.583.3371
Heidi.Adams@ihsmarkit.com

IHS Markit Customer Care:

CustomerCare@ihsmarkit.com
Americas: +1 800 IHS CARE (+1 800 447 2273)
Europe, Middle East, and Africa: +44 (0) 1344 328 300
Asia and the Pacific Rim: +604 291 3600