SURVEY REPORT

Operator Opinions and Strategies for 5G, AI/ML, O-RAN, Cloud, and Energy Usage

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Executive Summary

Mobile operators are in a new cycle of decision-making as they craft their network strategies for the next five years. The process is complex because an array of sophisticated technologies will be used to transform network performance and efficiencies, and operators must weigh the role each technology plays, and its likely impact on their businesses, before placing it on their technology roadmaps.

To gauge mobile operator opinions, priorities, and plans for key technology trends, GSMA's Mobile World Live surveyed executives from 119 global network operators. The questions we asked them about focused on five technology topics: 5G's standalone architecture (5G SA), artificial intelligence (AI) and machine learning (ML), the open radio access network (O-RAN), cloud computing, and tools for energy management and sustainability.

The results show that all these technologies are important to mobile operators and companies are investing strategically in them to take advantage of anticipated business and performance benefits. Depending on the technology, deployments are underway already or expected within the next 5 years. Slower deployment timelines are associated with concerns about technology maturity or perceived deployment difficulties.

Key Findings

A strong majority of operators say they plan to move to 5G SA: One-fourth (25%) of those surveyed say they will move to 100% 5G SA within 1 to 2 years and another 45% will make the move within 3 to 4 years. They want to use it for competitive advantage, network slicing, and to create opportunities with enterprises.

AI/ML has strong traction and potential for significant growth. 42% of operators say they are already using AI/ML functions in their networks. Another 49% are planning to use AI/ML once results and benefits are more established.

81% of operators are deploying, trialing, or evaluating O-RAN. More than half (57%) plan to deploy it within 2 years. They are bullish about RAN automation, with the vast majority (74%) planning to use this as part of their O-RAN architectures. They are evenly divided about unifying network management systems. The chief concerns about O-RAN include technology maturity and integration challenges.

Almost all respondents (98%) say they will use the cloud in their network strategies. The vast majority (80%) will use hybrid clouds that include both public and private cloud infrastructure.

Mobile operators are paying close attention to energy usage and feel good about their progress on this issue. Almost all (95%) are tracking energy consumption in their networks. Strong majorities say they are satisfied with their energy management capabilities and on track to meet their sustainability objectives, but they still want to do better.

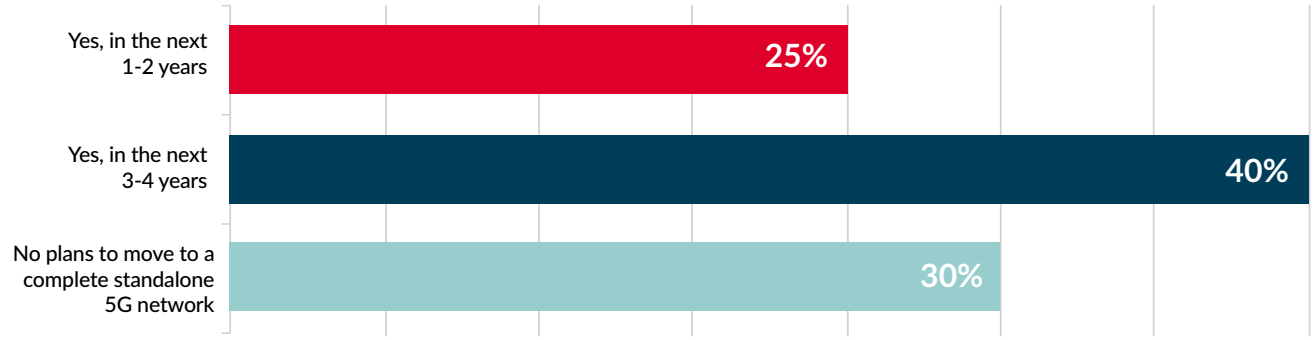
Methodology

We conducted the survey online in July 2022. We asked 19 questions distributed among the five topics: 5G, AI/ML, O-RAN, the cloud, and energy use/sustainability. The questions were crafted to measure operators' opinions, priorities, and plans for the technologies. Among the respondents, the majority (55%) represented operators with annual revenues of less than US$10 billion, with 45% representing operators reporting annual revenues of more than US$10 billion.

5G Deployment Plans and Key Performance Motivators

A strong majority of operators surveyed (63%) have deployed a public 5G network. Their motivations for deploying 5G vary but emphasize opportunities to create new revenues, increase data speeds, and increase data capacity. Most respondents have strategies for migrating to 5G SA: 25% say they will have an all-SA network within 1 to 2 years and another 45% will achieve all-SA within 3 to 4 years. Their No. 1 reason for migrating to 5G SA is to gain competitive advantage.

Does your organization plan to move to a 100% standalone 5G network?

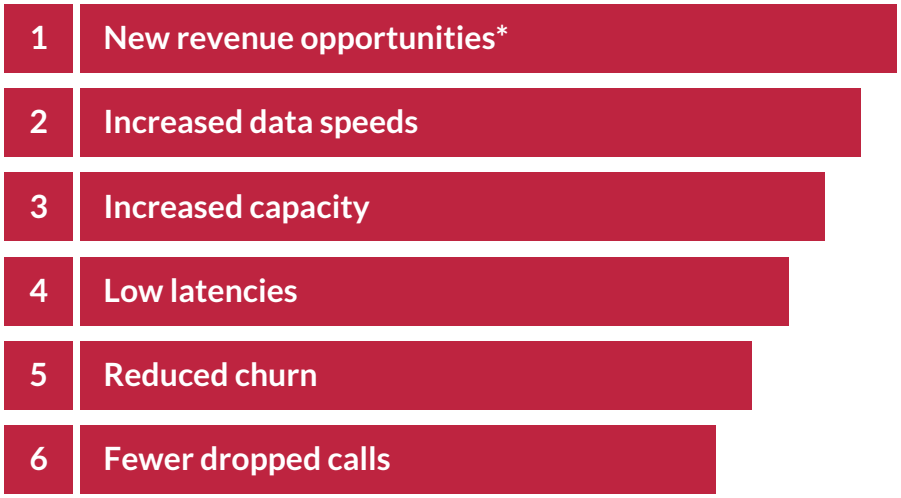


5G is well established in commercial networks: nearly two-thirds of operator respondents (63%) say they have deployed a public 5G network.

To understand the business performance motivations for offering 5G, we asked the respondents to rank a selection of KPIs in order of importance. The opportunity to create revenues through new use cases and applications achieved the top ranking, with 28% of the responses (see see Figure 1 on page 5). While this KPI came in first place, opinions were mixed: another 20% ranked it lowest in importance.

Following the new revenues opportunity, increased data speeds came in second place, with 28% of responses at this ranking, and increased capacity placed third, with 33% of responses at this rank. Operators gave lower rankings, in order, to low latencies, reduced customer churn, and reducing the number of dropped calls customers experience. Reduced churn was notable for a preponderance of lower rankings, with 60% of respondents ranking it outside their top three. Reducing the number of dropped calls was also a low priority overall, with 50% of respondents ranking it fifth or sixth in importance.

Figure 1. Respondent rankings of KPIs driving their 5G deployments



**Despite earning the top rank with 28% of responses, another 20% of respondents ranked new revenue opportunities in last place*

Figure 2. Respondent rankings of the most compelling reasons for migrating to 5G SA

**Despite its top rank with 43%, another 35% ranked this in last place. Another option, edge computing, did not place*

Figure 3. Respondent rankings for migrating to 5G SA based on aggregation of top two scores for network slicing and competitive advantage

5G came to market with the so-called 5G non-standalone (5G NSA) architecture that uses the 5G RAN in conjunction with the 4G evolved packet core. It is now rolling out as 5G standalone (5G SA) deployments that feature a 5G core built with a cloud-native, service-based architecture like that used by webscale companies.

The transition to 5G SA is picking up steam. Today, nearly half (49%) of operator respondents say they are using both 5G SA and 5G non-standalone (5G NSA) architectures for their 5G infrastructure. One-third (33) are using 5G NSA only and nearly one-fifth (19%) are using 5G SA only.

As highlighted in the bar chart on page 4, a strong majority of operators (70%) say they have plans in place to move to 100% 5G SA networks: one fourth (25%) say they will move to all-SA within 1 to 2 years; and another 45% expect to have an all-SA deployment in 3 to 4 years. The remaining (30%) have no plans for a 100% 5G SA network.

To understand their business reasons for migrating to 5G SA, we asked the respondents to rank a selection of reasons in order of importance. The opportunity to gain competitive advantage received top ranking (43%), followed by network slicing (30%) and the enterprise opportunity (30%), which tied for second place. Although competitive advantage came in first, another 35% ranked it in fourth (and last) place, revealing mixed opinions about this as a motivator.

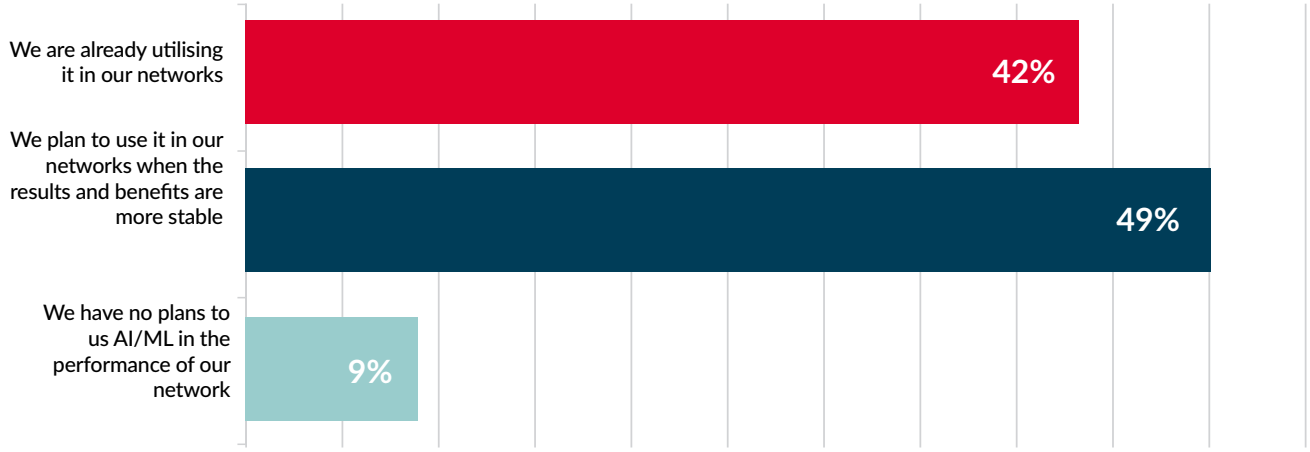
While enterprise opportunity tied for second place, it also came in third with 41% of responses. Edge computing did not earn a ranking at any level, and in fact 65% of its respondents selected third or fourth place. (See Figure 2.)

A deeper look at the responses for network slicing and competitive advantage adds perspective on these two motivators (see Figure 3). Network slicing, for example, did not receive top ranking but 70% of respondents placed it in the top two positions. Competitive advantage, by comparison, received a lower percentage (59%) of responses when its top two scores were combined.

Positive (but nuanced) opinions about AI/ML

The vast majority of operator respondents (91%) are already using or planning to use AI/ML functions in their networks. Respondents expect the technologies will deliver the most benefits when applied to the RAN, OSS/BSS and core compared to other network systems, but these opinions are nuanced.

How do you feel about the use of artificial intelligence (AI)/machine learning (ML) functions in your network?



AI and ML are used throughout a network to analyze and predict network conditions and automate services in real time to optimize performance and efficiencies, and achieve demanding use cases for customers. AI/ML can be applied from the RAN to the core to operations and management systems, and it has a role maximizing network energy efficiency to help operators reduce carbon emissions. These roles will take on added importance and capabilities in the next few years as the industry evolves to 5G Advanced (3GPP Release 18), which makes greater use of AI/ML to more fully automate the network, improve performance, and optimize energy savings.

AI/ML is well established in mobile networks today. As the bar chart above illustrates, 42% of operator respondents say their companies are already using AI/ML functions in their networks and 49% say they are planning to use it when the technology's results and benefits are more established. Just 9% have no plans to use it.

Respondents had nuanced opinions when asked to rank in importance the benefits AI/ML offers their organizations for various use cases: the RAN, O-RAN, network core, network edge, and OSS/BSS (see Figure 4).

OSS/BSS and the RAN tied for first place (each with 26%), followed by the network core (32%). While OSS/BSS and RAN had equal rank, their support was not equivalent. For example, respondents placed most of their RAN scores (68%) in the top three rankings.

Figure 4. Respondent rankings of AI/ML benefits

1	RAN and OSS/BSS (tied)*
2	Network core
3	O-RAN
4	OSS/BSS

**Despite sharing the top rank, OSS/BSS also outperformed the other options for last place. A fifth technology evaluated by respondents, the network edge, did not place.*

Figure 5. Respondent rankings of AI/ML benefits based on aggregation of top 3 scores for Core vs RAN

1	Core
2	RAN

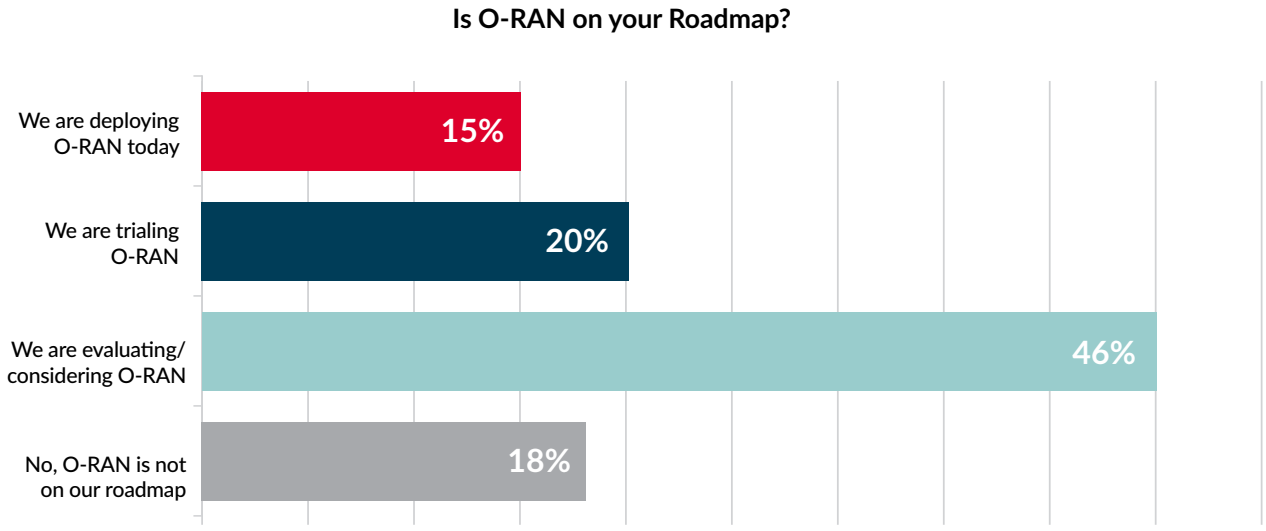
Respondents had widely varying opinions about OSS/BSS, offsetting its support: in fact, the OSS/BSS option received a higher percentage of responses (35%) at the lowest ranking, fifth place, compared to the 26% of responses ranking it in first place.

While the network core did not receive top ranking, it received a greater percentage of scores in the top three (82%) compared to RAN and all other options (see Figure 5). Both RAN and the core scored 9% for lowest (fifth) place: the equally low opinions can't be used to distinguish one from the other.

O-RAN and the network edge did not receive meaningful support. The best ranking O-RAN received was fourth place, and the network edge did not place.

O-RAN Roadmaps, Timeframes, and Implementation Strategies

A strong majority of surveyed operators (81%) say they have O-RAN on their network technology roadmaps. More than half (57%) expect to deploy it within the next two years. Implementation strategies vary. The majority (74%) plan to use a RAN automation platform as part of their O-RAN architectures. Nearly half (47%) plan to unify network management systems, but an equal percentage are unsure. Overall, respondents expressed concerns about O-RAN technology maturity and integration challenges, among others.



Mobile operators are adding O-RAN to their network strategies. As the bar chart above illustrates, a strong majority of respondents (81%) say O-RAN is on their technology roadmaps. Of these respondents, 15% say they are deploying it today, 20% are conducting trials, and 46% are evaluating or considering it.

As would be expected with varying strategies, deployment timeframes also vary: 23% say they will deploy O-RAN within the next year, 34% will deploy it within 2 years, 29% will deploy it within 5 years, and 14% will not deploy for 5 or more years (see Figure 6).

Figure 6. Respondents' planned timeframes for deploying O-RAN

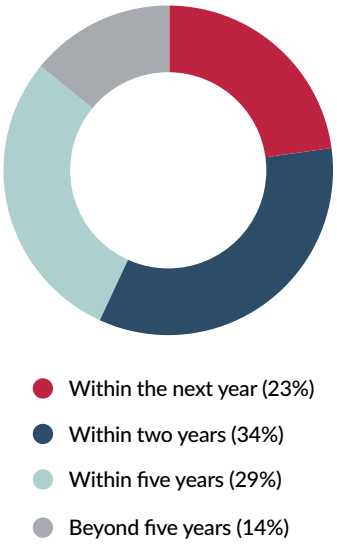
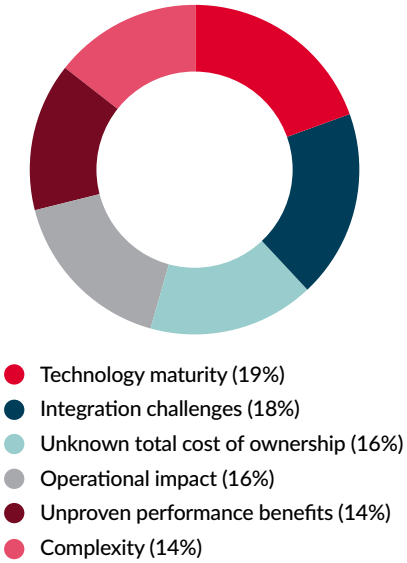
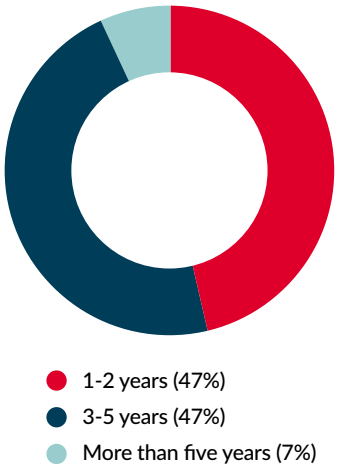


Figure 7. Respondents' concerns about deploying O-RAN (multiple answers allowed)



The commitments to O-RAN are meaningful, as fewer than 40 countries had operators that had commercially deployed or were trialing O-RAN solutions in their networks as of April 2022, according to another study by GSMA Intelligence research.[1] The technology decouples RAN hardware from software and makes it possible for operators to deploy the RAN as containerized microservices that simplify scaling, automation, and management. The approach also frees operators to select best-of-breed solutions from different vendors to get away from vendor lock-in. The ability to use commercial off-the-shelf servers can also reduce costs.

Figure 8. Respondents' planned timelines for NMS unification



Operators do have concerns about O-RAN, whether their companies are pursuing it or not. We gave the full sample an opportunity to select multiple options from a list of six suggested concerns (see Figure 7). Responses were fairly even, with each concern selected by 14 to 19% of respondents, as follows: technology maturity (19%), integration challenges (18%), unknown total cost of ownership (16%), operational impact (16%), unproven performance benefits (14%) and complexity (14%).

Results and experiences among operators that have O-RAN deployments, including NTT Docomo and Rakuten Mobile in Japan, Dish Network in the U.S., and Vodafone UK, should help clarify these issues, along with community education, solution testing, vendor certification, and other activities hosted by the Telecom Infrastructure Project and O-RAN Alliance.

We asked respondents about their plans to use RAN automation and network management system (NMS) solutions to simplify and manage their O-RAN architectures.

RAN automation has strong support: 16% of respondents say they are already using a RAN automation platform in their O-RAN architectures, and 58% say they plan to use it when its results and benefits are more established. The others (26%) have no plans for this.

On the topic of Network Management System (NMS), we asked respondents if they plan to use a single management system, such as a Service Management and Orchestration (SMO) platform or the Open Network Automation Platform (ONAP), to unify NMS layer functions for self-organizing networks (SON), OSS, orchestration, and the element management system (EMS).

Nearly half (47%) of the respondents say they plan to unify the NMS. Among these respondents, 84% say it is part of their O-RAN strategies. The respondents were split equally on two timelines for deployment, with 47% considering unification in 1 to 2 years, and another 47% considering unification in 3 to 5 years. A small percentage (7%) expects it to take more than 5 years (see Figure 8).

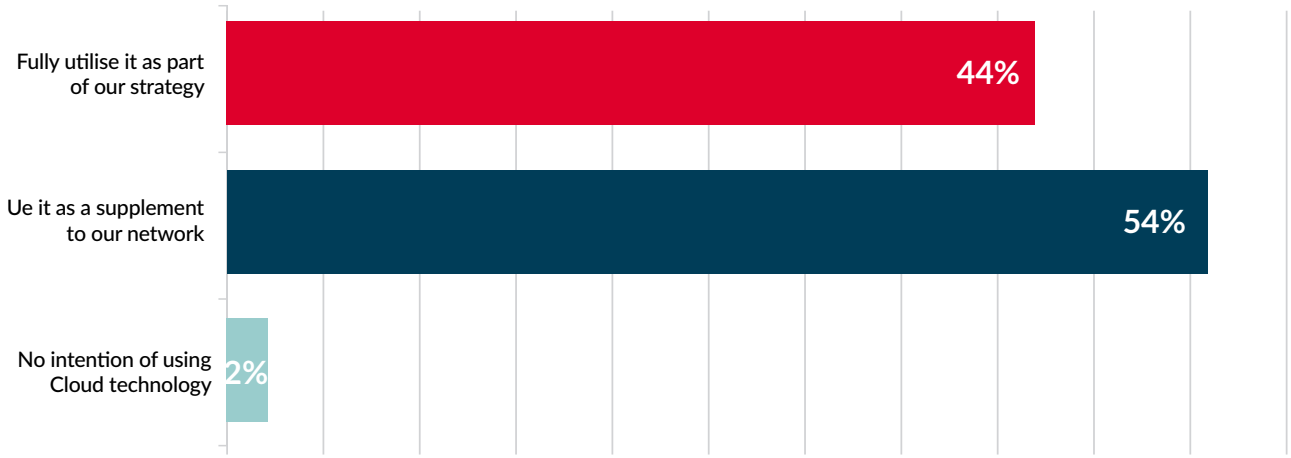
While 47% of operators plan to unify the NMS, 5% say they have no plans for this and another 47% said they are unsure.

[1] *"Open RAN: De-risking Deployments via Unified Radio Offerings," an Insight Spotlight published by GSMA Intelligence, April 2022.*

Hybrid Approach to the Cloud

Nearly all respondents (98%) expect their companies to use cloud technologies in their network strategies, either fully or partially. Hybrid clouds will predominate over public-only and private-only options.

What is your expected use of cloud technology in your network strategy?



Almost all respondents in the full sample (including those that have deployed 5G and those that have not) expect their companies to include cloud technologies in their network strategies. As the bar chart above illustrates, a slight majority (54%) say they will use the cloud as a supplement to their network, and 44% say their companies will fully use it as part of their network strategies. Just 2% say their companies have no intention of using the cloud.

The responses indicate operators want flexibility to move selected network functions, management systems, or services to the cloud to make their networks more efficient, lower costs, or improve customer services. Verizon's 5G Edge service, just one example of a supplementary approach, places clouds from AWS and Microsoft at the edge of its network to minimize latency. Dish Network is using its greenfield cloud-native 5G SA network, built on AWS, to optimize automation and network slicing. Legacy operator and early cloud advocate AT&T, which had virtualized 75% of its network functions by end-2020, has shifted its 5G core network to Microsoft and migrated to cloud-native functions as part of its strategy for its 5G SA mobility core[2].

Survey respondents were queried about their preference for public clouds, private clouds, or hybrids of the two. The vast majority (80%) said their organizations will use hybrid clouds. Less than one-fifth (18%) will use private clouds only, and 2% will use public clouds only.

[2] *"Blog: Microsoft Fuels AT&T Cloud-Native Ambitions," by Mike Robuck, Mobile World Live, April 20, 2022.*

Sustainability in Focus

Almost all operators surveyed (95%) are tracking energy consumption, in either all or parts of their networks. The vast majority (85%) are satisfied with their capabilities to manage network energy usage and costs, but most of these respondents want to do better. A strong majority (68%) say their companies are on track to meet their sustainability objectives.

Are you satisfied with the capabilities you have to manage network energy consumption and costs?

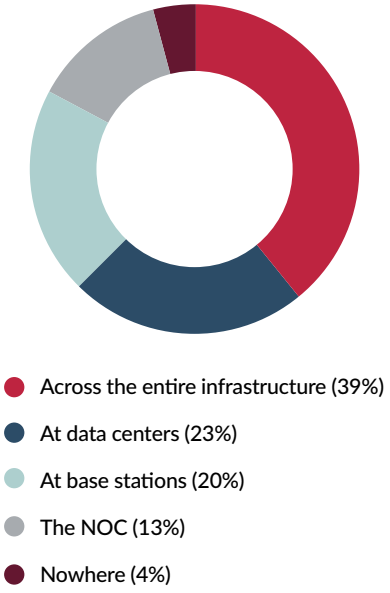
Mobile operators must manage network energy consumption so they can continue to deliver more services to more people and devices while meeting their targets for net-zero carbon emissions. They also need to reduce energy costs, especially in today's volatile energy markets.

We asked respondents where in their networks their companies are tracking energy consumption. Respondents could select multiple options. The options, and the percentage of selections, included the following: tracking energy consumption across their entire network infrastructure (39%); tracking energy consumption at data centers (23%), base stations (20%), and the NOC (13%). A small percentage (4%) said their companies are not tracking energy consumption anywhere in the network (see Figure 9).

Asked if they are satisfied with the capabilities they have in place today to manage network energy consumption and costs, 74% said yes, they are satisfied but they could do better; 11% said they are fully satisfied, and 10% said they are not satisfied.

The respondents had positive outlooks on sustainability, but many of them need to know more. A strong majority (68%) say they are confident that their organizations are on track to meet their sustainability objectives; 10% say their organizations are not on track to sustainability; and a meaningful percentage (22%) said they do not know the status of this strategy for their companies.

Figure 9. Where in the network operators are tracking energy consumption (multiple answers allowed)



The responses reinforce recent findings from GSMA Intelligence research that the industry has made progress toward sustainability. In its Mobile Net Zero: State of the Industry on Climate Action 2022 report, GSMA Intelligence noted mobile data traffic was up 31% in 2021 compared to the previous year, and electricity was up 5%. Environmental impacts grew at 2%, a much slower pace.[3] While emissions were up globally, a number of operators, including AT&T, Verizon, Telenor and KDDI effectively reduced their emissions during this period by transmitting data much more efficiently and using more renewable electricity.

The industry continues offering new technologies to save network energy consumption. Software scheduling tools used with AI, for example, can analyze network traffic and other conditions to turn off equipment that is not in use, or schedule shutdowns to avoid operation when it is not needed. This is especially valuable in the RAN, where nearly three-fourths (73%) of network energy consumption takes place.[4] As previously mentioned, 5G Advanced will offer more AI/ML capabilities to further help operators evolve to green networks.

[3] *"Mobile Net Zero: State of the Industry on Climate Action 2022," GSMA and GSMA Intelligence, 2022, pages 4, 5, 20, and 26.*
[4] *Ibid, p. 25.*

Conclusion: operators are pursuing new network technologies strategically (and carefully)

It is not a stretch to say that the most important strategic decisions for mobile operators involve selecting technologies to add to their networks, determining how to use the technologies to best serve their customers and their businesses, and when to deploy them.

This Mobile World Live survey shows that operators today are investing in multiple new and transformative technologies, from 5G SA to AI/ML, O-RAN, and cloud computing, among others that facilitate energy conservation and sustainability. Most operators have placed the technologies on their roadmaps, with early adopters using technologies now and others planning deployments in the next 1 to 5 years.

The cloud has the strongest support, with 98% of operator respondents saying their companies will include it in their network strategies; the vast majority will use hybrid clouds. Managing energy usage also drew strong, positive opinions, with 96% of operators indicating their companies are tracking this in all or part of their networks; these respondents are also satisfied with their energy management efforts and on track to meet their sustainability objectives, but they want to do better.

5G SA has firm support, with 70% of current 5G operators planning to move to 100% 5G SA networks in timeframes that fall within 1 to 2 years or 3 to 4 years. Operators will use the new architecture to gain competitive advantage, facilitate network slicing, and create opportunities with enterprises.

AI/ML has widespread support, traction in the market, and potential for strong growth. Its foothold has been established by 42% of operators that are using it already. Another 49% are planning to, but they are waiting until the technology's benefits are more established.

Operators are positive about O-RAN, with some qualifications. Overall, 82% of operators are deploying, trialing, or evaluating the technology. Their plans for specific O-RAN use cases vary. The vast majority say they will use O-RAN to automate the RAN. Nearly half say they will use O-RAN for NMS unification, but this opinion is offset by an equivalent number of respondents saying they are unsure about it. Overall, respondents have concerns about O-RAN technology maturity, integration challenges, and other issues.

In summary, operators are moving ahead with new technologies, but carefully. As the technologies gain maturity and market experience generates positive results and benefits, operators will gain the confidence they need to get started. Industry groups and vendors would do well to address this need for data and insights through continued research, communications, and outreach to the operator community.

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