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HEAVY READING WHITE PAPER

5G Transport:
A 2021 Heavy Reading Survey

A Heavy Reading white paper produced for Ericsson, Fujitsu, Infinera, and Nokia

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EXECUTIVE SUMMARY

5G commercialization is in full swing in 2022. The Global Mobile Suppliers Association (GSA) counted 487 operators in 145 countries and territories investing in 5G as of year-end 2021, including trials, license acquisitions, planning, network deployments, and commercial launches. Omdia forecasts that by the end of 2022, there will be nearly 1.3 billion 5G mobile subscriptions globally. For some perspective, 5G subscriptions in 2019 totaled under 11 million worldwide.

Although these early statistics are impressive, the 5G industry is still just starting to ramp up. The full possibilities of 5G—in functionality and in revenue-generating potential—lie ahead.

Heavy Reading survey data shows that operator deployment drivers for 5G networks are shifting as the focus moves beyond only faster speeds (primarily for consumer markets) to new markets and new services (heavily targeting enterprises). This is where the advanced 5G functions, defined in ultra-reliable low latency communications (URLLC) and massive machine-type communication (mMTC) use cases, come into play. The coming shift beyond higher data rates to advanced 5G services has big implications for the supporting transport networks, including fronthaul, midhaul, and backhaul—collectively called "xHaul." While early deployments are about laying fiber and increasing capacity, the next phase is more complex.

In its third year, Heavy Reading's **Operator Strategies for 5G Transport Survey** project focuses on the xHaul network considerations and requirements as operators work to meet the new challenges of advanced 5G services delivery. Heavy Reading project partners that aided in survey development are **Ericsson**, **Fujitsu**, **Infinera**, and **Nokia**.

Completed in November 2021, this year's survey received 81 qualified network operator responses from around the world, all of which reported involvement in network planning and/or purchasing of network equipment. Geographically, 56% of respondents come from North America. This Heavy Reading white paper is based on the survey results and provides the industry's most in-depth look at the current state and future trajectory of 5G transport based on operators' views and plans.

Key findings

The following are the key findings from this study.

Priority initiatives

Edge/multi-access edge compute (MEC) tops the list of priority initiatives communications service providers (CSPs) expect to implement over the next five years. 64% of CSPs surveyed expect to implement by 2025. Following closely behind at 62% is centralized RAN (C-RAN), with deployment expected by 62% of respondents over the time period. Cloud RAN trails a bit behind (at 57%), followed lastly by network slicing, with deployment expected by just under half of respondents (at 49%).

Centralized RANs

Increasing network resiliency is the top motivation to move to a C-RAN architecture, scoring higher than improving RAN performance, virtual RAN migration, and simplifying cell sites. These motivations were selected by 68%, 54%, 52%, and 50% of CSP respondents, respectively. The top ranking of network resiliency in this survey is a bit of a surprise. RAN performance and RAN virtualization have typically been the top factors in past Heavy Reading surveys. Still, it is clear that network resiliency is crucial to differentiation in 5G, and CSP awareness of the role that centralization can play here may be increasing.

Service providers have multiple means at their disposal to transport legacy CPRI, and the data shows that they intend to make use of all of them, but legacy overlay using dark fiber or wavelength-division multiplexing (WDM) is the top choice for legacy Common Public Radio Interface (CPRI; selected by 64% of CSPs). Still, CSPs seek greater efficiency than packetized transport offers, with eCPRI via CPRI to eCPRI conversion selected by 52%, structure-agnostic radio over Ethernet (RoE) selected by 43%, and structure-aware RoE selected by 29%. When combined, the two RoE options actually come out top, selected by 72% of CSPs surveyed.

Bidirectional optics that allow transmit and receive connectivity over a single fiber are expected to play a significant role in CSP fiber-to-the-tower builds. 52%of CSPs surveyed see single fiber working (SFW) as "important," which Heavy Reading defined as up to 50% of towers connected with SFW. 20% of the survey group believes the technology is "critical," meaning greater than 50% of towers will be connected with single fibers. The "important" and "critical" responses combine for 72% of the survey group. On the other hand, just 1% view SFW as "not important."

Cloud RAN

Globally, there has been minimal adoption of cloud RAN to date, but CSPs surveyed have ambitious growth plans over the next five years. Just over two-thirds of respondents expect 20% or less of 5G RAN sites to have virtualization by year-end 2022. However, more than three-quarters of those surveyed expect greater than 20% of 5G RAN sites will have virtualization by the end of 2025. At 43%, a plurality anticipates cloud RAN adoption will range from 21% to 40% of 5G RAN cell sites. While growth expectations are encouraging, it is also clear that cloud RAN architectures are not universally appealing, as 43% of the survey group expect no cloud RAN deployments through 2025.

Among CSPs pursuing cloud RAN, capacity requirements are, by far, the biggest transport network challenge. Transport capacity was cited as a challenge by 72% of respondents and well ahead of latency requirements (selected by 54%) and synchronization requirements (in a distant third at 35%).

Timing and synchronization

Among the network functions introduced in 5G that require high phase and time synchronization accuracy, performance-boosting coordinated RAN features and fronthaul with ring or mesh protection top the list. These two were selected by 59% and 52% of CSPs, respectively. Following in third, but still significant, is fronthaul with RoE (at 43%). It is worth noting that CSPs may use all three of these functions together, as radio coordination requirements are one of the drivers for fronthaul architectures.

Strict synchronization requirements for 5G applications, including packet fronthaul, tops the list of expected challenges faced when deploying terrestrial (or non-satellite) timing and synchronization. 70% of CSPs see synch requirements for 5G (e.g., Class C) as a challenge.

Ranking second, but still significant to a majority of respondents, is simultaneous support for different synchronization profiles (selected by 59% of respondents). Profiles include ITU-T G.8275.1 and G.8275.2.

Edge

CSP 5G edge strategy can be driven by external goals (such as low latency services) or by internal goals (such as RAN virtualization); interestingly, both are equally important as the primary driver for edge, according to the survey. 35% of respondents reported that low latency services are their primary edge driver and another 35% reported that 5G RAN virtualization is their primary driver. Additionally, 27% of CSPs indicated that both virtualization and low latency services are equally important.

The edge is defined as a location, but service providers do not expect it to be one location; rather, they expect it to be many locations. Heavy Reading survey results point to multiple important edge locations, including the cell site (selected by 56%), the centralized unit (CU) site (54%), the distributed unit (DU) site (50%), and the core node (50%). And while alternative locations individually registered lower than these top four choices, the alternative locations were selected by 50% of respondents in combination. Thus, all service provider locations are currently in play for the edge at this very early stage of rollout. What cannot be known at this time is whether one (or more) of these promising locations might fall out of favor over time as CSP edge strategies become clearer.

Slicing and segment routing

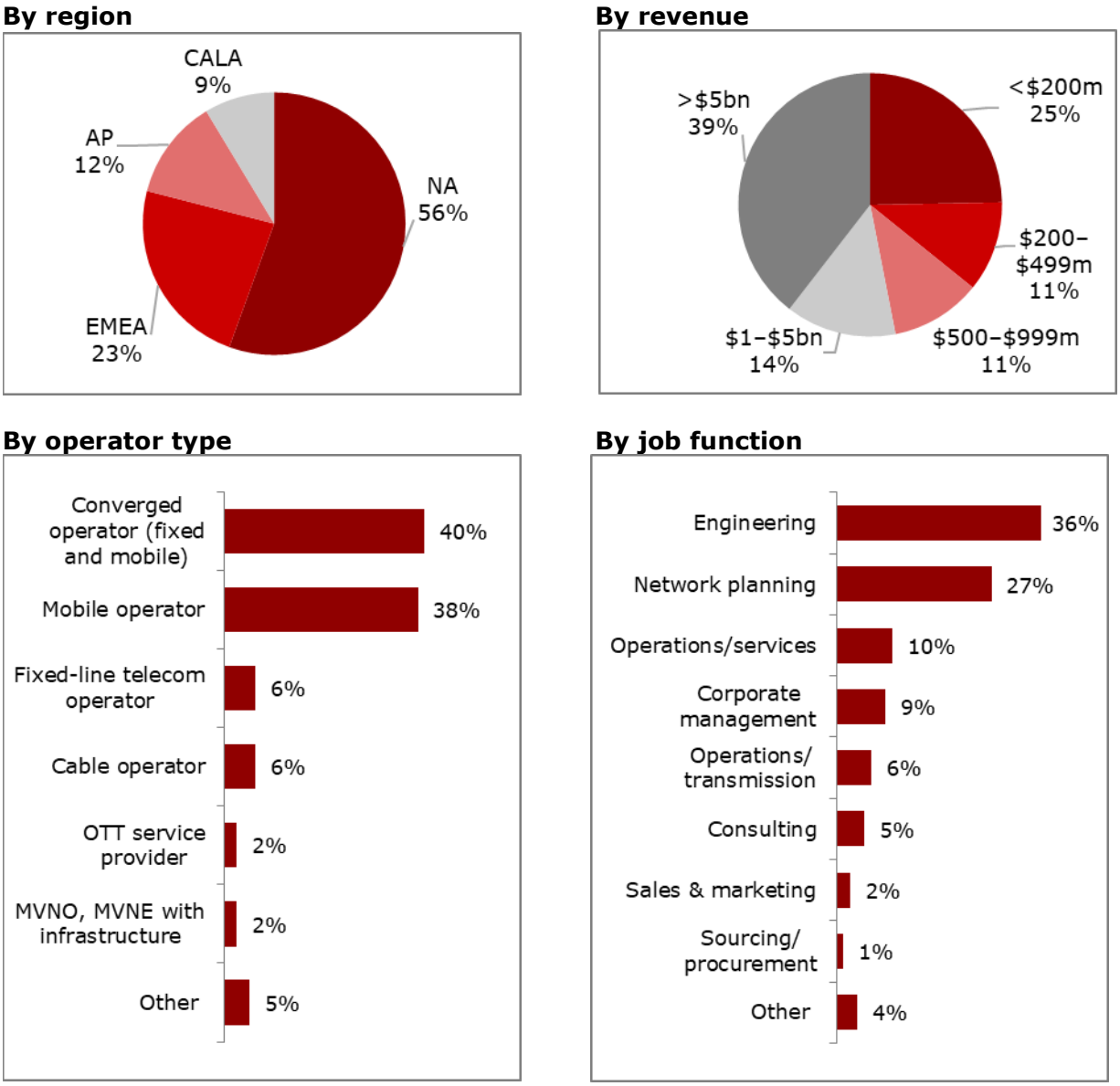
CSPs will require both hard and soft slicing to meet different 5G use case requirements, but they will likely require soft slicing more than hard slicing—and potentially much more. The combination of hard and soft slicing was selected by 55% of survey respondents, clearly pointing to the need for both. However, while 35% of respondents expect to implement soft slicing alone, just 5% of those surveyed expect to rely solely on hard slicing—a significant 7x difference in appeal.

Segment routing has emerged as an important soft slicing technology, but transport slicing itself is not segment routing's primary use case, at least in the near to mid term. Of the three primary segment routing use cases, protocol simplification is the most advanced, with 63% of the survey group expecting to have implemented segment routing by the end of this year. Traffic engineering follows, with 60% of CSP respondents expecting implementation by the end of 2022. Compared to these two applications, segment routing for transport slicing lags. Just 12% of respondents reported segment routing use by the end of 2021, though 32% expect to implement segment routing for slicing in 2022—totaling 44% of CSP respondents by the end of this year.

Survey demographics

This Heavy Reading report is based on a web-based survey of network operators worldwide conducted in October and November 2021. Respondents were drawn from the network operator list of the Light Reading readership database. After reviewing responses, 81 were judged qualified participants and were counted in the results. To qualify, respondents had to work for a verifiable network operator and be involved in network planning and/or purchasing network equipment. Additional screening was conducted to remove incomplete surveys and bad responses. The full survey demographics are detailed in **Figure 1**.

Figure 1: Survey response demographics



n=81

Source: Heavy Reading, 2021

5G PRIORITIES

Heavy Reading asked CSPs to assess plans for various initiatives related to 5G, including MEC, C-RAN, and others. Specifically, the survey asked respondents to identify which of these initiatives they intend to implement by 2025 by selecting all that apply (see **Figure 2**).

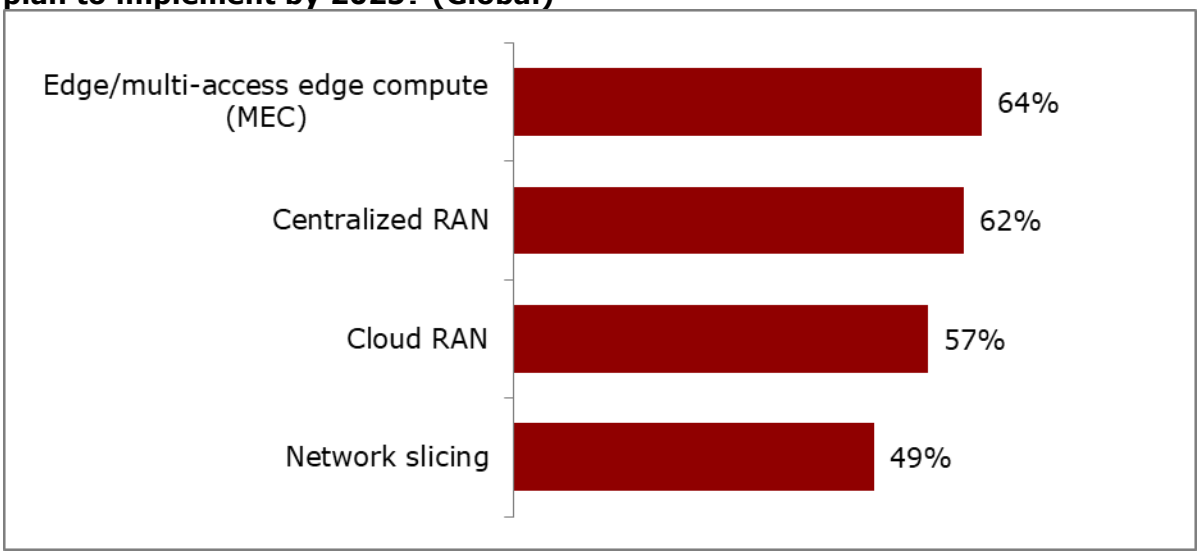
Because there can be some confusion, respondents were provided with the following definitions for C-RAN and cloud RAN:

- **Centralized RAN (C-RAN):** A RAN where radio units/remote radio heads are located at the cell site, and Layer 2 and higher baseband functionality is geographically separated at a centralized location for resource pooling. May be physical or virtual.
- **Cloud RAN:** A centralized RAN that employs hardware and software disaggregation with RAN virtualization using commercial off-the-shelf (COTS) servers.

Originally conceived as a qualifier question to steer respondents away from sections that are not relevant to their plans, the aggregate data also reveals CSP prioritization across these initiatives. At the top of the priority list is edge/MEC, which 64% of CSPs surveyed expect to implement by 2025. Following closely behind at 62% is C-RAN, with deployment expected by 62% of respondents over the time period. Cloud RAN trails a bit behind (at 57%), followed lastly by network slicing, with deployment expected by just under half of respondents (at 49%).

The prioritization synchs up well with past survey data, as well as anecdotal data from one-on-one discussions that indicate that edge strategy is top of mind for service providers today. Network slicing, though still important, has slipped a bit down the priority list over the past two years as the complexities of end-to-end slicing have become apparent.

Figure 2: Which of the following is your organization currently implementing or plan to implement by 2025? (Global)

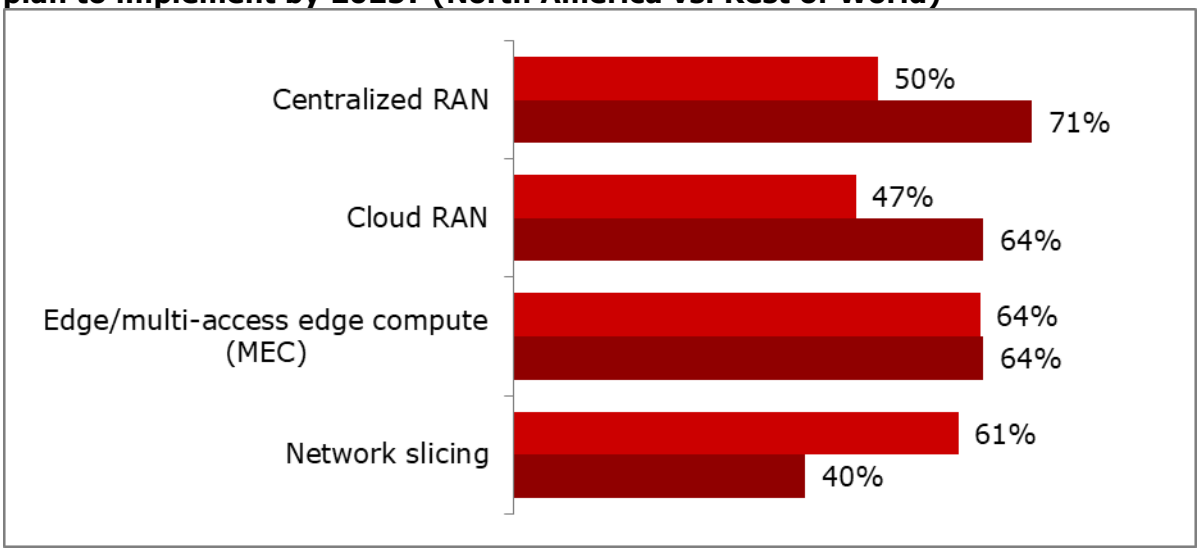


n=81
Source: Heavy Reading, 2021

Breaking out initiative timelines to compare North American respondents with their Rest of World (RoW) counterparts yields some differences. In particular, North American CSP expectations over the next five years for both C-RAN and cloud RAN are far more aggressive than RoW CSP expectations. While 71% of North American CSPs expect to roll out C-RAN by 2025, just 50% of RoW CSPs expect to do so. Similarly, 64% of North American CSPs expect to deploy cloud RAN, while just 47% of RoW CSPs expect to do so (see **Figure 3**).

The survey findings track well with what Heavy Reading is seeing currently—with C-RAN plans and deployment expectations in North America far more aggressive than expectations in Europe, the Middle East, and Africa (EMEA). Still, the survey data indicate that, by 2025, C-RAN architectures will make further headway outside of North America (e.g., 50% of RoW respondents expect at least some deployments). For network slicing, expectations are far greater for RoW respondents compared to their North American counterparts.

Figure 3: Which of the following is your organization currently implementing or plan to implement by 2025? (North America vs. Rest of World)



n=45, North America; n=36, Rest of World
Source: Heavy Reading, 2021

CENTRALIZED RANS

RAN functional decomposition creates distinct segments in the RAN to be addressed by transport networks in cases where those functions are physically separated in the access network. In decentralized RAN architectures dominant through 4G, the backhaul segment connects baseband unit (BBU) processing with the mobile core. This is served by Ethernet.

Centralized RAN and partially centralized RAN (also called split RAN) architectures maintain the backhaul segment but add two new segments:

- Midhaul, connecting DU processing with a physically separated and centralized unit.
- Fronthaul, connecting the cell site-located radio unit (RU) to physically separated DU processing.

The fronthaul segment has been the area of greatest challenges and industry attention to date due to the high bandwidth requirements combined with extreme latency restrictions relative to both backhaul and midhaul.

This section addresses C-RAN architectures and fronthaul connectivity.

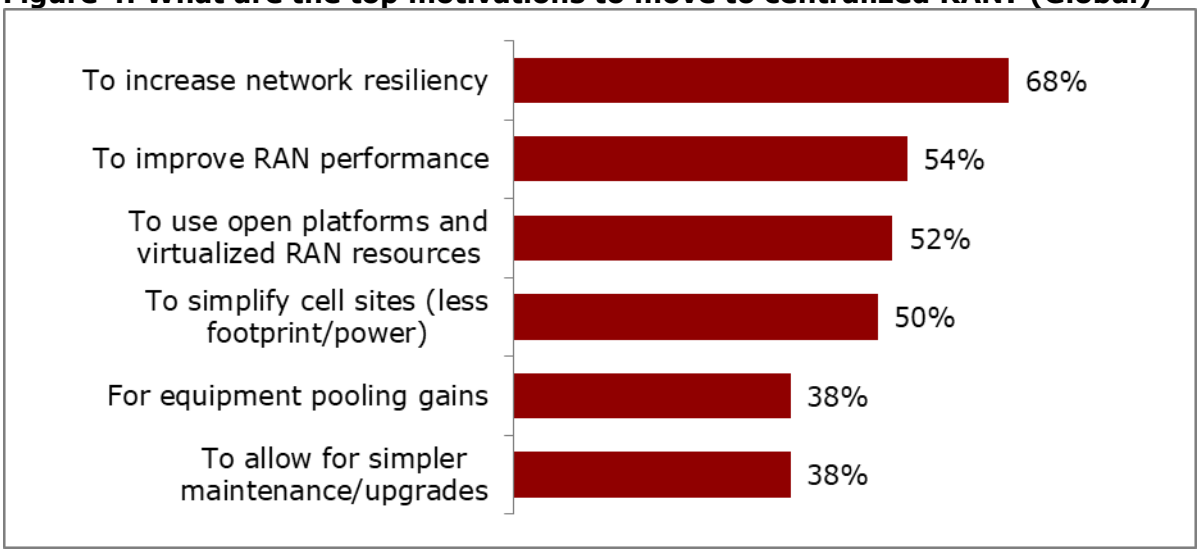
Increasing network resiliency is the top motivation to move to a C-RAN architecture, selected by 68% of CSP respondents. Second-tier motivations cited by CSPs are improving RAN performance, migration to virtualized RANs, and simplifying cell sites (see **Figure 4**).

Centralization contributes to greater RAN resiliency by pooling BBU resources across multiple cell sites—thus delivering BBU resource redundancy. As a motivation to centralize resources, the top ranking of network resiliency in this survey is a bit of a surprise. RAN performance and RAN virtualization have typically been the top factors in past Heavy Reading surveys. Still, it is clear that network resiliency is crucial to differentiation in 5G, and CSP awareness of the role that centralization can play here may be increasing. Not only does centralization improve resiliency for the baseband elements, but CSPs also see resiliency benefits in centralizing the timing source and distributing the grandmaster location instead of relying on satellite at the cell sites.

Improving RAN performance and cell site simplification benefits are straightforward motivations. Processing traffic from multiple antenna sites within the same data center or central office aids inter-site coordination functions such as carrier aggregation and coordinated multi-point (CoMP). These functions are important for increasing both coverage and capacity in 5G—particularly when using mid-band and low-band spectrum.

The importance of C-RAN in virtualization is not surprising, as centralization has been promoted as a requirement for virtualization from the beginning. Over the past few years, a decoupling has occurred whereby the benefits of centralization have been recognized beyond virtualization. The survey results reflect this ongoing trend: virtualization remains an important driver, but C-RAN architectures are driven by more than virtualization alone.

Figure 4: What are the top motivations to move to centralized RAN? (Global)

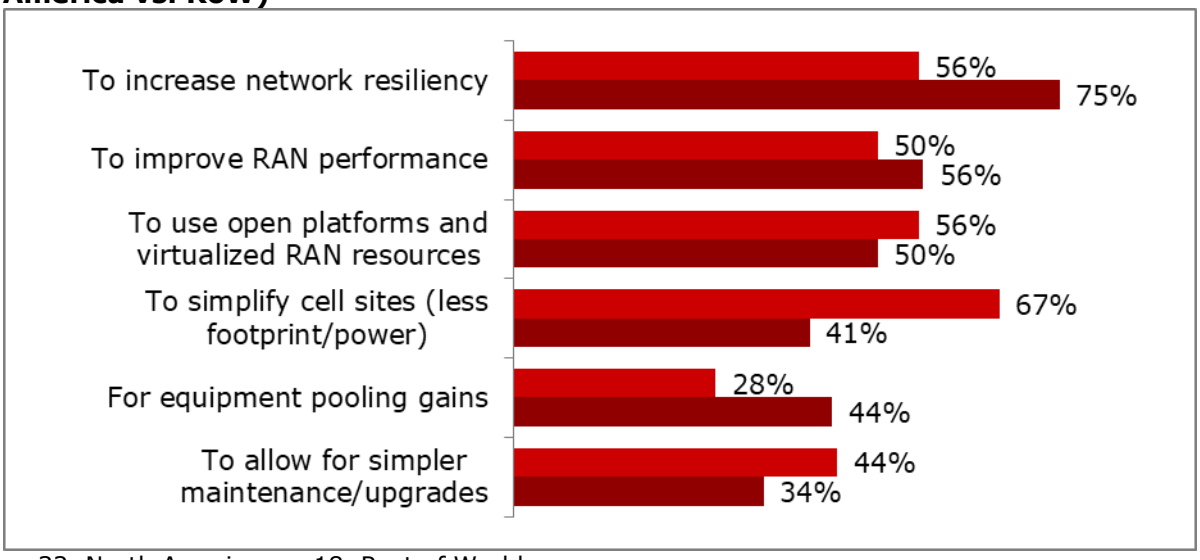


n=50

Source: Heavy Reading, 2021

Motivations vary by geographic region, with North American respondents citing increased network resiliency as a motivation for centralization (at 75%) at a far greater rate than their RoW counterparts (at 56%). RoW respondents, in contrast, selected cell site simplification as their top choice (at 67%), far ahead of North American respondents (**Figure 5**).

Figure 5: What are the top motivations to move to centralized RAN? (North America vs. RoW)

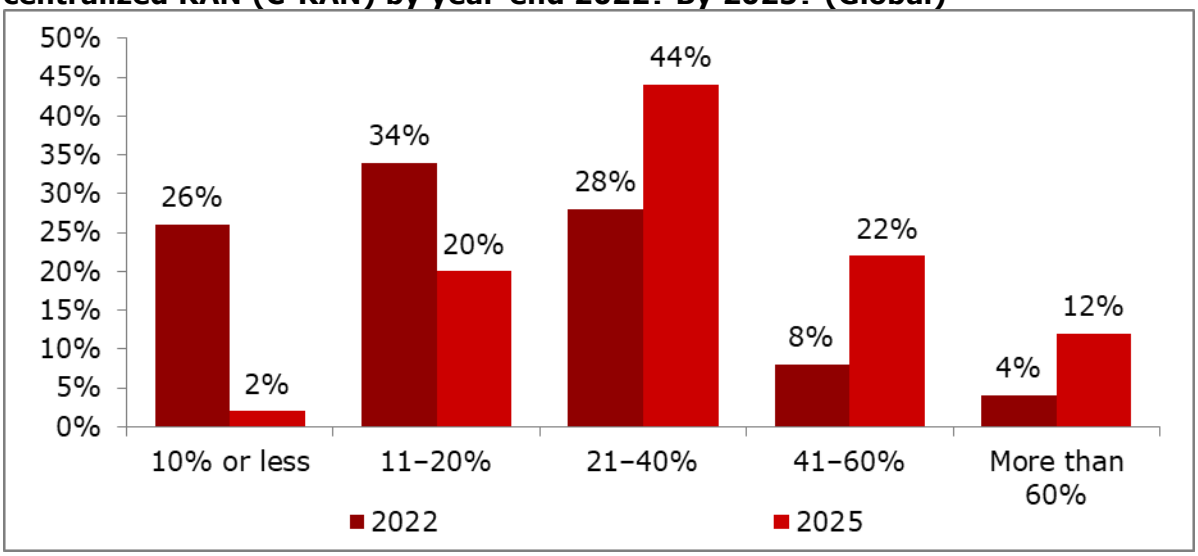


n=32, North America; n=18, Rest of World
Source: Heavy Reading, 2021

Delving a bit further, the survey asked about timelines for deploying C-RANs for those operators interested in this architecture (the 62% of respondents identified in **Figure 2**).

In 2022, 60% of CSPs expect 20% or less of 5G RAN sites will have C-RAN, but this drops to just 22% in 2025 as C-RAN penetration in 5G RAN architectures increases. While early 5G deployments rely on existing facilities that are predominantly distributed, by 2025, operators will have acquired more fiber and implemented more virtualization. In 2022, a small minority of 12% expect greater than 40% of 5G sites will have centralization, but by 2025, this increases to more than one-third of the group (at 34%) (see **Figure 6**).

Figure 6: What percentage of your organization's 5G RAN sites will implement a centralized RAN (C-RAN) by year-end 2022? By 2025? (Global)



n=50

Source: Heavy Reading, 2021

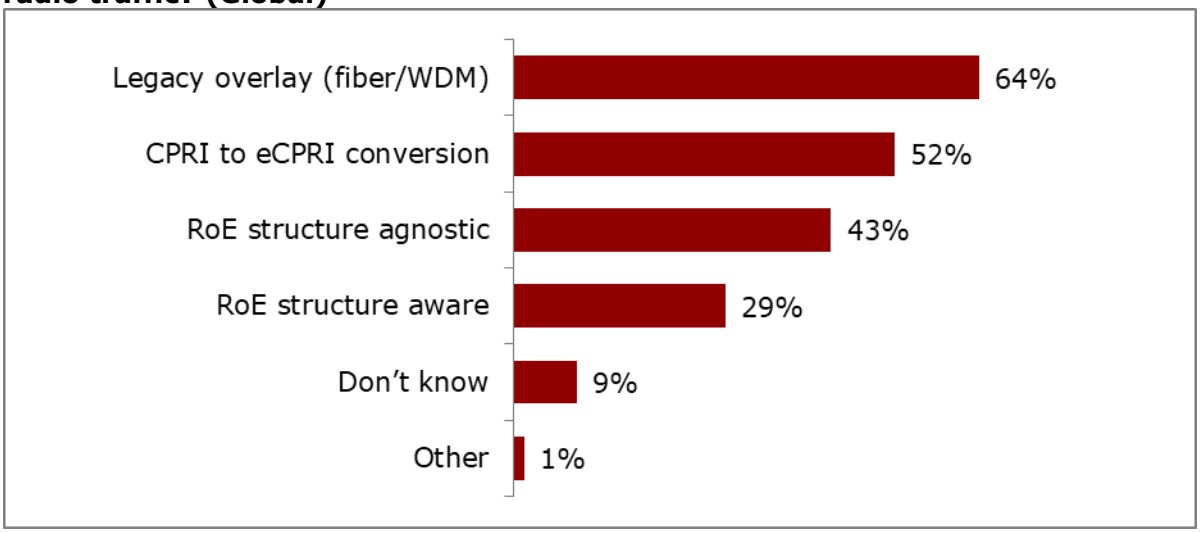
5G transport efficiency is improving significantly through the CPRI Consortium's eCPRI specification. However, CSPs will continue to have massive amounts of legacy CPRI streams, since 5G and previous mobile generations (particularly 4G) will coexist in networks for many years. Handling legacy CPRI traffic as 5G emerges is a crucial issue for nearly every CSP globally.

To better understand CPRI plans, Heavy Reading asked CSPs to identify which technologies they plan to use to transport legacy CPRI moving forward. (Respondents were asked to select all that apply.) **Figure 7** shows the results.

Service providers have multiple means at their disposal to handle legacy CPRI, and the data shows that they intend to make use of all of them. Selected by 64% of the survey group, legacy overlay using dark fiber or WDM is the top choice for legacy CPRI transport, followed by transport via eCPRI via CPRI to eCPRI conversion (selected by 52%). Trailing individually are structure-agnostic RoE (selected by 43%) and structure-aware RoE (selected by 29%). Combined, however, RoE comes out as the top option, selected by 72% of CSPs surveyed.

Fiber-rich networks will make use of dedicated direct fiber transport, while networks with fiber scarcity will use technologies and techniques to boost transport efficiency, including WDM and/or packetized transport, with time-sensitive networking. Smart self-tuning optics are also important for many CSPs.

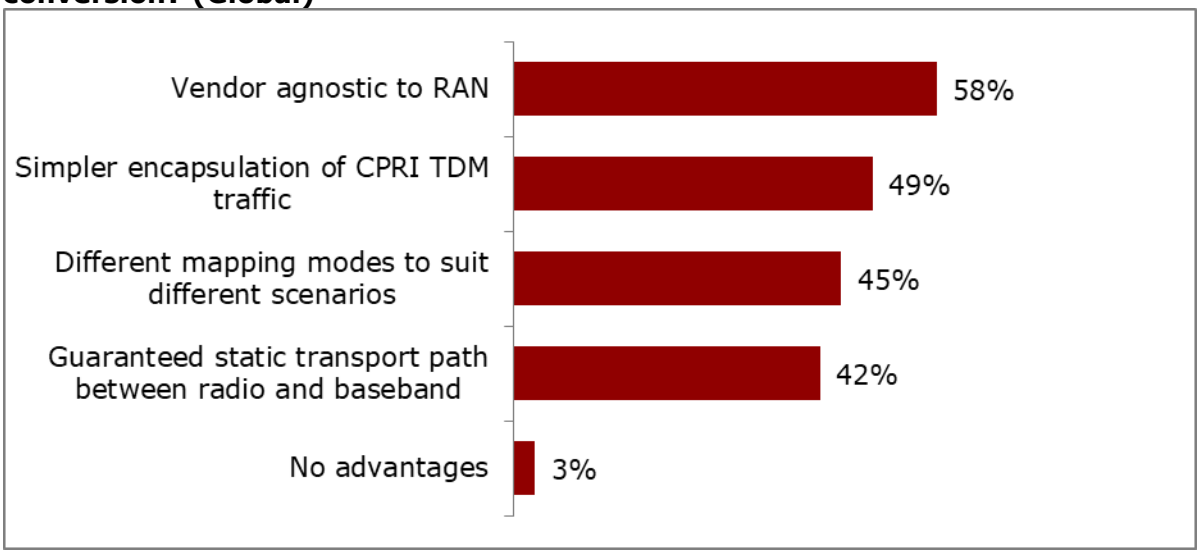
Figure 7: Which technologies will your organization use to transport legacy CPRI radio traffic? (Global)



n=69
Source: Heavy Reading, 2021

Comparing RoE to CPRI to eCPRI conversion, Heavy Reading wanted to better understand the advantages and disadvantages of each migration approach. Respondents reported that the biggest advantage of RoE is that it is vendor agnostic to the RAN (selected by 58%), followed by the simplicity of CPRI traffic encapsulation (selected by 49%) (see **Figure 8**).

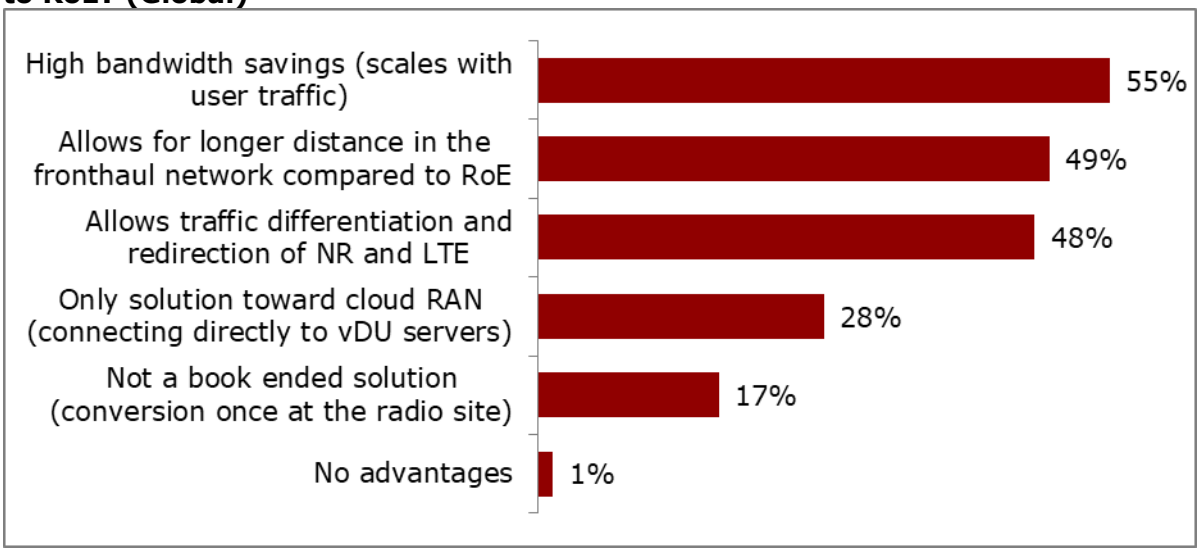
Figure 8: What are the biggest advantages of RoE compared to CPRI to eCPRI conversion? (Global)



n=69
Source: Heavy Reading, 2021

On the other hand, CSPs reported that higher bandwidth savings, longer distances in the fronthaul network, and traffic differentiation and redirection are the biggest advantages of CPRI to eCPRI conversion, chosen by 55%, 49%, and 48% of respondents, respectively (see **Figure 9**).

Figure 9: What are the biggest advantages of CPRI to eCPRI conversion compared to RoE? (Global)

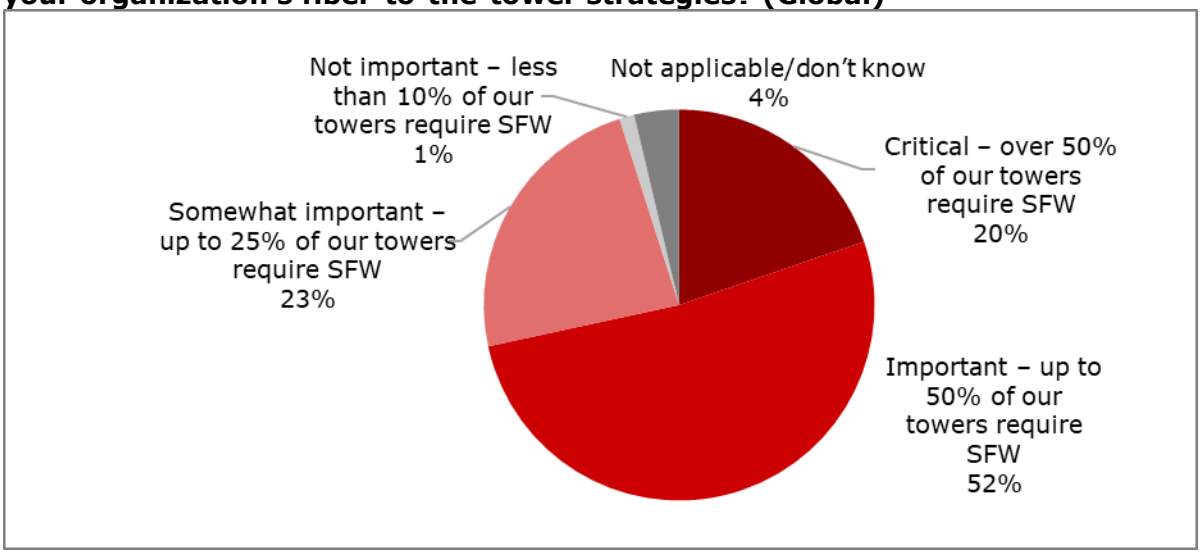


n=69
Source: Heavy Reading, 2021

One of the bigger surprises to come from the survey is the high interest in SFW in CSPs' fiber-to-the-tower strategies. Bidirectional optics include transmit and receive wavelengths within the same fiber, allowing single fiber connectivity to cell sites (versus historical dual fiber connectivity). 52% of CSPs surveyed see SFW as "important," which Heavy Reading defined as up to 50% of towers connected with SFW. 20% of the survey group believes the technology is "critical," meaning greater than 50% of towers will be connected with single fibers. The "important" and "critical" responses combine for 72% of the survey group. On the other hand, just 1% view SFW as "not important" (see **Figure 10**).

These results point to the overwhelming need to conserve fiber capacity, even in access networks that may be considered "fiber rich." The reality is that C-band and mid-band 5G traffic will consume large amounts of bandwidth, which, when combined with legacy 5G traffic, can add up to 200–300Gbps of fronthaul capacity.

Figure 10: How important is single fiber working (SFW) with bidirectional optics to your organization's fiber-to-the-tower strategies? (Global)

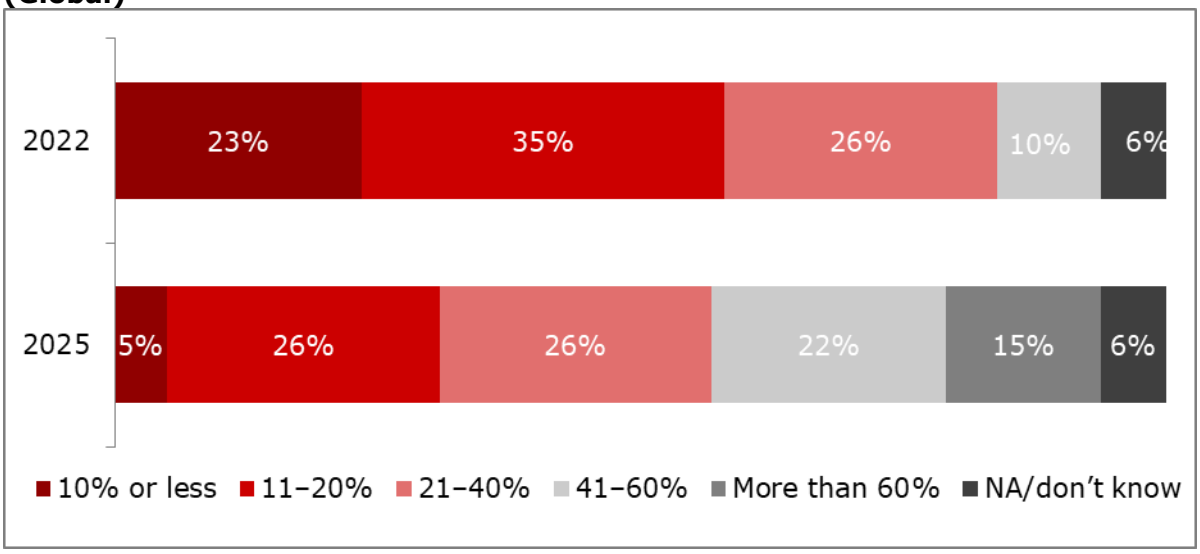


n=81
Source: Heavy Reading, 2021

The final question in this section looks at deployment plans for small cells. Specifically, the question asked respondents to identify the portion of small/pico cells expected to be deployed with mmWave and/or C-band spectrum in 2022 and in 2025 (**Figure 11**).

As expected, near-term small cell expectations are modest. In 2022, 58% of CSPs expect 20% or less of small cells to be deployed with these spectrum bands, and 23% expect 10% or less. Just 10% expect greater than 40%. In 2025, however, 37% predict that more than 40% of their small cells will use mmWave or C-band spectrum, and 15% anticipate that share of small cells to be more than 60%. Just 5% expect 10% or less of small cells will use mmWave or C-band by 2025.

Figure 11: What portion of your organization's small/pico cells will be deployed with mmWave spectrum and/or C-band spectrum in the following timeframes? (Global)



n=81
Source: Heavy Reading, 2021

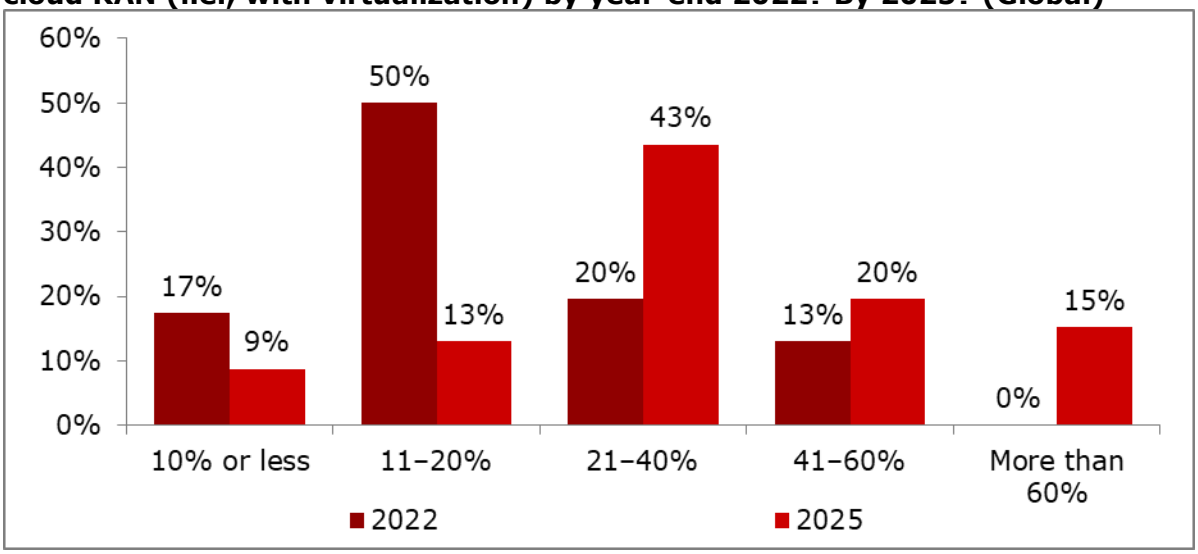
CLOUD RAN

As noted earlier, cloud RAN and C-RAN can be related, but they are not the same and can also be implemented independently of one another (e.g., a C-RAN with no virtualization or virtualization over a distributed RAN architecture). This section explores CSPs' plans specifically for cloud RAN.

Globally, there has been minimal adoption of cloud RAN to date, but CSPs have ambitious growth plans over the next five years based on survey results. Just over two-thirds of respondents (67%) expect 20% or less of 5G RAN sites to have virtualization by year-end 2022. However, more than three-quarters of those surveyed (78%) expect greater than 20% of 5G RAN sites will have virtualization by the end of 2025. At 43%, a plurality anticipates cloud RAN adoption will range from 21% to 40% of 5G RAN cell sites. **Figure 12** shows the results.

The expectations are ambitious, but readers should keep in mind that Heavy Reading surveyed only the portion of respondents that have cloud RAN plans (57% of the total survey group). Thus, 43% of CSPs surveyed expect no cloud RAN deployments through 2025.

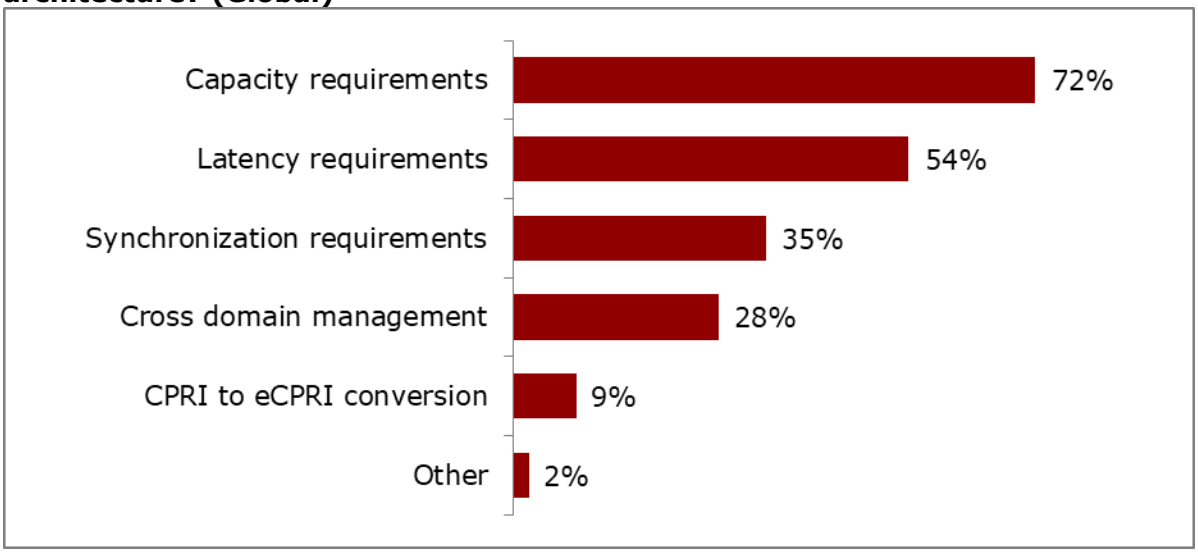
Figure 12: What percentage of your organization's 5G RAN sites will implement a cloud RAN (i.e., with virtualization) by year-end 2022? By 2025? (Global)



n=46
Source: Heavy Reading, 2021

Even for those with plans for RAN virtualization, transport challenges remain. According to the survey, capacity requirements are, by far, the biggest transport network challenge to cloud RAN (selected by 72%). Ranking second at 54% is latency, followed by synchronization in a distant third at 35% (see **Figure 13**).

Figure 13: What are the biggest transport challenges in adopting a cloud RAN architecture? (Global)



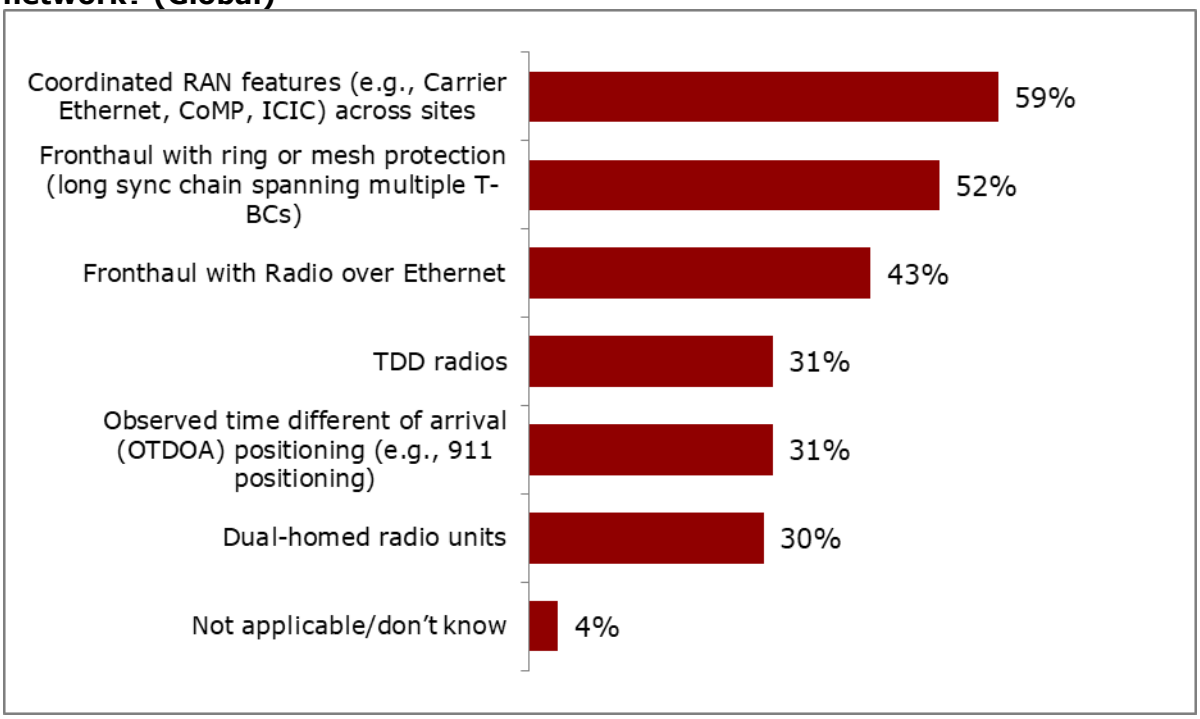
n=46
Source: Heavy Reading, 2021

TIMING AND SYNCHRONIZATION

Synchronization in mobile networks is not a new topic, as timing and synchronization have always been required in cellular communications. The move from 4G radio technologies to 5G introduces new challenges and requirements in delivering timing and synchronization, however. These include the migration from frequency division duplex (FDD) spectrum to time division duplex (TDD) spectrum, cell site densification, and others. This section explores timing and synchronization issues related to 5G.

Heavy Reading asked CSPs to identify network features requiring high phase/time synch accuracy that they intend to use in their network (**Figure 14**). Topping the list are performance-boosting coordinated RAN features (selected by 59%), followed by fronthaul with ring or mesh protection (selected by 52%). Following in third, but still significant, is fronthaul with RoE (at 43%). It is worth noting that CSPs may use all three of these features together, as radio coordination requirements are a driver for fronthaul architectures.

Figure 14: Which of the following network features, requiring highly accurate phase/time synchronization accuracy, does your organization plan to use in your network? (Global)

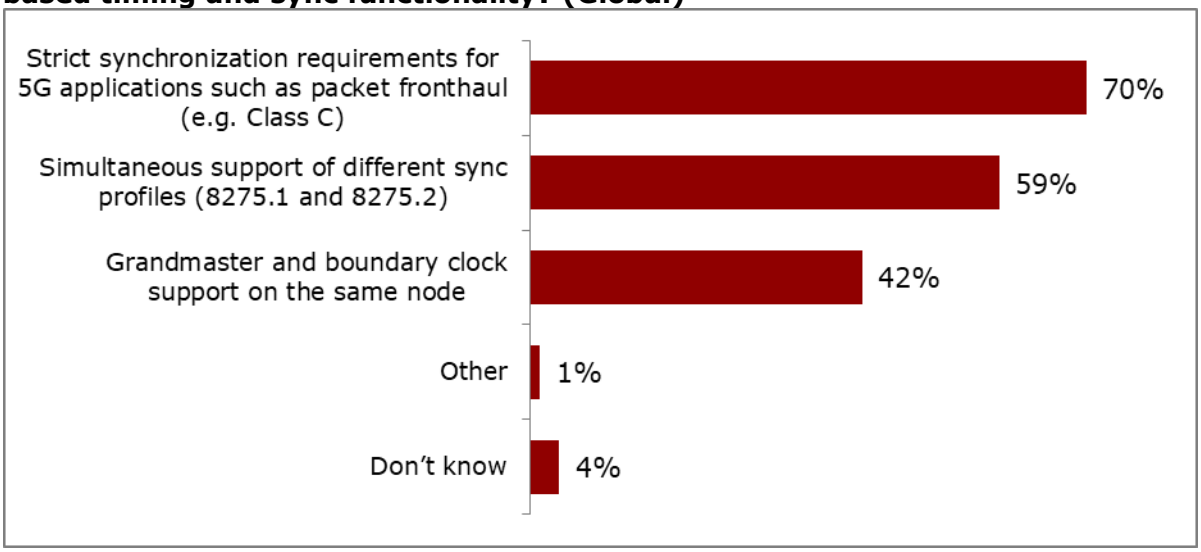


n=81

Source: Heavy Reading, 2021

Next, Heavy Reading asked respondents to identify the top challenges they foresee when deploying terrestrial (i.e., non-satellite) timing and synchronization. Topping the list of challenges by a large amount is strict synch requirements for 5G applications, including packet fronthaul. Ranking second, but still significant to a majority of respondents, is simultaneous support for different synchronization profiles (selected by 59% of the group) (see **Figure 15**).

Figure 15: What challenges do you foresee when deploying terrestrial network-based timing and sync functionality? (Global)



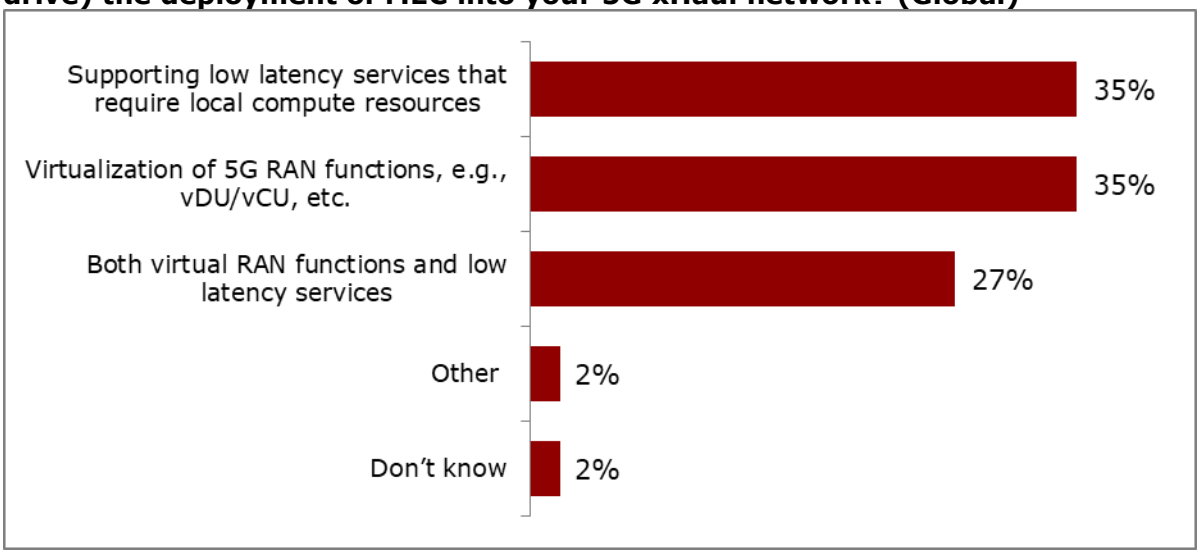
n=81
Source: Heavy Reading, 2021

EDGE

Developing an edge strategy is a crucial topic for CSPs today, as evidenced by the highest priority placed on edge/MEC earlier in **Figure 2**. In the survey, Heavy Reading sought to better understand the most significant application (or use case) that is driving edge deployments in 5G. Interestingly, supporting low latency services and virtualization of 5G RAN scored equally important as the primary driver (each selected by 35% of the survey group). **Figure 16** shows the results.

The two drivers are very different: low latency services are aimed at enterprise customers and revenue generation, but the virtualization of functions is a network-centric internal use case. For 27% of CSP respondents, both virtualization and low latency services are being eyed at the same time.

Figure 16: What is the most significant initial application that is driving (or will drive) the deployment of MEC into your 5G xHaul network? (Global)



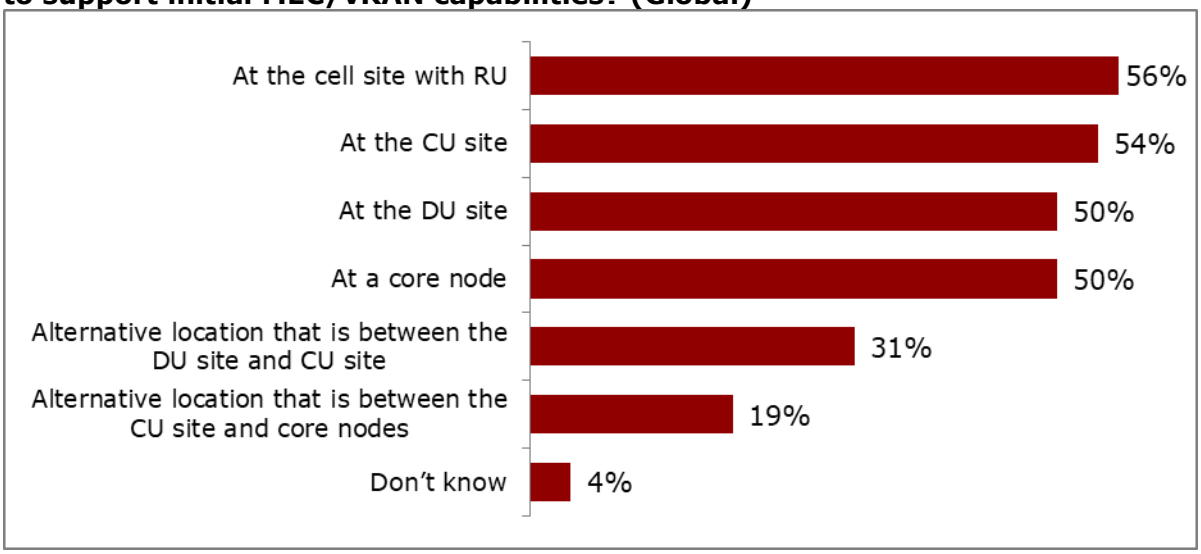
n=52
Source: Heavy Reading, 2021

The industry defines "edge" as a location—not a thing—but where the edge resides in a CSP network continues to be a matter of great discussion and debate. While Heavy Reading had hoped to pin down the location of the service provider edge, the survey results point to multiple important locations, including the cell site (selected by 56%), the CU site (54%), the DU site (50%), and the core node (50%). And while alternative locations individually registered lower than these top four choices, the alternative locations were selected by 50% of respondents in combination (**Figure 17**).

The high figure for RU is a bit of a surprise. It could be driven by respondents selecting this for some very specific RU locations such as sports stadiums rather than a general wide-scale rollout to RU sites across the network.

Thus, all service provider locations are currently in play for the edge at this very early stage of rollout. What cannot be known at this time is whether one (or more) of these promising locations might fall out of favor over time as CSP edge strategies become clearer.

Figure 17: Where do you plan to deploy MEC hardware in your 5G xHaul network to support initial MEC/vRAN capabilities? (Global)



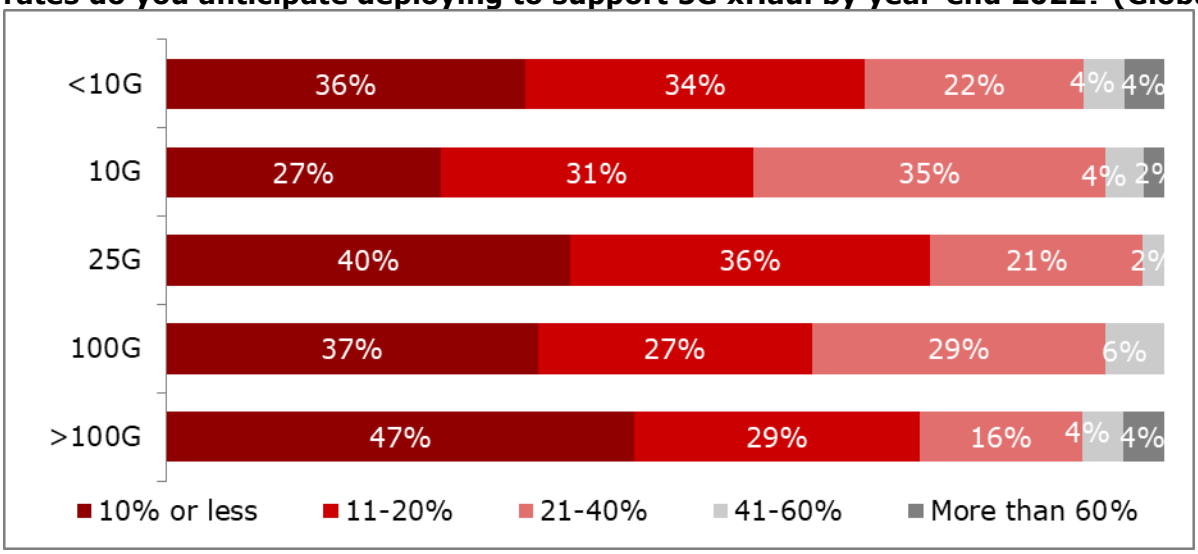
n=52
Source: Heavy Reading, 2021

Figure 18 and **Figure 19** track the migration of dense WDM (DWDM) access rates used in 5G xHaul between 2022 and 2025, respectively. The goal was to gain insights into how those 5G xHaul data rates rise and fall over that timeframe.

Looking at the near term (**Figure 18**), shares of any given data rate are relatively small in 2022, as reflected in the single-digit responses for high penetration rates—such as the 41–60% range and the more than 60% range. This is not surprising, as commercial 5G is recent and the majority of the data rates have been used in other applications (broadband, enterprise, or even 4G backhaul) for many years.

The one exception here is 25G, which is relatively new and has a strong early foothold, particularly in 5G fronthaul. About 60% of CSPs report that xHaul accounts for 11–40% of 25G DWDM interfaces currently.

Figure 18: Approximately, what percent of each of the following DWDM access rates do you anticipate deploying to support 5G xHaul by year-end 2022? (Global)



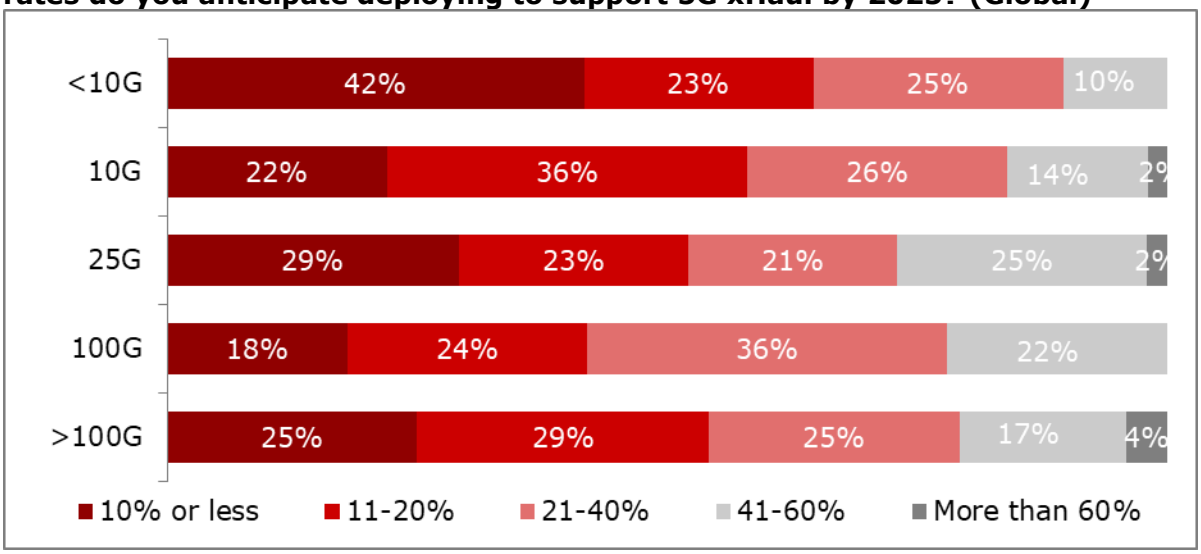
n=52
Source: Heavy Reading, 2021

Looking at the longer term (**Figure 19**), the key observations are in how xHaul increases as a share of nearly each of them—with the exception of <10G, where it mainly decreases. The increases are particularly strong in the following DWDM data rates when looking at the share of 41–60% and more than 60% in combination:

- **25G:** >41% xHaul share increases from 2% in 2022 to 27% in 2025
- **100G:** >41% xHaul share increases from 6% in 2022 to 22% in 2025
- **>100G:** >41% xHaul share increases from 8% in 2022 to 21% in 2025

The 10G data rate, meanwhile, moves from a position of strength in 2022 to a position of greater strength in 2025. Migration from 1G to 10G is a hallmark of early 5G deployments. Still, 16% of CSPs expect xHaul to account for >41% of 10G rates deployed in 2025.

Figure 19: Approximately, what percent of each of the following DWDM access rates do you anticipate deploying to support 5G xHaul by 2025? (Global)



n=52
Source: Heavy Reading, 2021

NETWORK SLICING AND SEGMENT ROUTING

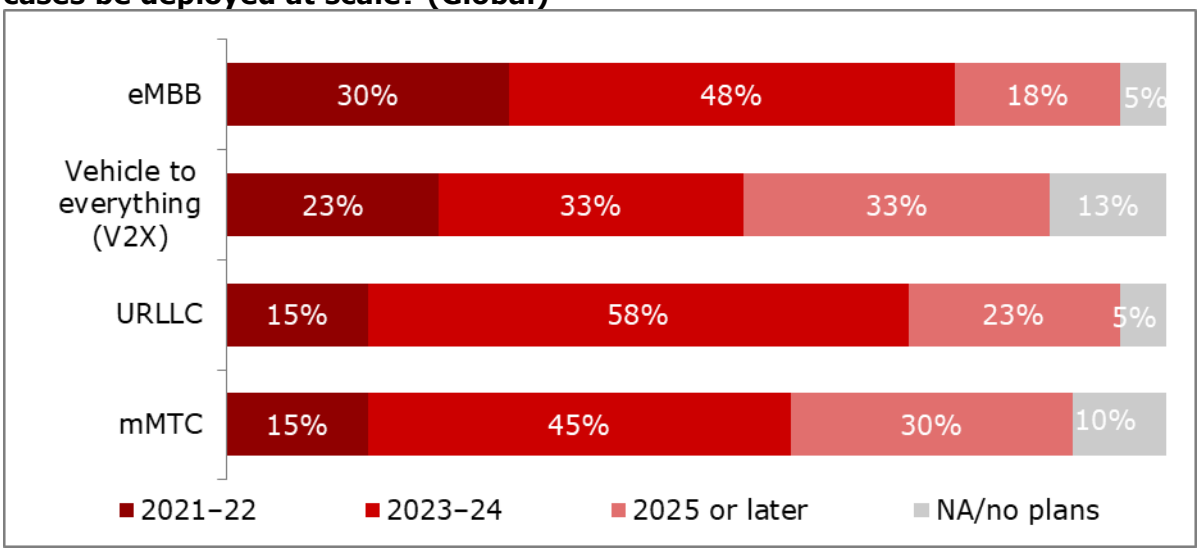
The final section of this survey report examines network slicing and the related topic of segment routing, which is an important routing technology for slicing in transport networks. Different requirements for different 5G use cases drive the need for network slicing (including transport slicing). Thus, understanding CSP plans for 5G use cases helps shed light on when they will need to adopt slicing.

In the near term, enhanced mobile broadband (eMBB) use cases will continue to drive CSP deployments. Nearly one-third of respondents (30%) expect to deploy eMBB at scale by the end of 2022, followed by vehicle to everything (V2X) at 23%. Both URLLC and mMTC use cases are expected to trail in adoption, with just 15% of respondents expecting wide-scale adoption of either use case by the end of 2022 (see **Figure 20**).

Looking out over the medium term (2023–24), eMBB is expected to continue to dominate, with 78% of respondents expecting to have reached wide-scale deployments by the end of that timeframe. But CSPs anticipate URLLC will also experience a significant adoption surge. By the end of 2024, 73% of CSPs surveyed expect significant deployments of URLLC.

Interestingly, after a relatively strong initial push, V2X adoption is expected to slow relative to other major use cases, according to the survey. It appears that while some CSPs hope to move quickly into V2X, the use case is not a key target for all service providers.

Figure 20: Within your organization, when will each of the following major 5G use cases be deployed at scale? (Global)

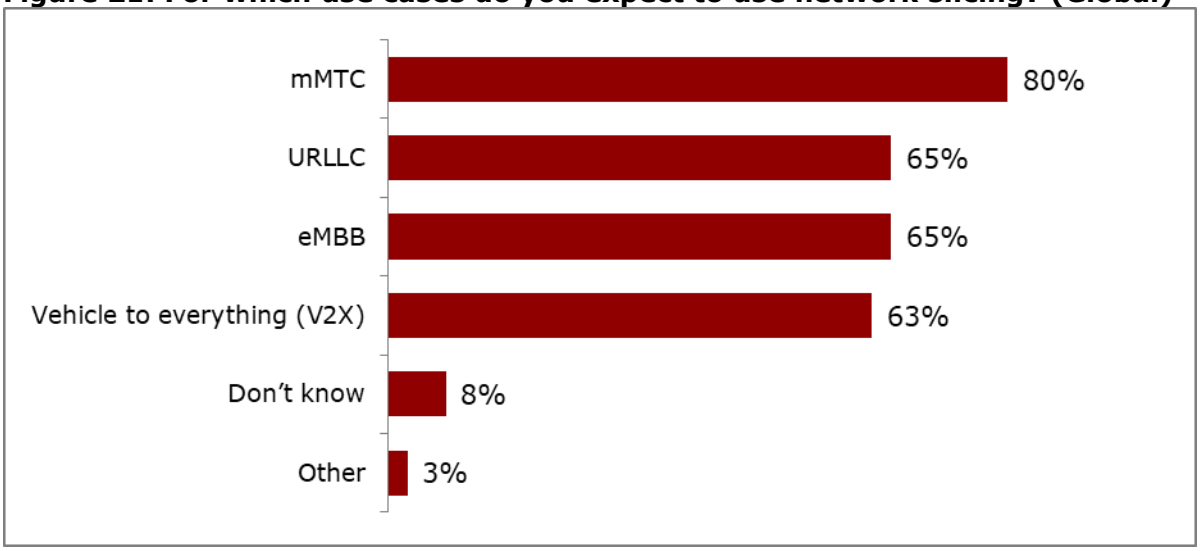


n=40
Source: Heavy Reading, 2021

Not surprisingly, network slicing is of interest across all major use cases, as slicing will be required to create the partitioned logical networks that meet the performance and service-level agreement (SLA) needs of each use case. A majority of respondents expect to use network slicing in any given 5G use case. However, mMTC stands out as a particularly important one for network slicing, as it was selected by 80% of respondents.

Shedding a bit of light on the low timeline priority of slicing initiatives (relative to other 5G initiatives listed in **Figure 2**), mMTC correlates most strongly with slicing but is also expected to reach scale later than other use cases (**Figure 21**).

Figure 21: For which use cases do you expect to use network slicing? (Global)



n=40
Source: Heavy Reading, 2021

There is significant industry discussion and debate on the benefits of software slicing techniques versus hard slicing techniques for 5G. **Figure 22** provides a high level overview of the characteristics of each.

Figure 22: Hard slicing vs. soft slicing characteristics

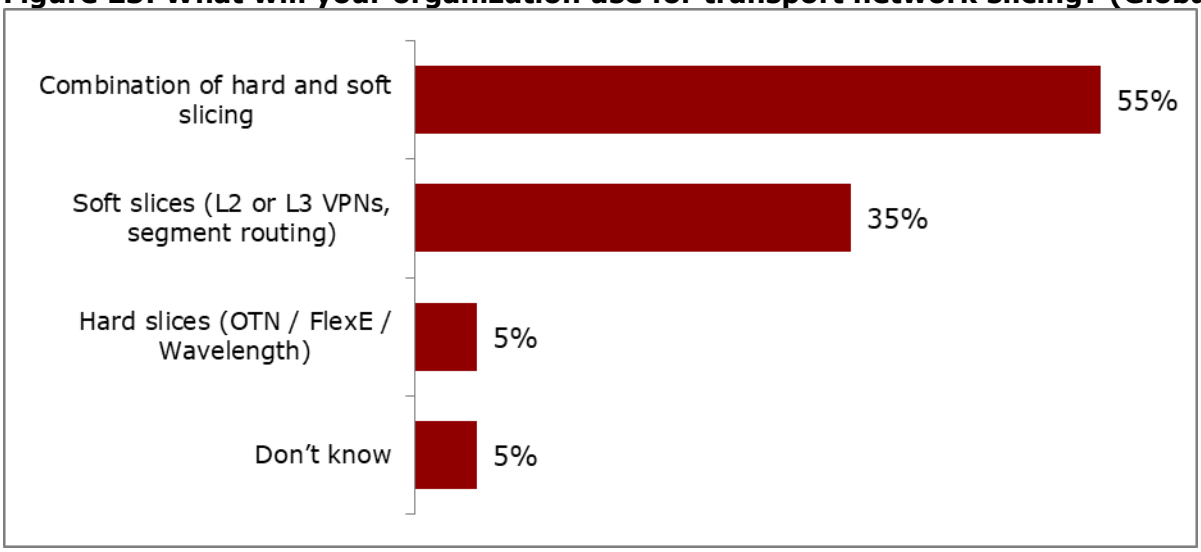
	Hard isolation			Soft isolation
	Connection Oriented			
	Wavelength	ODUk/ODUflex (OTN)	FLexE (MTN)	MPLS, Segment routing
Path	Hard wired	Virtual path pre-negotiated	Virtual path pre-negotiated	Virtual path pre-negotiated (label switched path)
Traffic isolation		Circuit isolation (on L1) (L2 VPN within containers)	Circuit isolation (on L1) (L2 VPN within timeslots)	Packet level isolation (L2/L3 VPN)
Exclusivity / Traffic isolation	No impact of other streams	No impact of other streams. Transparent mapping of client signals	No impact of other streams. Traffic limited to Ethernet clients	Potential impact of other streams. Mitigated vis QoS constructs
Bandwidth efficiency/ granularity	Less efficient for sub-lambda rates	Good. Ability to resize ODU links (1.5G -100G)	Good. Time slot resizing (5G increments)	Very good. Stat muxing

Source: Nokia, 2021

Survey data shows that both hard and soft transport slicing techniques will be used by a majority of CSPs—with the combination of hard and soft slicing selected by 55% of respondents. However, anecdotal evidence shows that soft slicing will be used predominantly to meet most slicing requirements, with hard slicing expected to be used in special cases (see **Figure 23**).

The survey data also supports this strengthening assessment. While 35% of respondents expect to implement soft slicing alone, just 5% of those surveyed expect to rely solely on hard slicing—a significant 7x difference in appeal.

Figure 23: What will your organization use for transport network slicing? (Global)



n=40
Source: Heavy Reading, 2021

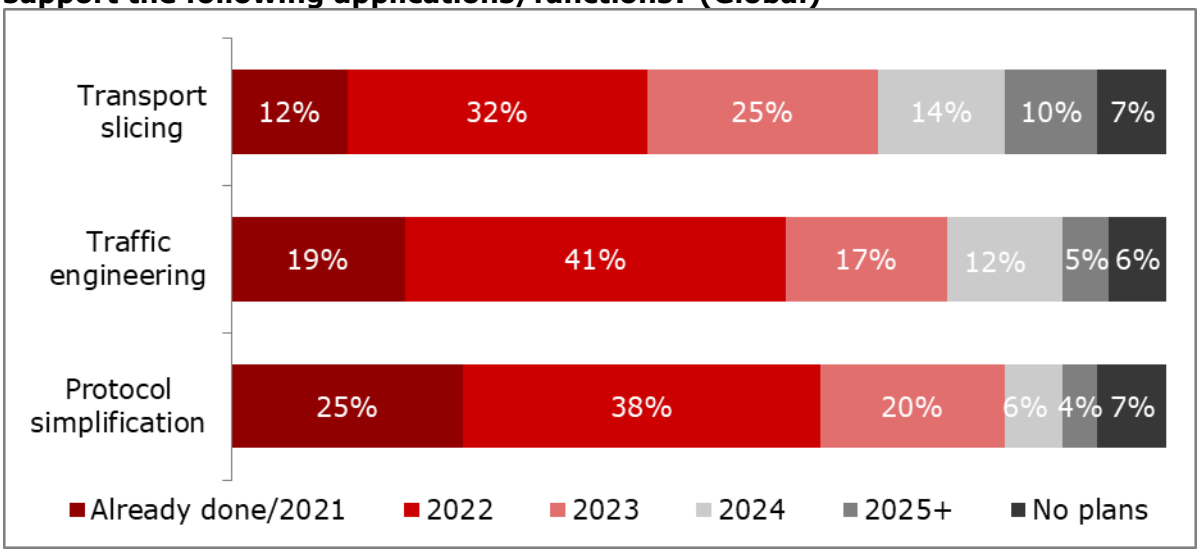
Lastly, the Heavy Reading survey looks at segment routing, an emerging routing technology that is closely associated with soft slicing. We asked the full survey group (i.e., all 81 qualified respondents) to identify expected timelines for segment routing in several applications, specifically, transport slicing, traffic engineering, and protocol simplification (see **Figure 24**).

Of the three, protocol simplification is the most advanced, with 25% of CSPs already implementing segment routing and an additional 38% expecting to use segment routing by the end of 2022—totaling 63% of the survey group by the end of this year. Traffic engineering follows, with 19% having implemented segment routing by the end of 2021 and an additional 41% expecting to use segment routing by the end of 2022—totaling 60% of CSP respondents by the end of this year.

Compared to these two applications, segment routing for transport slicing lags. Just 12% of respondents reported segment routing use by the end of 2021, though 32% expect to implement segment routing for slicing in 2022—totaling 44% of CSP respondents by the end of this year.

Given the other finding regarding network slicing, Heavy Reading suspects that the modest near-term expectations are not a knock on the merits of segment routing itself, but rather, a reflection of the scaled-back expectations of networking slicing in general for the near term. Clearly, segment routing is already showing live network promise in applications outside of 5G, and these trends will continue even as slicing emerges as an additional application for the technology.

Figure 24: When does your organization plan to introduce segment routing to support the following applications/functions? (Global)



n=81

Source: Heavy Reading, 2021