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Building the Cloud Metro: Heavy Reading Survey Analysis 2023

A Heavy Reading white paper produced for Juniper Networks

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INTRODUCTION

The acceleration and convergence of IT and communications innovations are unlocking new revenue opportunities for communications service providers (CSPs) and driving significant changes in how metro networks are built. In 5G, operator migration from non-standalone to standalone 5G cores, combined with new capabilities to come from 5G-Advanced, will open new use cases, many in the enterprise. In addition, cloud adoption continues globally, and the buildout of edge cloud will underpin many of the emerging 5G use cases.

To meet networking demands—largely driven by migration to the cloud by customers as well as by CSPs themselves—network operators must apply cloud principles to architecting, building, and operating their metro networks. Core principles of the emerging cloud metro include the following:

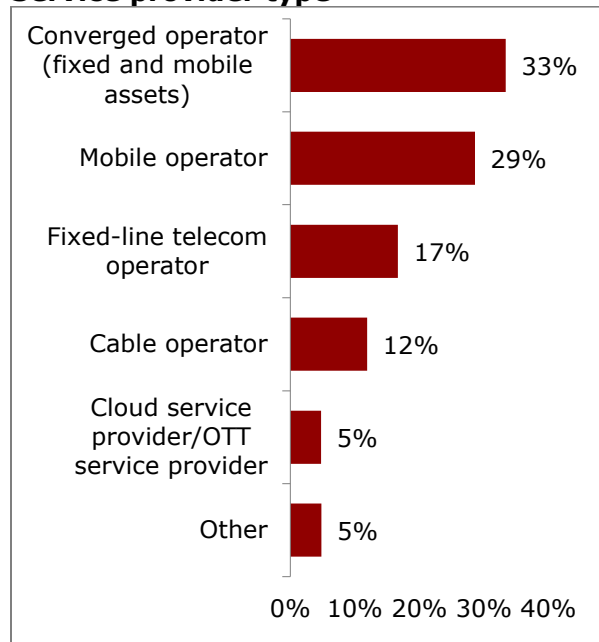
- Architecture design is built to scale up and scale out
- Open interfaces and open application programming interfaces (APIs)
- Use of cloud native software design, including containers and microservices
- Network automation that applies artificial intelligence (AI) and machine learning (ML)
- Adoption of cloud-based delivery for network applications (i.e., software as a service [SaaS])
- Adaptive energy efficiency for the lowest possible power consumption

Aimed at understanding the metro network evolution of CSPs, Heavy Reading launched its first Cloud Metro Survey in 2022. In April and May 2023, we conducted a Year 2 version of the survey, with responses from 84 network operators globally. This white paper presents a high level view of the key findings from the 2023 survey, including metro network modernization drivers, essential networking capabilities, network automation, and the role of coherent pluggable optics.

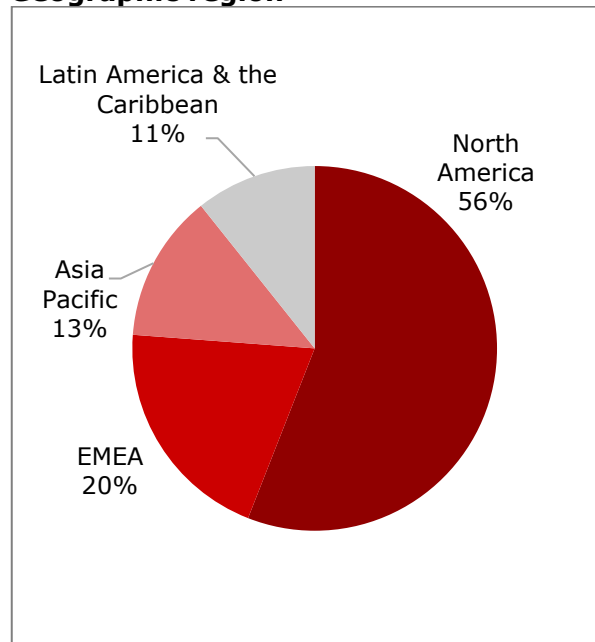
The survey demographics are detailed in **Figure 1**.

Figure 1: Survey response demographics

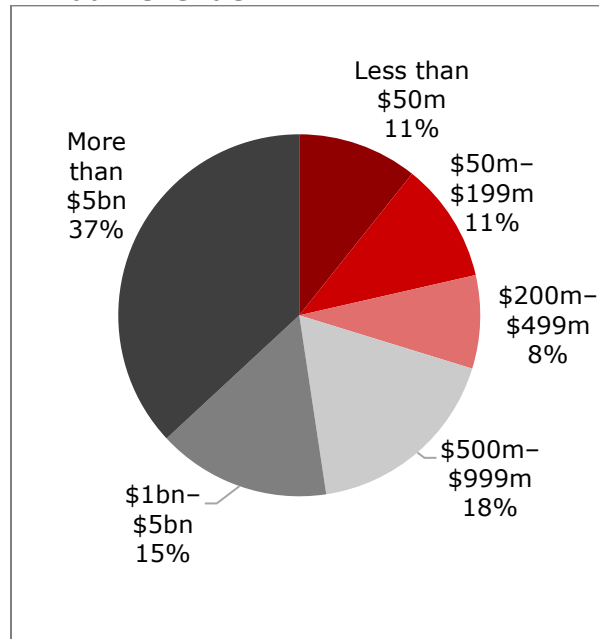
Service provider type



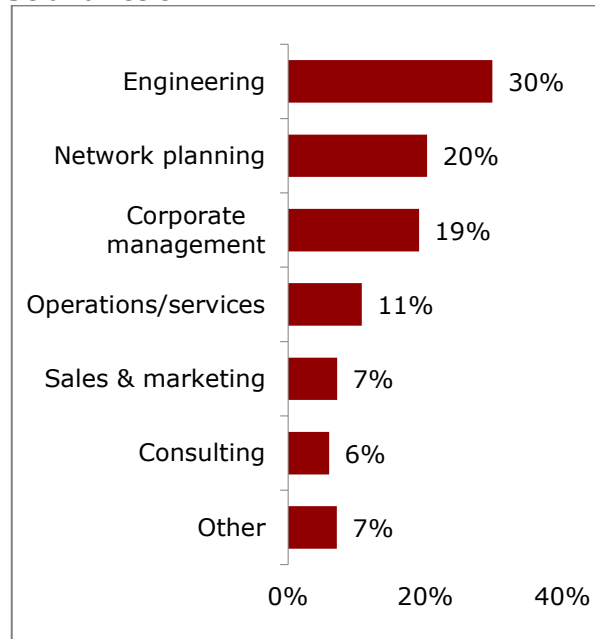
Geographic region



Annual revenue



Job function



n=84

Source: Heavy Reading, 2023

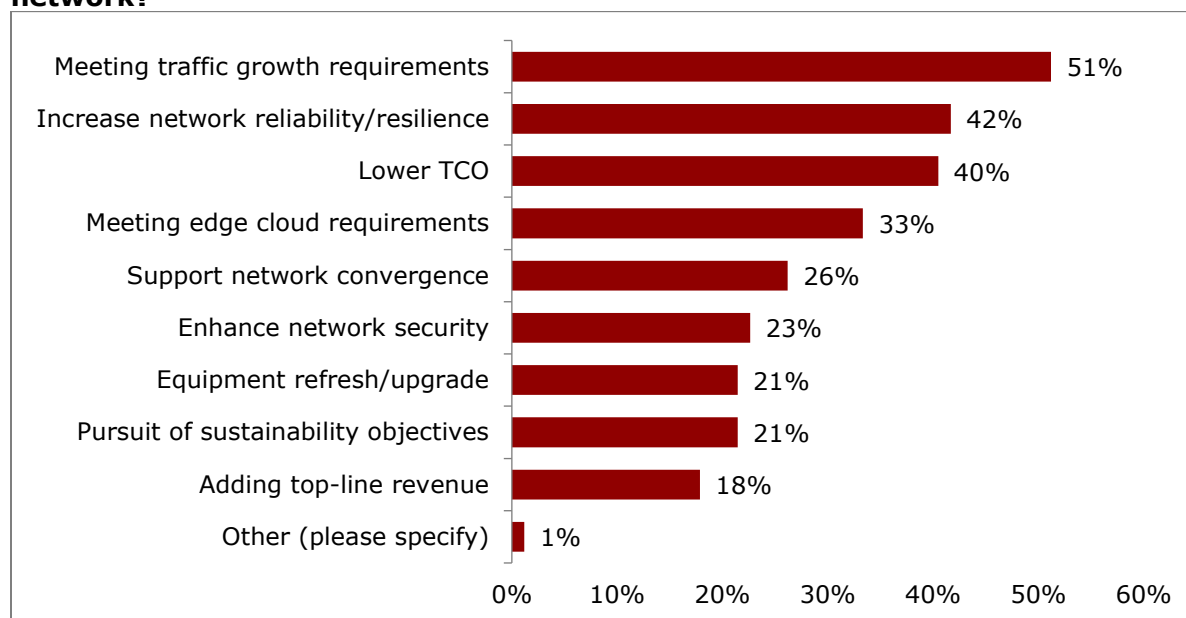
METRO NETWORK MODERNIZATION

For most network operators (68% of survey respondents), metro network modernization to address priority use cases is a work in progress. Just 2% of operators report that metro modernization is complete. Comparing results from last year's survey, the share of CSPs planning modernization in the near term (defined as starting in the next 6–12 months) is on the rise.

The top three business drivers for metro network modernization initiatives, according to the survey, are meeting traffic growth requirements, improving network reliability and resilience, and lowering total cost of ownership (TCO). Each of these network modernization drivers was selected by at least 40% of respondents, well ahead of any other drivers (see **Figure 2**).

Meeting traffic growth requirements while lowering the costs of doing so is a familiar story in telecom; therefore, it is no surprise that these drivers continue to top the list. However, the rise of resilience/ reliability to be essentially on a par with lower TCO is a newer trend, but one that has been coming through in other recent Heavy Reading surveys. Resiliency has become particularly important in 5G network plans as operators seek to differentiate 5G from 4G best effort mobility and target new enterprise use cases that place a premium on network reliability.

Figure 2: What are the primary business drivers to modernize your metro network?



n=84

Source: Heavy Reading, 2023

Indeed, 5G and edge/cloud services are the number 1 and 2 application/ use case drivers, respectively, for metro network modernization. 5G and edge/ cloud were also the top two application drivers in the 2022 Cloud Metro Survey. They are also tightly linked initiatives, as network operators view edge cloud as essential for many of the emerging enterprise 5G use cases that require ultra-low latency and hosting workloads close to customers (see **Figure 3**).

Although enterprise services, residential broadband, and Internet of Things (IoT) all follow 5G and edge on the priorities list, the reality is that 5G and edge computing infrastructure will be required for many emerging opportunities across enterprise, residential, and IoT.

Figure 3: What are the main application/use case drivers for modernizing your metro network?

Use case	2023 rank	2022 rank
5G	1	1
Edge/cloud services	2	2
Enterprise services (including SD-WAN)	3	3
Residential broadband	4	5
IoT (Internet of Things)	5	4

2023 n=84; 2022 n=76

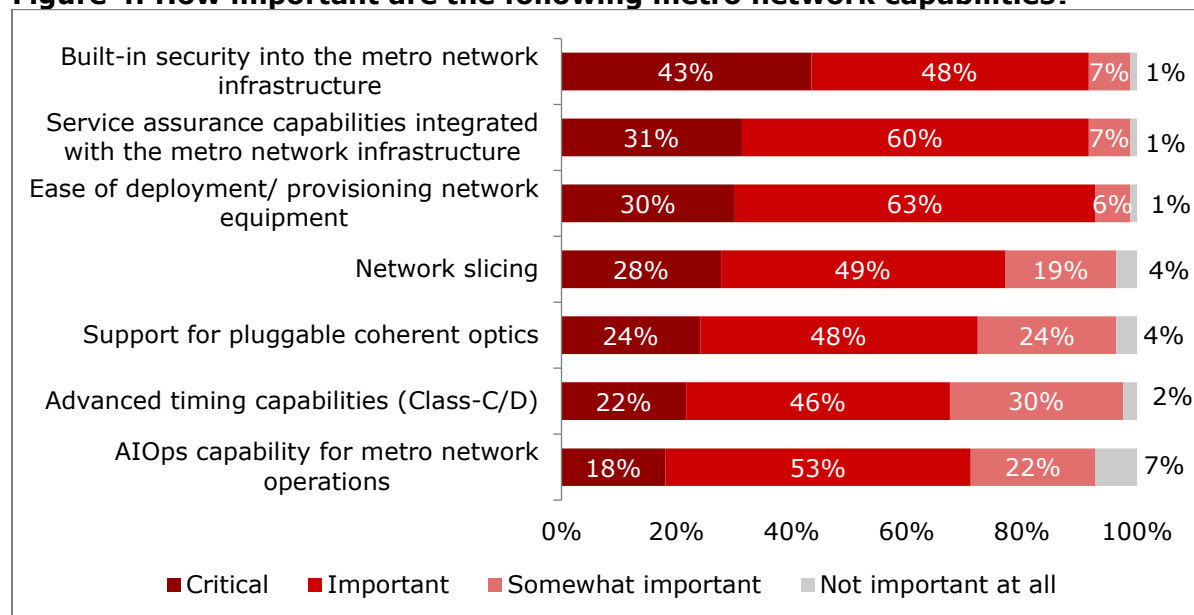
Source: Heavy Reading, 2023 and 2022

IMPORTANT FEATURES AND FUNCTIONS

Three capabilities are rated as at least “important” by more than 90% of operators surveyed. These capabilities are built-in security, integrated service assurance, and ease of deployment/provisioning. Of the top three, built-in security stands out as particularly important as it was rated “critical” by 43% of the survey group, well ahead of any other function on the list (see **Figure 4**).

Network slicing and coherent pluggable optics both rank in the middle of the pack for operators overall; however, this is because these technologies have less universal appeal compared to, for example, security. Among mobile operators surveyed, network slicing ranks second only to built-in security. Similarly, network operators modernizing their metro networks with a coherent routing architecture (or IP over dense wavelength-division multiplexing [DWDM]) will place coherent pluggable optics as a top priority, while operators keeping traditional architectures may not prioritize coherent pluggables as highly.

Figure 4: How important are the following metro network capabilities?



n=83

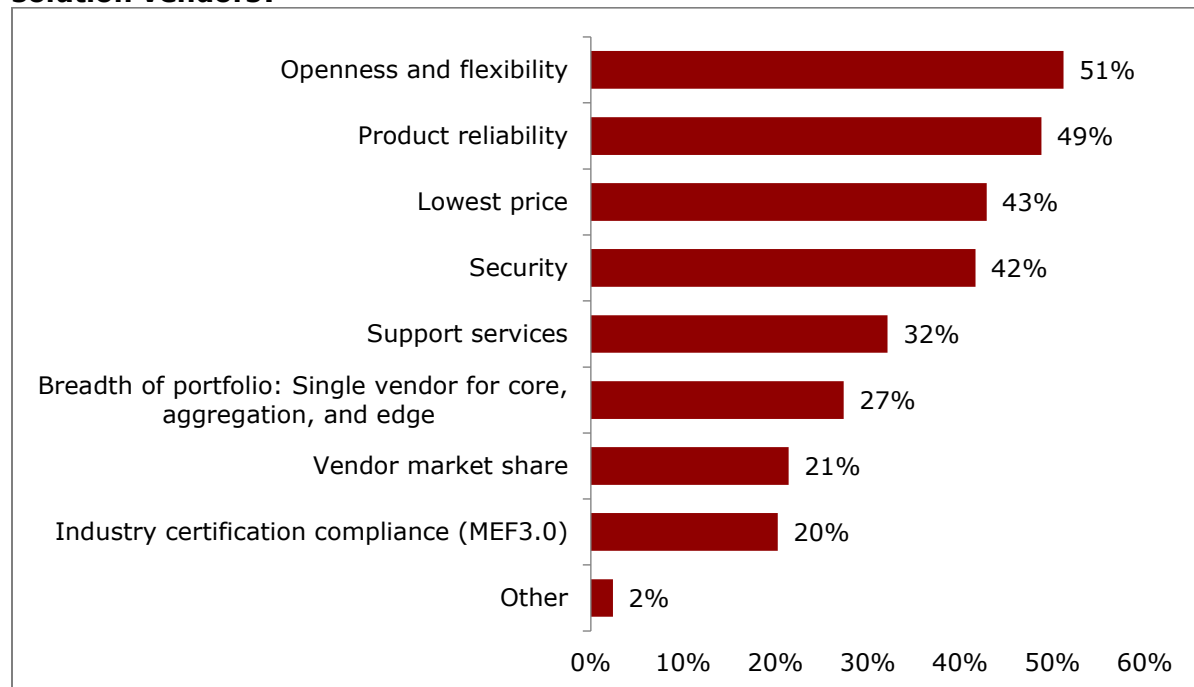
Source: Heavy Reading, 2023

Heavy Reading wanted to understand the most significant attributes that network operators evaluate when selecting their metro networking suppliers. Topping the list are openness and flexibility, product reliability, lowest price, and security (see **Figure 5**). In general, the top desired attributes map closely to the primary metro network modernization drivers identified in **Figure 2** (including higher reliability, lower TCO, and greater security).

Openness and flexibility moved up from the third most important attribute in 2022 to the top spot in this year's survey. The results suggest that multiple trends under the umbrella of "openness" that have been percolating and progressing for several years have now reached critical momentum in the market. Prime examples include software-defined networking (SDN), disaggregation, open APIs, open RAN, virtualization, and standardized pluggable optics.

Suppliers must understand that openness is no longer "nice to offer" or something that operators use to gain pricing leverage with their incumbent suppliers. Rather, openness attributes are essential for vendors and their customers.

Figure 5: What are the most critical attributes when evaluating metro network solution vendors?



n=84

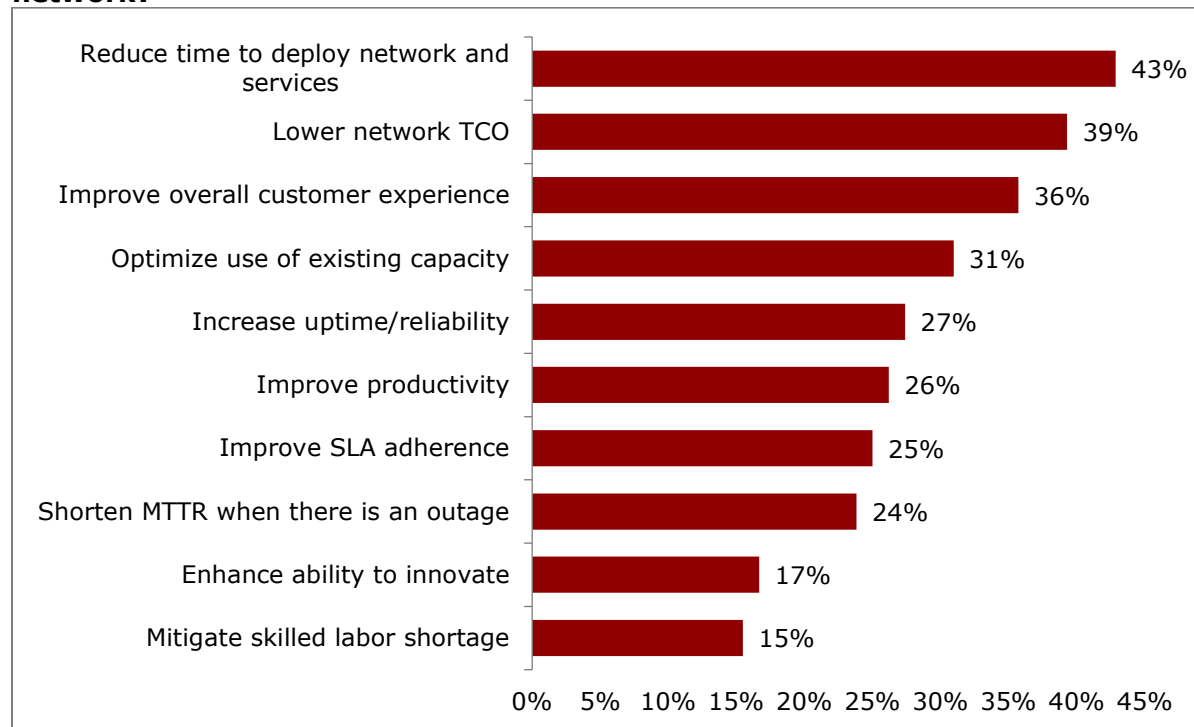
Source: Heavy Reading, 2023

NETWORK AUTOMATION

Network automation holds tremendous promise to help CSPs build and operate networks more efficiently and reliably at lower cost—and with greater innovation than ever before. The advent of AI and ML technologies makes the promise greater and the competitive motivation to automate more urgent.

Primary drivers for network automation span both customer-facing external goals and internal network-focused goals. Reducing the time to deploy network and services (ranked first) leads to faster time to revenue, while improving customer experience (ranked third) can help boost revenue as well as retain customers in churn-heavy markets. Automation can help lower TCO (ranked second) in many ways, such as by reducing truck rolls for provisioning, activation, and maintenance or by better managing network capacity (i.e., network optimization) to do more with less capex (see **Figure 6**). Notably, this dual-focused finding is consistent across multiple Heavy Reading network automation surveys.

Figure 6: What are the primary drivers for implementing automation in your metro network?



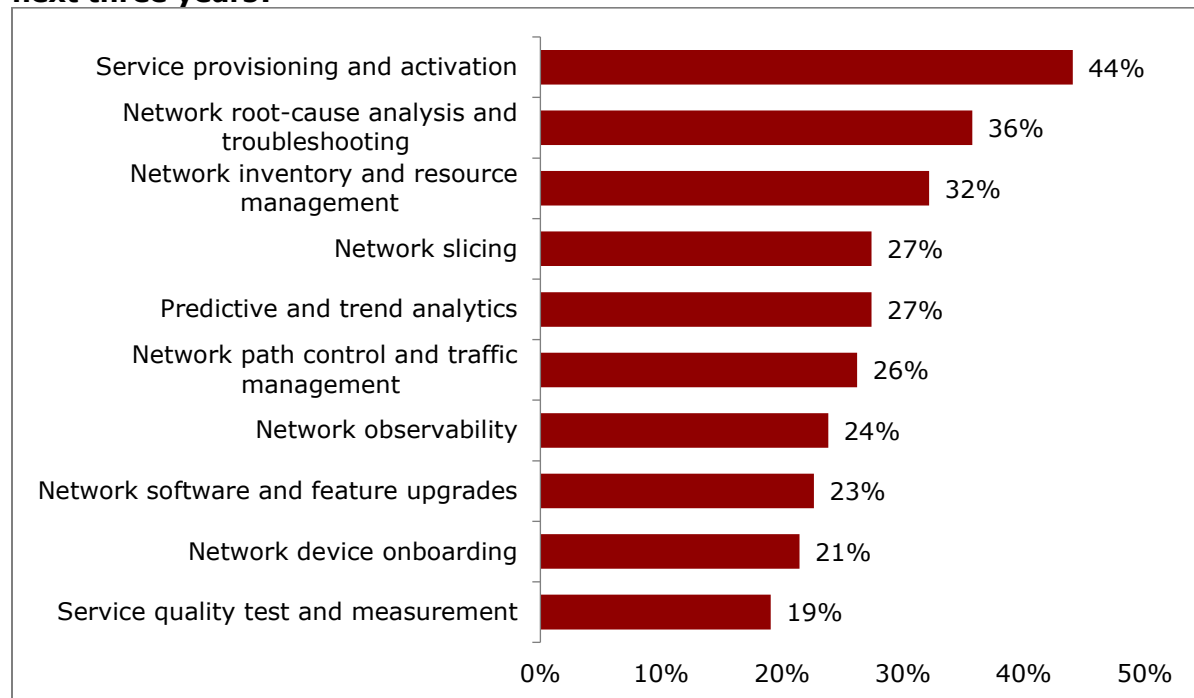
n=84

Source: Heavy Reading, 2023

Network automation is relatively new to operators. Therefore, it is not surprising that, at this early stage, they are casting a wide net in terms of targeted use cases. Nine use cases were selected by more than 20% of respondents (**Figure 7**). Service provisioning and activation was the top-scoring use case among operators, as was also the case in the 2022 Cloud Metro Survey. Network root-cause analysis/ troubleshooting and network inventory/ resource management were also highly important.

As technology and plans mature, the broad set may narrow. Still, the fact that automation is driven broadly by both customer-facing and internal factors may ensure that the wide set of use cases endures.

Figure 7: What are the primary use cases for metro network automation over the next three years?



n=84

Source: Heavy Reading, 2023

To achieve its network automation aims, the communications industry collectively must address the primary challenges that stand in the way. Network operators consistently identify the complexity of integrating automation tools with existing systems and the lack of technology maturity as the biggest barriers to adoption. High costs are also commonly cited, particularly by smaller operators that lack staff and budget.

Significantly, a new cloud-delivery model for network automation (i.e., SaaS) can address many of the top challenges, including simplifying integration with an API-first approach that also can reduce application integration times from weeks to just hours. SaaS delivery also addresses staffing challenges by moving the development burden from the operator to the software vendor (a factor that may also free up operators' budgets). Juniper Networks is a pioneer in cloud-delivered automation software as part of its Cloud Metro solution.

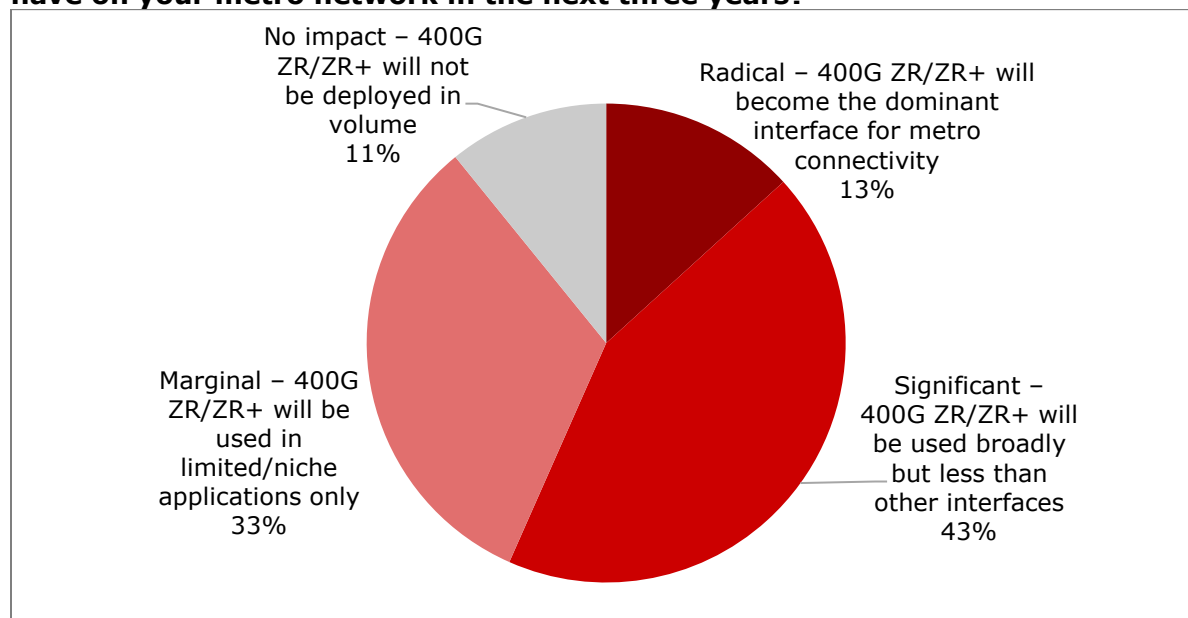
COHERENT PLUGGABLE OPTICS

The commercialization of point-to-point 400ZR coherent pluggable optics started a revolution, largely driven by the hyperscalers. Omdia counts 109,000 400ZR modules shipped in 2022, making 400ZR the most successful coherent launch in optics history by volume. Although 400ZR is a great solution for 400 Gigabit Ethernet connectivity between large data centers, point-to-point connectivity, and limited reach make Optical Internetworking Forum (OIF)-defined 400ZR less applicable for the needs of CSPs.

More applicable to CSPs are high performance versions of 400G coherent pluggables that fit into small form factors (such as QSFP-DD) but also achieve metro/regional-type distances and are capable of passing through multiple reconfigurable optical add-drop multiplexer (ROADM) hops along a route. The industry labels these emerging coherent pluggables as 400G ZR+, and they are being defined in groups, including the Open ZR+ multi-source agreement (MSA), the Open ROADM MSA, and the Open XR Forum.

CSP interest in coherent pluggables in the broader scope of 40ZR and 400G ZR+ is very strong. Of all operators surveyed, 56% expect 400G ZR/ZR+ pluggable optics will have at least a significant impact on their metro networks within the next three years (see **Figure 8**). At 13%, a minority of operators believe the impact will be “radical,” with 400G ZR/ZR+ becoming the dominant interface in the metro.

Figure 8: How much impact do you expect 400G ZR/ZR+ coherent pluggable to have on your metro network in the next three years?



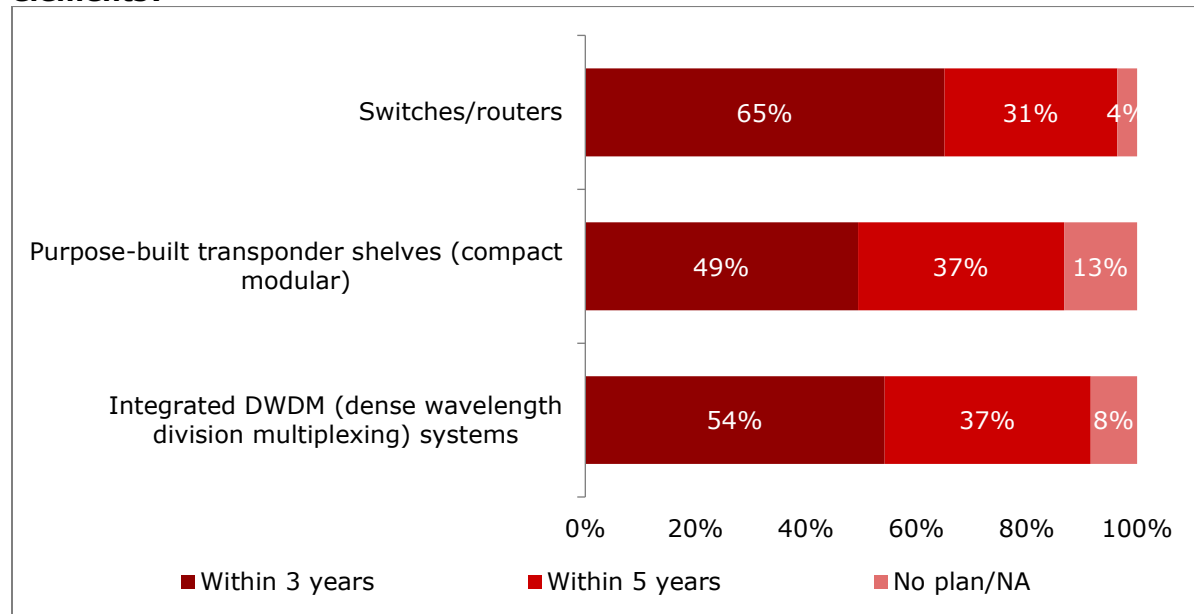
n=83

Source: Heavy Reading, 2023

Integrating coherent optics directly onto routers (known as IP over DWDM or, more recently, coherent routing) is a big part of the appeal of coherent pluggables for CSPs. This is also the architecture adopted by hyperscalers buying 400ZR optics. At 65%, a majority of operator respondents expect to use coherent pluggable optics in switches/routers over the next three years.

However, IPoDWDM is not the only use for high speed coherent modules that network operators have in mind. A majority of respondents (54%) also plan to use coherent pluggables in their traditional DWDM systems in the three-year timeframe, and just under half (49%) expect coherent pluggable in their compact modular DWDM systems. In other words, operators expect to use high speed coherent pluggables everywhere (see **Figure 9**).

Figure 9: When will you deploy coherent pluggable optics to the following network elements?



n=83

Source: Heavy Reading, 2023

Naturally, barriers to adoption exist, particularly for the IPoDWDM architecture that calls for the biggest changes to the metro network, both technically and operationally. Lack of compatibility with existing routers/switches tops the list and is a major area of industry focus today. Physics and hardware are part of the challenge. Routers/switches must have the right interface slots, and modules must have the right power profiles. Vendors have been addressing these hardware challenges over the past couple of years, though legacy switches/routers might not be compatible.

In addition to hardware, management plane compatibility across modules and router/switch vendors is also a major piece of the compatibility puzzle. Standardization is needed to ensure the uniform management of coherent modules required for vendor interoperability. Here, the OIF has taken the lead with its Common Management Interface Specification, targeted specifically for coherent pluggables.

CONCLUSIONS

Most network operators are currently modernizing their metro networks to meet changing network demands, largely driven by the migration to cloud services and architectures among customers and by the CSPs themselves. Heavy Reading survey data shows that top drivers for modernization include meeting traffic growth requirements, increasing network reliability/ resilience, lowering TCO, and enhancing network security.

For CSPs, success will come from applying cloud principles to all aspects of their metro networks. Network automation is an important tool that operators will use to address both customer-facing requirements (such as faster time to revenue) and network-centric needs (such as higher reliability and lower costs). This will increasingly include the adoption of automation delivered from the public cloud. On the hardware side, open coherent pluggable optics integrated directly into routers introduce a new metro architecture that can dramatically lower both capex and opex. Migration to the cloud metro is not without its challenges, however, and operators will rely on leading vendors to help them navigate the changes. In choosing strategic suppliers, CSPs will place the strongest emphasis on openness, reliability, security, and the lowest TCO.