Independent market research and competitive analysis of next-generation business and technology solutions for service providers and vendors

HEAVY READING
WHITE PAPER

Heavy Reading's 2021 Open RAN Operator Survey

A Heavy Reading white paper produced for Analog Devices, Cisco, Ericsson, and Qualcomm

AUTHOR: GABRIEL BROWN, PRINCIPAL ANALYST, HEAVY READING

INTRODUCTION AND KEY FINDINGS

This report presents the results of the **2021 Heavy Reading *Open RAN Operator Survey*** conducted in the summer of 2021. This is the third report in a series and follows surveys conducted in the fall of 2018 and summer of 2020. The survey was open to employees of communications service providers (CSPs) only.

At the start of the survey, respondents were presented with the following definition:

"Open RAN" refers to the ability to integrate, deploy, and operate radio access networks using components, subsystems, and software sourced from multiple suppliers.

Key findings: Steady but real progress in open RAN

The outlook for open RAN is positive with real signs of momentum; however, the survey suggests steady, rather than spectacular, progress. Just over half (54%) of survey respondents say their company has not changed the pace of its planned open RAN deployments in the past year. There has been movement in the other half, split between those accelerating their plans (20%) and those slowing down (27%). Despite this volatility in just under half the survey base, it cancels the other half out and, overall, operators as a group are working at a steady, measured pace. This is a positive sign at this stage of technology and market development because it recognizes that open RAN is a major change in RAN architecture and is a long-term, multi-year exercise.

Close to a fifth (22%) of respondents say their company already operates a live, commercial open RAN; however, this means that a large majority (78%) have not yet deployed commercially. This is an important reality check to runaway claims of open RAN success. For open RAN to achieve mainstream adoption, the survey indicates that the next two to three years will be critical. A solid 23% of respondents expect their company to go live in the next 12 months and a further 37% in 12–24 months. These results suggest widespread deployment of open RAN by the end of 2023. However, while this is a solid indicator of sentiment, the timing may be less reliable, given that survey respondents are often over-optimistic on the timelines for the commercial introduction of new technologies. Moreover, these deployment dates do not indicate much about the size of individual operator rollouts; going "live" could mean a city or rural region has been deployed or simply a few cell sites.

Open RAN capex expectations give a better indication of how fast open RAN might scale. The survey shows that, by 2025, a majority of respondents expect that more than 10%, but less than 20% of their RAN capex will be dedicated to open RAN. This, again, is an important reality check on the hype around open RAN but nevertheless represents a positive move toward this technology. To put this in context, 20% of RAN capex allocated to open RAN by 2025 is ahead of industry analyst forecasts; for example, Omdia estimates that 10% of the $34bn RAN equipment spending in 2025 will be on open RAN. Operator respondents in this survey are, therefore, more optimistic.

There is no single standout open RAN deployment scenario. Operators have, on average, 3.6 use cases in mind for the technology, led by urban small cells (62%), private enterprise networks (57%), and venues and other gathering spots (57%). A positive way to interpret this finding is that open RAN is being pursued across a broad base of mobile communications scenarios and that once these models solidify and become

"product ready," the market will then see widespread adoption and, perhaps over time, open RAN could become the predominant mode of operation. A less positive analysis, but nevertheless worth considering, is that open RAN is a technology still in search of a solution in the sense that the industry has committed to open RAN and now needs to find ways to make it work. It is worth noting that the same three use cases also led Heavy Reading's 2018 survey; this reinforces the key message from 2021 that open RAN progress is steady and consistent.

Tier 1 operators are significantly more likely to pursue open RAN for private enterprise networks than smaller operators. Among the respondents working for operators with >$5bn in annual revenue, 73% intend to address this market within three years versus 43% of operators with <$5bn in revenue. Heavy Reading's preferred explanation for this is that these larger operators are typically more focused on enterprise services, in general, so a move into private networks is a logical follow-through from their interest in open RAN. Another explanation might be that these operators are more risk-averse and see private networks as a way to introduce open RAN technology without risking the subscriber experience on the wide area public network.

"Systems integrators [SIs] partnered with an O-RAN vendor" will lead open RAN integration projects. With a score of 54%, this is more than double any other option presented in the questionnaire. The lead vendor could be a distributed unit (DU)/centralized unit (CU) supplier, an open remote unit (O-RU) supplier, or, perhaps at a stretch, a server or cloud software vendor. This analysis implies that pure-play specialist SIs targeting open RAN will be drafted as partners in support of a lead RAN technology vendor.

A quarter of respondents say that open RAN will be "deployable and competitive" for high capacity 5G sites in the next 12 months. This finding is fairly positive. However, the majority think there will be feature and/or performance compromises. Overall, these results are in accord with a view that open RAN is now suitable and competitive for lower bandwidth 2x2 and 4x4 multiple input, multiple output (MIMO) LTE systems, but that further development is needed for high capacity 5G applications. This is particularly the case for mid-band massive MIMO and millimeter wave (mmWave) systems, as well as for features such as advanced beamforming, dynamic spectrum sharing (DSS), and new radio (NR) carrier aggregation. Clearly, more work is needed to address high end RAN scenarios.

Only 16% of operator respondents expect O-RUs to be "significantly less expensive" than single-vendor radio products, and a sizable 35% expect pricing to be "about the same." The key section of the response is the 46% that expects that "O-RU equipment will be a bit less expensive." This suggests that operators want and expect savings but have a realistic view of what is achievable on the cost side of the open RAN equipment equation. Note that the response is not uniform across the survey base. A large 62% of respondents in R&D and technical strategy roles expect lower pricing for O-RUs without an equivalent decrease in performance or features, versus just 23% in network operations, planning, and engineering roles.

For open RAN to succeed, it is vital for the industry to work collaboratively to address security challenges. Half of the respondents (49%) believe open RAN will be harder to secure than equivalent vendor-integrated solutions versus the 23% that say open RAN "will be more secure due to greater visibility and the ability to harden each layer" and the 22% that say, "open RAN security will be equivalent to integrated RAN." The primary

analysis, therefore, is that open RAN security is viewed as challenging today. However, given that a combined 45% think open systems can become as secure, or more secure, than single-vendor systems, the analysis also indicates that many in the industry believe a way forward can be found on security.

For private enterprise networks, operators have a slight preference for pre-integrated small cells versus novel RAN split architectures. Asked to identify preferred RAN split option for private networks, the most popular is a combined CU+DU+RU for both sub-6GHz (59%) and mmWave (39%). This is probably the simplest deployment from the point of view of the enterprise and reflects the current LTE private network market and vendor ecosystem. In this type of scenario, to make this "open RAN" would require open E2 and/or O1 interfaces to a third-party service management and orchestration (SMO) system. Or perhaps an integrated RAN system for private networks could be created from open RAN subsystems and components provided by different vendors. Telco operators or SIs are examples of organizations that could create such an integrated solution.

Virtualized private 5G network solutions are important because they enable better integration with edge cloud infrastructure. A large 40% expect "both the CU and DU to be virtualized" in a private network, ahead of 31% that expect "only the CU [to be] virtualized." Overall, a combined 60% do not expect to virtualize the DU in private 5G open RAN networks in the near term. The difference between virtual CU and virtual DU is significant. In simple terms, a hardware DU (i.e., based on a system-on-chip [SoC]) offers higher performance but less flexibility; only virtualizing the CU is simpler but reduces the potential gains from edge-cloud integration. Note that this is a fast-evolving area of technology and that there are many performance enhancements to edge-cloud infrastructure and open RAN silicon in development that may change the picture over the next year or two.

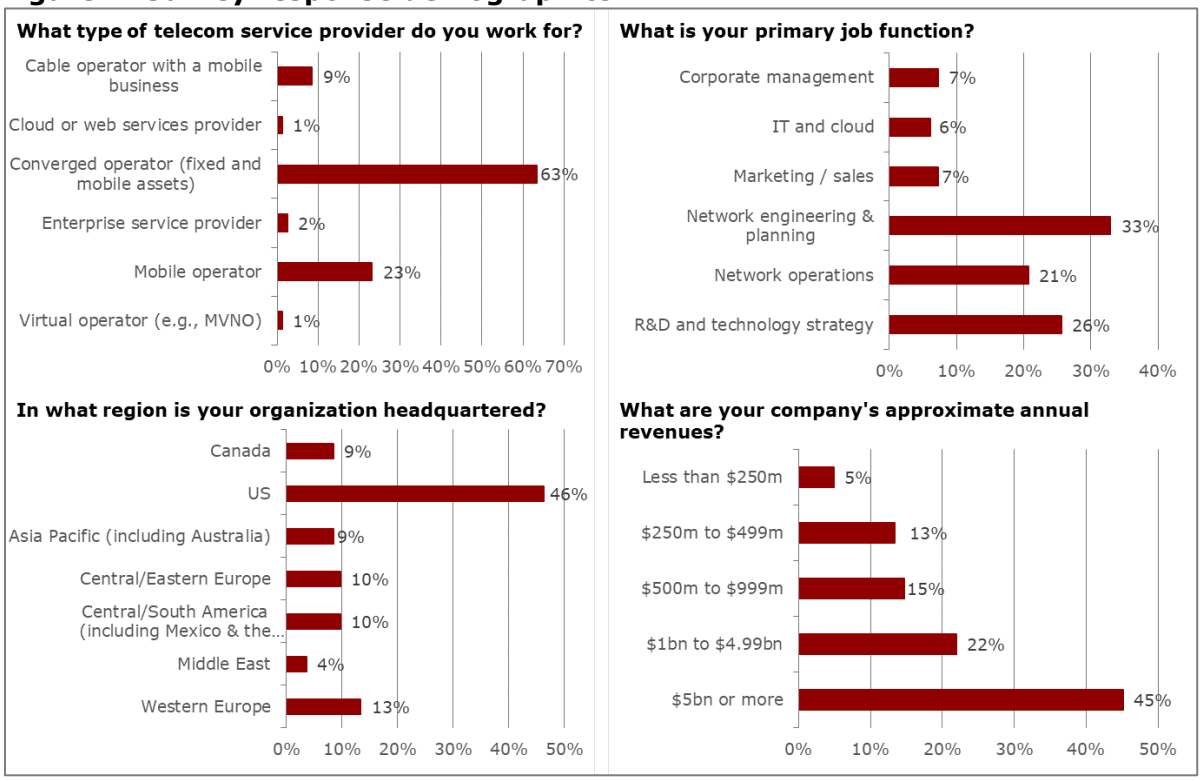
A new area of interest for public mobile network operators is the potential to host parts of their RAN in hyper-scale public cloud environments. The survey shows there is interest in this model, but that only a minority (15%) are currently "very comfortable" with the idea and plan to use it. A much greater percentage are "comfortable" (43%) but do not yet have plans for deployment, while 33% are "neutral – need to learn more." Very few respondents are categorically against the idea. Even though the "very comfortable" percentage is small, these results indicate that there is sufficient interest to look more closely at the public cloud for RAN models in future research.

Background to this study

The questionnaire used in this study was written by Heavy Reading, with input from Analog Devices, Cisco, Ericsson, and Qualcomm, as sponsors of the **2021 Heavy Reading *Open RAN Operator Survey***. The online survey was promoted by email to Heavy Reading's service provider databases. The survey garnered 82 qualified responses from individuals working at CSPs that own and operate mobile networks. Respondents were asked to self-assess their individual knowledge about mobile RAN strategy; those that reported "no direct knowledge" or only "a little knowledge" of their company's RAN strategy were excluded from the survey, and their responses are not considered in this analysis. The 82 respondents worked at 39 different operators.

Respondent demographics are shown in **Figure 1**. The response is led by mobile operators and converged operators with mobile businesses. Respondents are generally from developed economies, with the majority working for operators reporting more than $1bn in annual revenue. Network engineering & planning (33%) and R&D/technical strategy (26%) are the main job roles represented, accounting for a combined 59% of respondents, with network operations in third place with 21%. With 46% of the response, the US is the largest region by a distance; however, there is good representation from the rest of the world.

Figure 1: Survey response demographics



n=82

Source: Heavy Reading

OPERATOR DEMAND FOR OPEN RAN

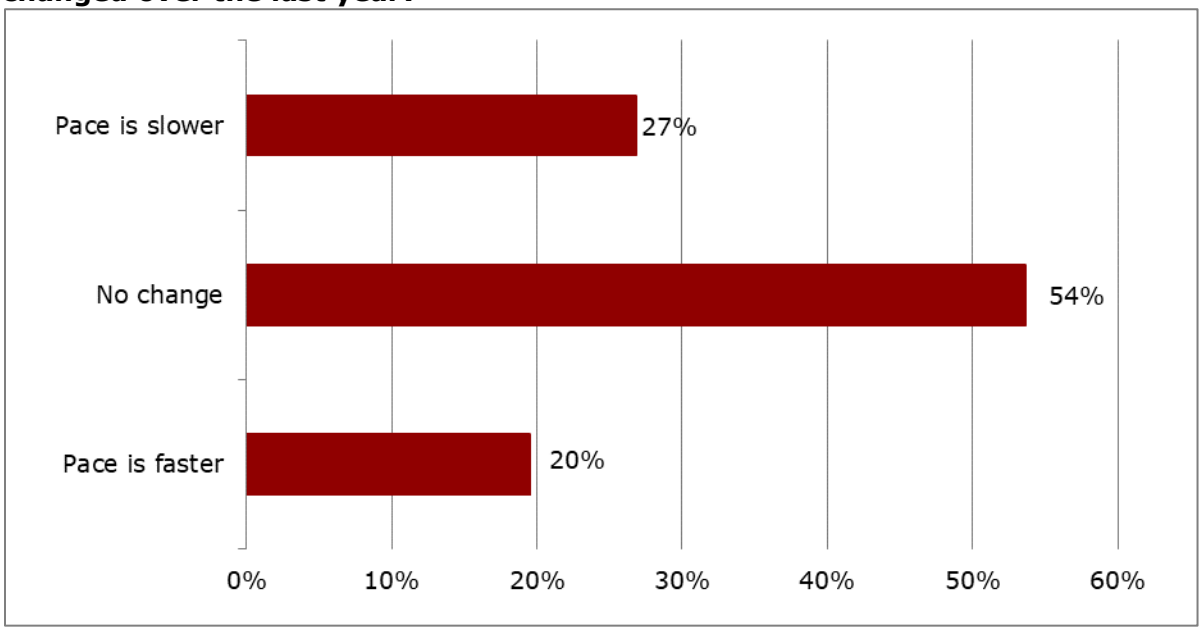
This section of the report discusses operator demand for open RAN, including their motivations, expected deployment timelines, and how they might scale open RAN in the future.

Sentiment and progress

The first question was designed to help understand how operator sentiment toward open RAN has changed over the past year, in light of better knowledge of the technology, experience from trials, increased maturity of solutions, changes in the policy environment, and so on. **Figure 2** shows that just over half (54%) say their company has not changed the pace of its planned deployments. There has been movement in the other half, split between those accelerating (20%) their plans and those slowing down (27%). The conclusion is that there is volatility in just under half the survey base, but that this cancels

the other half out and, overall, operators as a group are working at a steady pace. This reflects that open RAN is a major change in RAN architecture and is a long-term, multi-year exercise. A steady outlook is a positive outlook at this stage of open RAN development.

Figure 2: How has the pace of your company's planned rollout of open RAN changed over the last year?



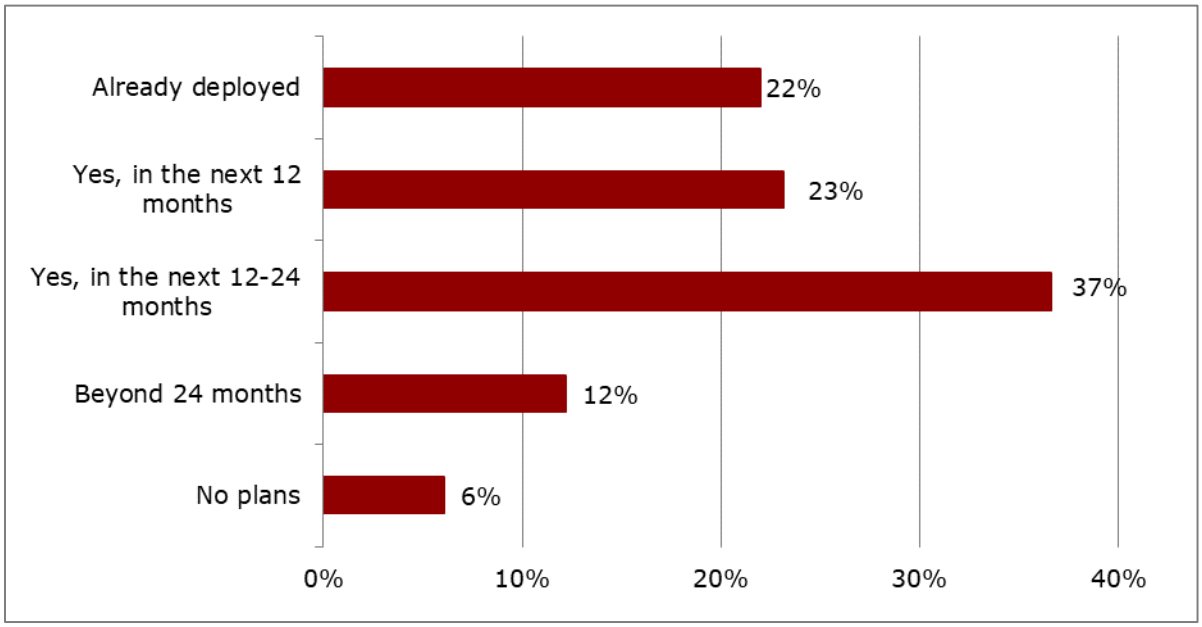
n=82
Source: Heavy Reading

In terms of commercial deployment, **Figure 3** shows close to a fifth (22%) of respondents say their company already operates open RAN commercially. This does not mean a fifth of all operators worldwide, but a fifth of those operators represented by individual professionals in the survey base. At first glance, 22% looks a little too bullish, but not outrageously unrealistic given that a good number of operators have now deployed some form of open RAN on a small scale and given that a few with larger-scale deployments are also now active. Leading operators, supported by the vendor ecosystem, have proven that open RAN technology works and is commercially competitive.

This result also shows that a large majority (78%) have not deployed a live, commercial open RAN. This is an important reality check to runaway claims of open RAN success. For open RAN to achieve mainstream adoption, the next two years will be critical. A solid 23% expect to go live next year, indicating that operators expect to make near-term progress. The largest group is the 37% that anticipate the 12–24-month period for commercial launch.

These results imply widespread deployment of open RAN in 2023. This is a solid indicator of sentiment. Timing may be less reliable, however. As a word of caution, Heavy Reading survey respondents are often overly optimistic about the timelines for the commercial introduction of new technology; probably because they work directly with these technologies and it is natural that professionals that elect to respond are, by nature, more "invested" in the technology than the market at large.

Figure 3: Has your company committed to a live commercial deployment of open RAN?



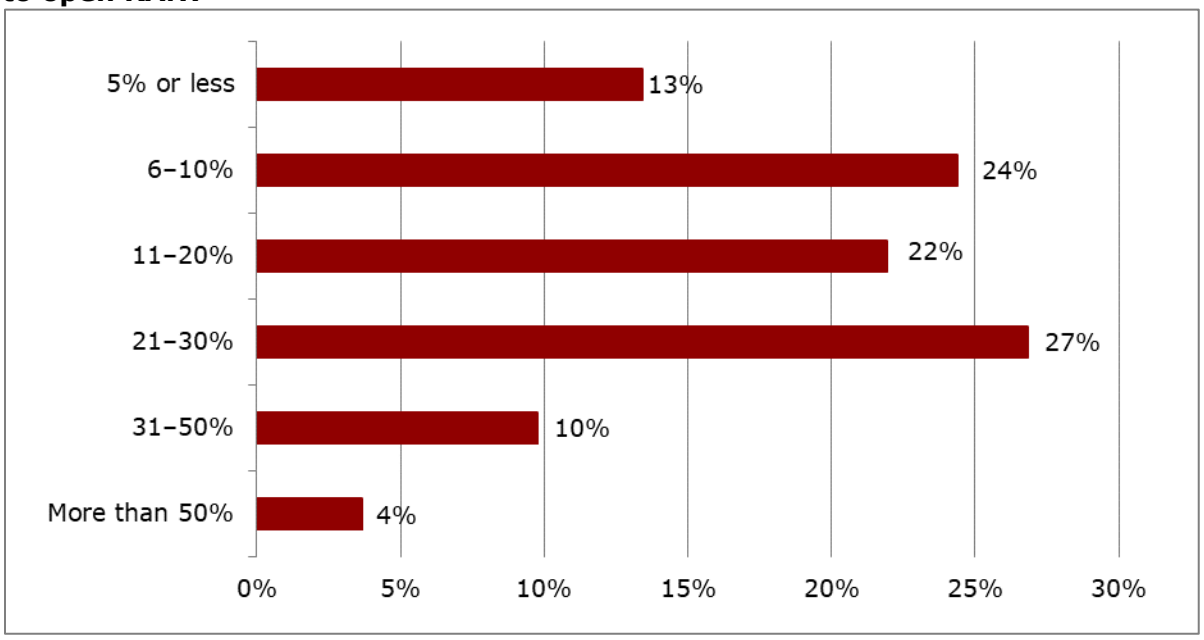
n=82
Source: Heavy Reading

Scaling open RAN

The findings on deployment dates do not indicate much about the size of individual operator rollouts. This could mean that a city or rural region has been deployed or simply a few sites with live traffic. The question in **Figure 4** on open RAN capex expectations gives a better indication of how fast open RAN might scale. It shows that, by 2025, a majority of respondents expect more than 10%, but less than 20% of their RAN capex will be dedicated to open RAN and that a large majority expect it to be less than 30%. This, again, is an important reality check on the hype around open RAN, but nevertheless would represent a very positive move toward open RAN technology.

To put this in context, 20% of RAN capex being allocated to open RAN by 2025 is ahead of industry analyst forecasts; for example, Omdia forecasts that 10% of the $34bn RAN equipment spending will be on open RAN by 2025. (Note: capex and equipment spending are not direct analogs.) This difference is perhaps due to the bullish nature of the survey base (employees for operators that are more active in open RAN), but this may also indicate that industry analysts are too conservative. In any case, the survey shows that the majority of RAN technology spending will be on classic integrated solutions over the next five years.

Figure 4: By 2025, what percentage of your RAN capex is expected to be dedicated to open RAN?

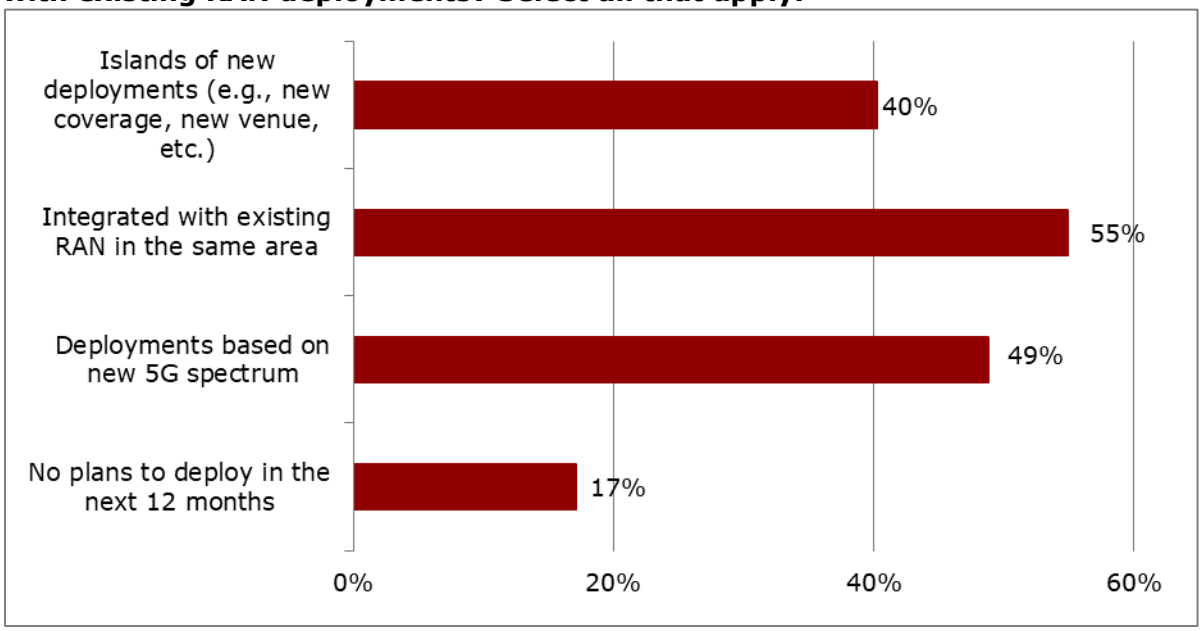


n=82
Source: Heavy Reading

OPEN RAN DEPLOYMENT PREFERENCES

How operators plan to use open RAN has been a consistent area of investigation in all three annual surveys. **Figure 5** shows that, in the 2021 survey, respondent expectations are spread evenly across the options presented, with no standout preferred deployment identified. The second observation is that with 161 responses from 82 individual respondents, on average, operators have at least two deployment scenarios in mind. This may reflect the diversity of the trial activity underway; it may also suggest that open RAN will eventually be used widely or even that operators are not yet clear on what their lead deployment scenarios will be.

Figure 5: In the next 12 months, how does your company plan to deploy open RAN with existing RAN deployments? Select all that apply.

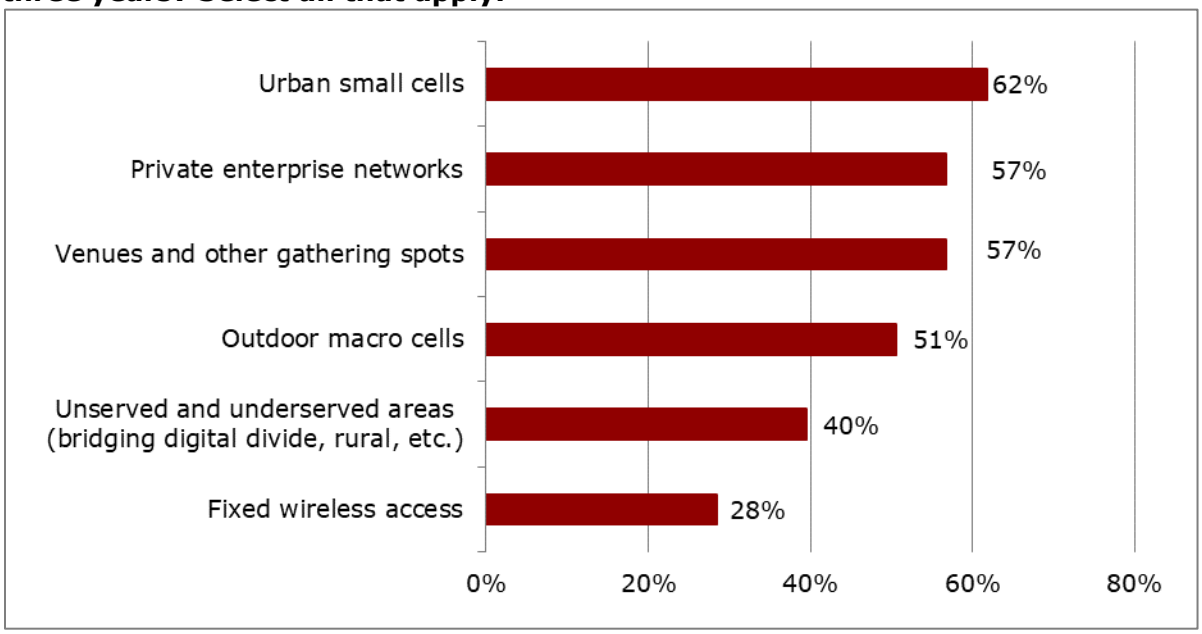


n=82
Source: Heavy Reading

Three leading use cases

The following question asks about use cases—a similar, but not identical, question to the one above—and again reveals that operator intentions are varied. In this case, as shown in **Figure 6**, 81 respondents placed a total of 294 votes for an average of 3.6 per respondent, showing that an even greater variety of scenarios are in play. Urban small cells (62%), private enterprise networks (57%), and venues and other gathering spots (also 57%) lead the responses. A positive way to interpret this finding is that open RAN is being pursued across a broad base of mobile communication scenarios and that once these models solidify and become "product ready," then the market might see widespread adoption and perhaps, over time, open RAN could become the predominant mode of operation. A less positive analysis, but nevertheless worth considering, is that open RAN is a technology in search of a solution in the sense that the industry has committed to open RAN and now it needs to find ways to make it work.

Figure 6: For which use cases does your company plan to use open RAN in the next three years? Select all that apply.



n=81
Source: Heavy Reading

Looking at responses to this question by operator revenue reveals an interesting skew in the data. **Figure 7** shows intent to use open RAN for private enterprise networks and venues and other gathering spots, according to operators with more than $5bn in annual revenue (i.e., Tier 1 operators) and reveals that larger operators are significantly more likely to be pursuing these use cases than those with less than $5bn in revenue. This is particularly the case for private enterprise networks, which score 73% from larger operators versus 43% from smaller operators.

Heavy Reading's explanation for this is that larger operators are typically more focused on enterprise services, in general, so a move into private networks is a logical follow-through, especially given the opportunity to use open RAN to create vertical- and customer-specific networks. Another explanation might be that these operators are more risk-averse and see private enterprise networks as a way to introduce open RAN technology without risking the subscriber experience in the wide area public network.

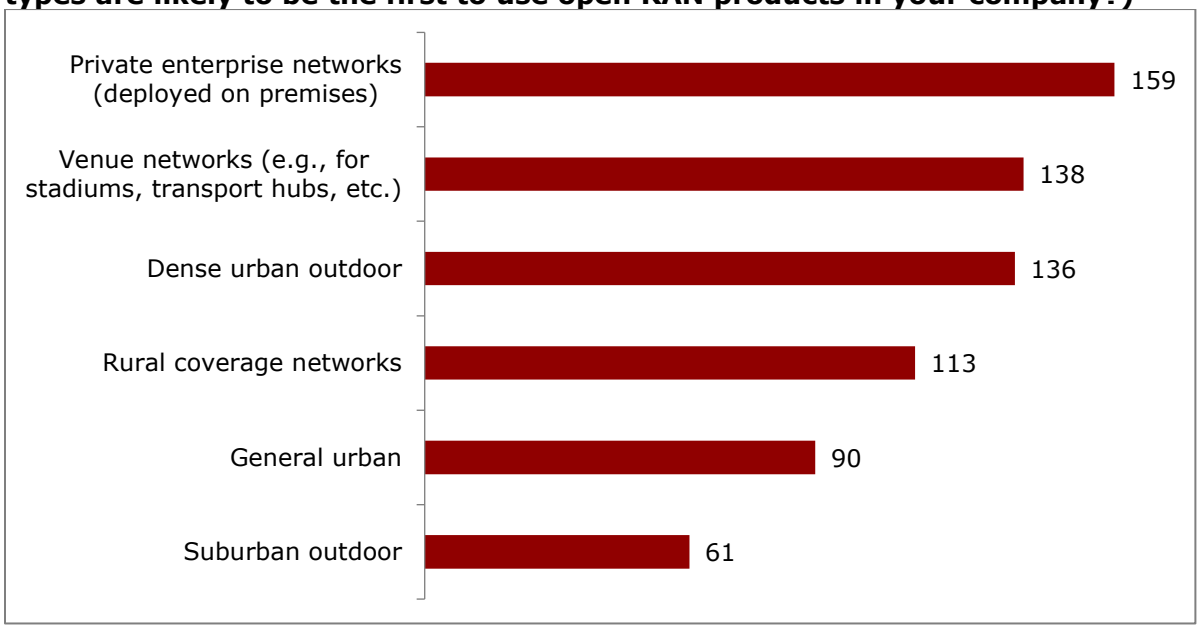
Figure 7: Intent to use open RAN for private and venue networks within three years by company revenue

	>$5bn (n=37)	<$5bn (n=44)
Private enterprise networks	73%	43%
Venues and other gathering spots	68%	48%

n=81
Source: Heavy Reading

It is also instructive to refer to a question in Heavy Reading's 2018 open RAN survey (see **Figure 8**), which shows a similar preference for private enterprise networks, venue networks, and dense urban outdoor deployments. This consistency over three years is encouraging and supports the view that open RAN will be a long-run process with operators working steadily over multi-year periods to introduce and operationalize the technology.

Figure 8: 2018 preferred open RAN use cases (Which use cases and deployment types are likely to be the first to use open RAN products in your company?)



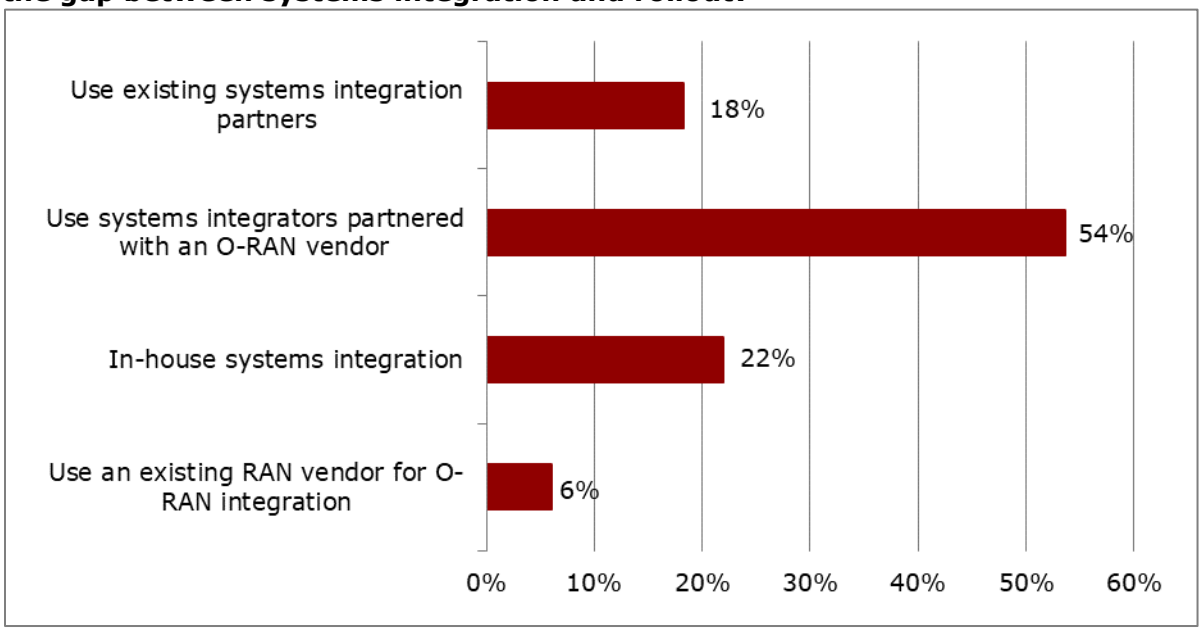
n=119 (weighted average scores)
Source: Heavy Reading (2018)

TECHNOLOGY MATURITY AND SYSTEMS INTEGRATION

A perennial question for open RAN is, in the absence of a single vendor supplier to deliver the solution, what will be the system integration model? **Figure 9** shows a clear expectation that "system integrators partnered with an ORAN vendor" will lead the integration project. With a score of 54%, this is more than double any other option. Among respondents that say they have "detailed knowledge" of their company's RAN strategy, this increases to 67%.

This model of application technology vendors leading with support from SIs is already familiar to operators that have introduced NFV to their core networks over the past few years, where more often than not, a software application vendor (such as an IMS or packet core supplier) is also responsible for the overall system performance, including stack integration. This may not be a "true" disaggregated network model, but it is a practical, tested approach to deployment. In an open RAN context, the lead vendor could be a DU/CU supplier or an O-RU supplier, or perhaps at a stretch, a transport network supplier, a server vendor, or a cloud software vendor. This analysis implies that pure-play specialist SIs targeting open RAN will need to have extremely well-developed RAN domain knowledge if they are to lead customer engagements, or more likely, that they will be drafted in as partners to support a lead RAN technology vendor.

Figure 9: For initial open RAN deployments, how does your company plan to bridge the gap between systems integration and rollout?



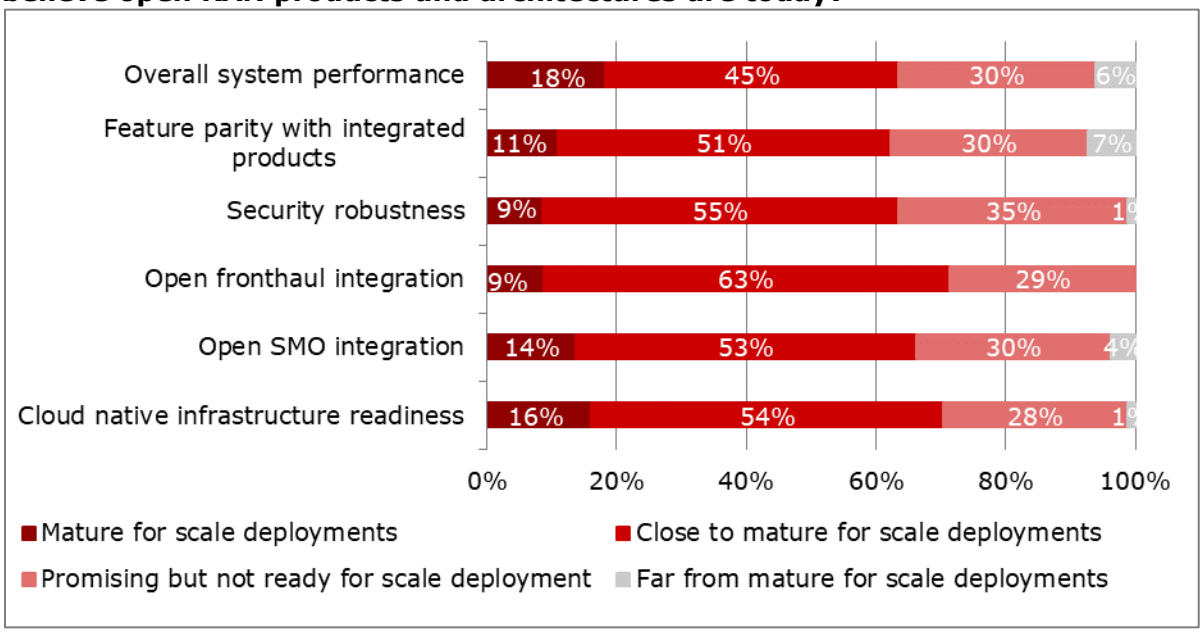
n=82
Source: Heavy Reading

Open RAN performance

The RAN is complex, and it is difficult to build and operate systems that perform reliably over a long deployment cycle. One of the reasons the integrated RAN vendor market has consolidated is the scissor effect of high R&D costs and competitive price pressure, making scale critical to long-term innovation and product support. The result is that classic, single-vendor "closed" RAN products set a high bar for the technical performance of open RAN systems and for their ongoing operation and maintenance.

To judge the maturity of open RAN systems, the survey asked operator respondents if they think open RAN products are ready for commercial deployment. The consensus, as shown in **Figure 10**, can be summarized as "nearly, but not quite." On overall system performance, for example, 18% think open RAN is "mature for scale deployments," 45% think it is "close to mature," and 30% say it is "promising but not ready for scale deployment." The "close to mature for scale deployments" group is consistent with expectations for greater deployments over the next two to three years as identified above, but this may also be a polite way for the survey taker to say, "no, it's not ready."

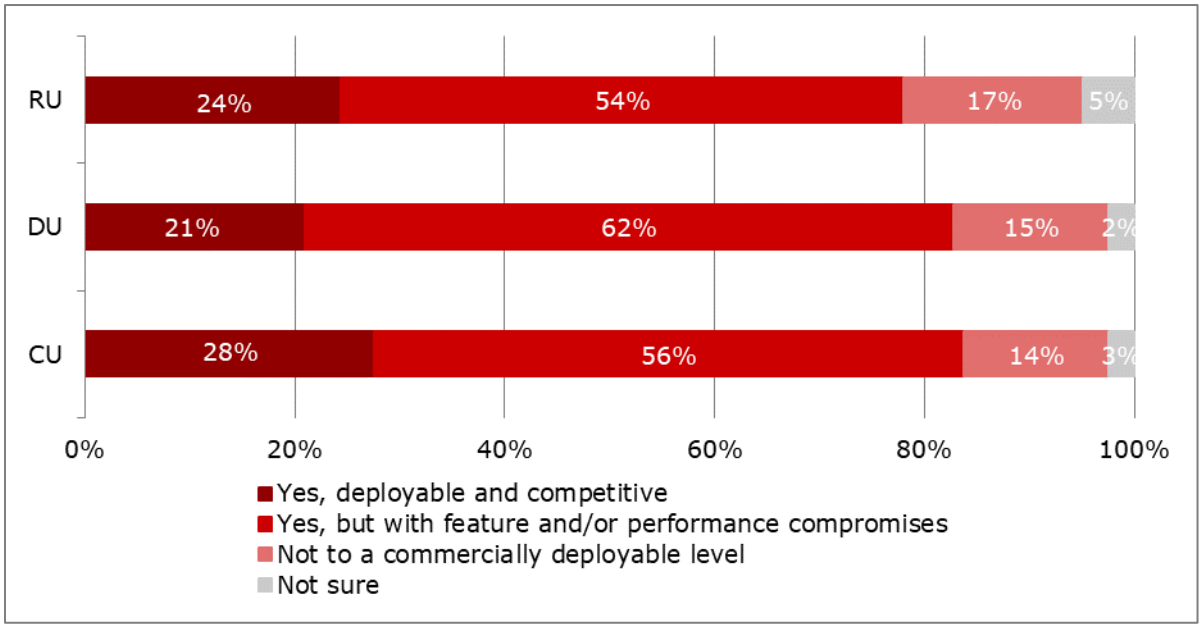
Figure 10: In terms of readiness for commercial deployment, how mature do you believe open RAN products and architectures are today?



n=80–82
Source: Heavy Reading

System performance is particularly important for 5G RAN because the technical requirements to process wide bandwidths, massive MIMO, mmWave, and so on, are very demanding. The survey also asked if open RAN systems will be commercially deployable and competitive on high capacity 5G sites in the next 12 months. The finding is fairly positive. **Figure 11** shows that about one-quarter say open RAN will be "deployable and competitive" in that timeframe. However, given that a majority thinks there will be "feature and/or performance compromises" across the radio unit (RU), DU, and CU functions, there is clearly more work to do. This is in accordance with a view that open RAN is now suitable for lower bandwidth 2x2 and 4x4 MIMO LTE systems, but that further development is needed for 5G, particularly in high end mid-band and mmWave systems, as well as for features such as advanced beamforming, DSS, and NR carrier aggregation.

Figure 11: In terms of high capacity sites, do you believe 5G open RAN systems will be commercially deployable and competitive with integrated RAN in the next 12 months?



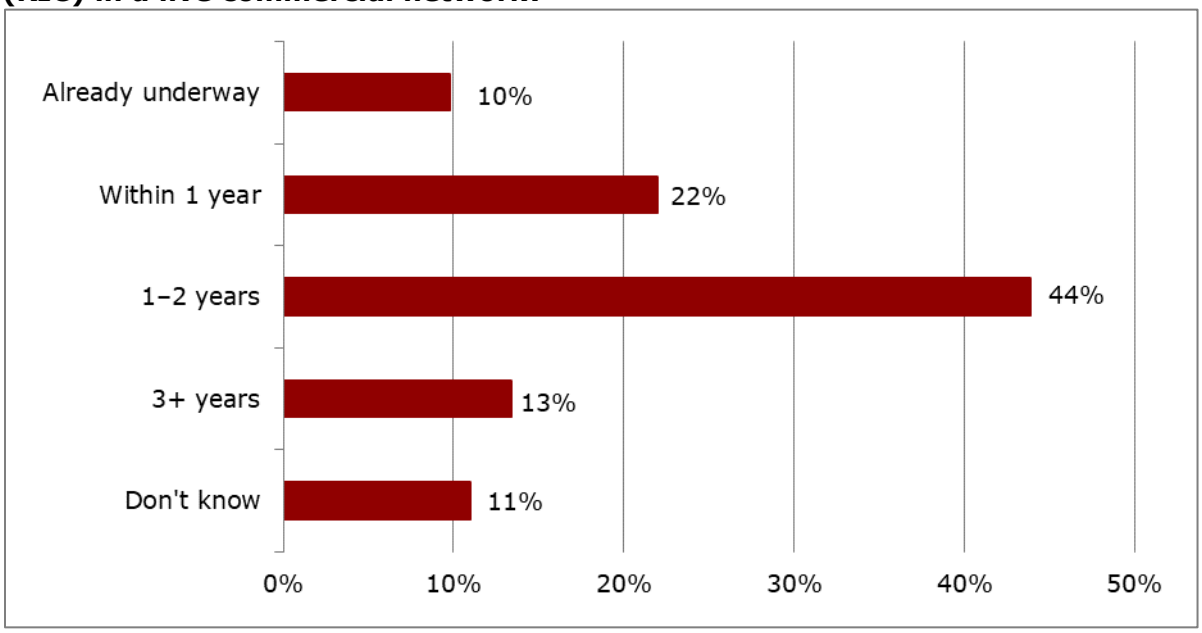
n=80–82
Source: Heavy Reading

RAN Intelligent Controller

A defining feature of the O-RAN architecture specified by the O-RAN Alliance is the RAN Intelligent Controller (RIC), which provides near- and non-real-time control of radio base stations. This is a new RAN function that is not present in the classic architecture. It is often referenced by operators and open RAN advocates as one of the primary ways open RAN is different (i.e., better) than classic RAN. However, this new node in the RAN architecture is immature in terms of interface specification and technology implementation. The question in **Figure 12** asks when RICs will be deployed in live commercial networks (note that this does not necessarily imply an at-scale deployment). A leading 10% say deployment by their organization is "already underway," and a further 22% say this will go live "within 1 year." With a score of 44%, the major time period for the deployment of a RIC is 1–2 years. In other words, by mid-2023, many advanced operators should have deployed a RIC—if this collective view turns out to be accurate.

In Heavy Reading's view, this seems to be an overly optimistic view of likely RIC deployment timelines. There may well be trial systems in service in 2022 and non-real-time RIC functions in commercial service by mid-2023, perhaps based on evolved self-organizing network (SON)/RAN automation technologies. But given the state of the RIC specification (version 1 of the O-RAN RIC specifications was just finalized) and the very challenging technical demands on near-real-time RIC and product development, it is likely to take longer for the industry to develop and broadly deploy mature commercial implementations.

Figure 12: When does your company expect to deploy a RAN intelligent controller (RIC) in a live commercial network?



n=82
Source: Heavy Reading

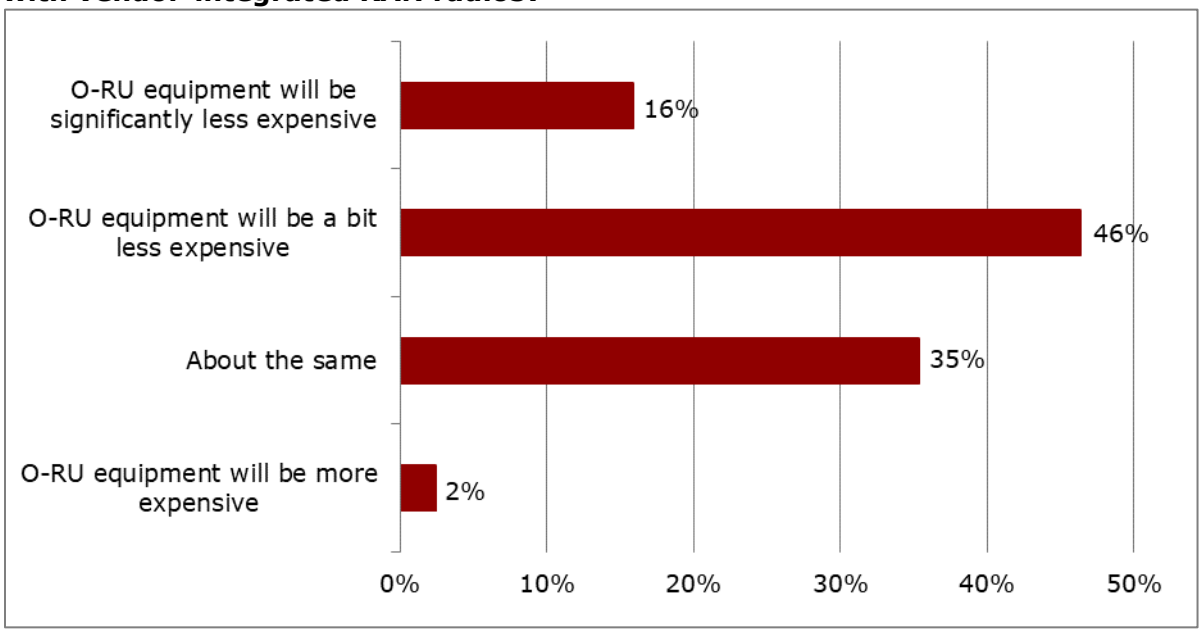
OPEN RADIO UNITS

A large part of RAN investment relates to the cost of the RU and its deployment on the tower, rooftop, or similar location. It is often claimed that open RAN will be less expensive than integrated RAN because the open fronthaul interface will create a more competitive market for RUs and reduce "margin stacking" on radio hardware equipment by big incumbent vendors. A common counterclaim is that the cost of RUs is related to volume and R&D investment and that fragmenting the market will not, therefore, help to greatly reduce costs when the bill of materials is essentially similar.

O-RU costs vs. single-vendor RUs

Figure 13 shows that only 16% of operator respondents expect open RUs to be "significantly less expensive" than vendor-integrated radio products, which signals that the market is not anticipating a large overall cost reduction from open RAN. A sizable 35% expect pricing to be "about the same." The key section of the response, therefore, is the 46% expecting that "O-RU equipment will be a bit less expensive." This suggests that operators want and expect savings but have a realistic view of what is achievable on the cost side of the open RAN equipment equation. It is also worth noting that it is normal in online surveys for operators to express a view that network technology products should be less expensive.

Figure 13: How does your company expect the cost of O-RU equipment to compare with vendor-integrated RAN radios?



n=82
Source: Heavy Reading

Cost/performance trade-offs for O-RUs

How do operators think the O-RU price relates to features and performance? **Figure 14** shows that about a third (33%) of respondents expect lower pricing and are prepared to accept slightly lower performance (28%) and features (20%) to achieve this. The majority, however, expect price (60%), performance (60%), and features (68%) of O-RUs to be about the "same as integrated RUs." These findings reinforce the analysis that operators in this survey are realistic about the trade-offs in radio hardware pricing.

It is worth noting, however, that this is not uniform across the survey base. A large number of respondents (62%) in R&D and technical strategy roles expect lower pricing for O-RUs without an equivalent decrease in performance or features, versus just 23% in network operations, network planning, and engineering roles. It is tempting to conclude that this reflects the difference between the R&D and strategy ivory tower and the real-world experience of network operations. However, it may also be that these price declines are not yet apparent to daily operations people because open RAN is not yet in production at scale.

Figure 14: Thinking about "white box" O-RUs, what are your company's expectations for performance, features, and price compared to integrated RU options?

	Lower than integrated RU	Same as integrated RU	Higher than integrated RU
Performance	28%	60%	11%
Features	20%	68%	12%
Price	33%	60%	7%

n=81–82
Source: Heavy Reading

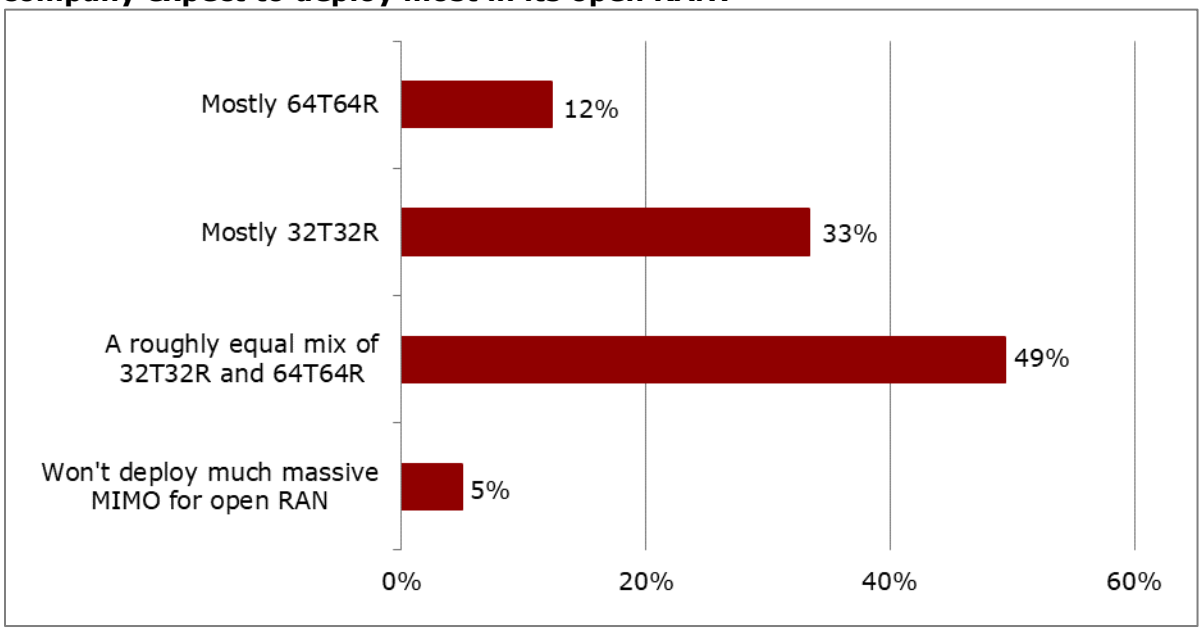
Massive MIMO preferences

High performance 5G mid-band sites typically use massive MIMO to increase capacity and improve the link budget to extend the cell edge for greater downlink coverage. There are two main configurations: 64T/64R and 32T/32R. Most of the early non-open massive MIMO 5G sites in China are 64T/64R, and most of the sites in South Korea are 32T/32R. European operators use a mix but trend to 32T/32R.

In todays' 5G networks, in areas with high rise buildings, 64T/64R has been shown to be the most effective solution in cost/performance terms because the technology provides superior vertical beamforming. However, in areas where there are not very tall buildings, 32T/32R is generally considered to give an almost equivalent performance for a significantly lower cost.

Figure 15 shows that only 12% of respondents expect their company will deploy "mostly 64T/64R" for open RAN. At first glance, this appears to be a low percentage, given this is the highest capacity configuration currently available. Almost half of respondents (49%) think their company will deploy a roughly equal mix of these two product types in the next three years, and 33% expect 32T/32R to lead. Inherent in this question is the assumption that open RAN will support massive MIMO in the next three years. There are commercial systems available and deployed today, but currently, the O-RAN Alliance fronthaul specification for the 7-2 lower layer split needs further work to fully support massive MIMO, with the uplink in need of particular attention.

Figure 15: In the next three years, which massive MIMO configurations does your company expect to deploy most in its open RAN?



n=81
Source: Heavy Reading

The above result shows both 64T/64R and 32T/32R products are likely to be in demand for mid-band open RAN. However, there may be a skew toward 32T/32R. Looking at the data according to job role (**Figure 16**), those respondents involved directly in network engineering and planning indicate a preference for 32T/32R systems, with a score of 44% compared to 28% for the remaining respondents. As already noted, these respondents may be closer to actual deployment than those in, for example, R&D and technical strategy roles, but also may be less aware of the capabilities of products not yet commercially available.

Figure 16: Massive MIMO by job role (In the next three years, which massive MIMO configurations does your company expect to deploy most in its open RAN?)

	Network engineering & planning (n=27)	All other respondents (n=38)
Mostly 64T64R	19%	9%
Mostly 32T32R	44%	28%
A roughly equal mix of 32T32R and 64T64R	37%	56%
Won't deploy much massive MIMO for open RAN	0%	7

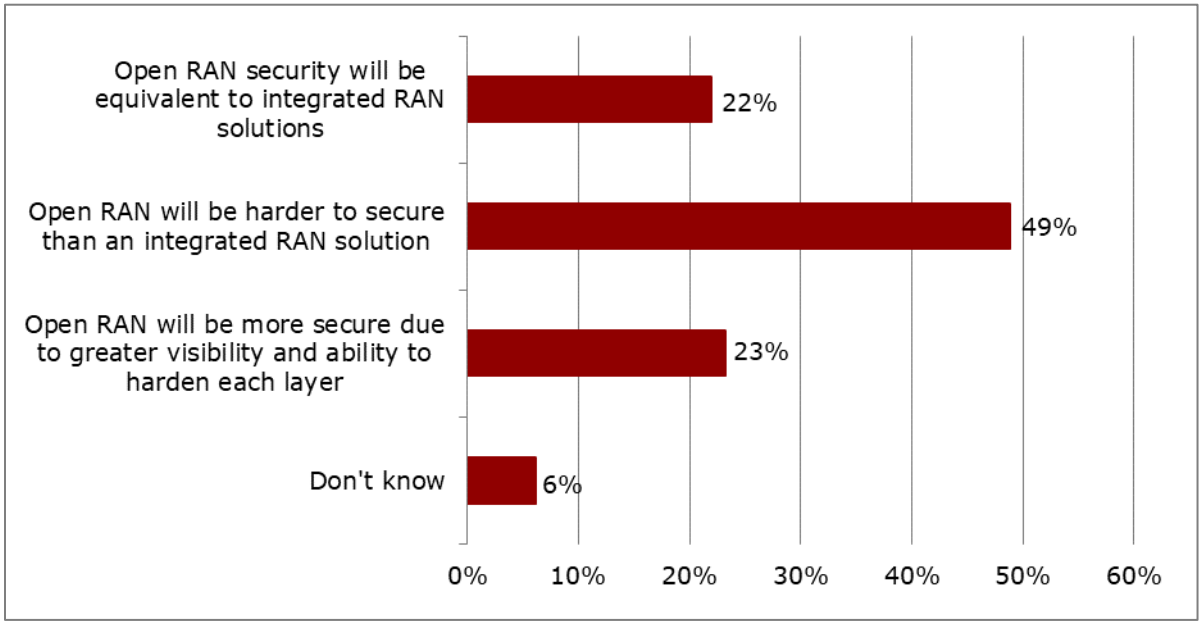
n=65
Source: Heavy Reading

OPEN RAN SECURITY

Operators, regulators, and customers have never been more focused on mobile network security. In countries where part of the rationale for open RAN is to replace incumbent suppliers considered to be high risk vendors, security has an even higher profile. The critical services expected to run over 5G raise the stakes further. For open RAN to succeed, it is vital that the industry works collaboratively to address security.

Figure 17 shows that half of the respondents (49%) believe open RAN will be harder to secure than equivalent vendor-integrated solutions, versus 23% that say open RAN "will be more secure due to greater visibility and the ability to harden each layer," and 22% that say "open RAN security will be equivalent to integrated RAN." The primary analysis, therefore, is that open RAN security is viewed as challenging relative to single-vendor integrated RAN, but also, given that a combined 45% of respondents think open systems can become as or more secure, respondents are also optimistic that a way forward can be found.

Figure 17: Which statement do you most agree with regarding the security of open RAN solutions in the future?



n=82
Source: Heavy Reading

There are valid arguments that both open and closed systems have security advantages and disadvantages. A new architecture using new, open interfaces, by definition, presents a security challenge. The potential for different vendors on each side of the interface means that each combination must be tested and verified, which increases the work to secure the deployment. Supply chain security for each part of a multi-vendor system must also be considered and monitored over time.

In a single-vendor system, closed RAN solution, there is a single responsibility and fewer partners, in theory reducing the risk. However, and there is an argument that single-vendor systems have simply not yet been exposed to the level of scrutiny being applied to open RAN or to other parts of the mobile networks and that it is only a matter of time until flaws

are revealed. The argument goes that because there is less visibility into single-vendor systems, there are fewer opportunities to identify and fix vulnerabilities.

OPEN RAN FOR 5G PRIVATE NETWORKS

The survey has already identified private and venue networks as lead deployment cases for open RAN technology. This section of the report investigates the private network market in more detail, specifically as it relates to 5G private networks.

RAN split options

The first question in this section covers RAN split options for private 5G networks. Asked to identify a preferred RAN split option, **Figure 18** shows a combined CU+DU+RU is most popular for both sub-6GHz (59%) and mmWave (39%); in effect, this means a small cell solution. This is the most familiar deployment from the point of view of the enterprise and reflects the current LTE private network market and vendor ecosystem. In this type of scenario, to make this "open RAN" would require opening E2 and/or O1 interfaces to a third-party service management and orchestration (SMO) system. Or perhaps an integrated RAN system for private networks could be created from open RAN subsystems and components provided by different vendors. Telco operators or SIs are examples of organizations that could create such a solution.

Figure 18: For private 5G networks, which RAN split option(s) is your company likely to deploy? Select all that apply.

	For sub-6GHz 5G private networks	For mmWave 5G private networks
None (integrated CU+DU+RU)	59%	39%
Option 2 (CU and DU)	28%	28%
Option 6 (SCF nFAPI)	17%	27%
Option 7.2x (O-RAN CUS)	24%	29%
Total	**128%**	**123%**
Total responses	105	101
Total respondents	82	82

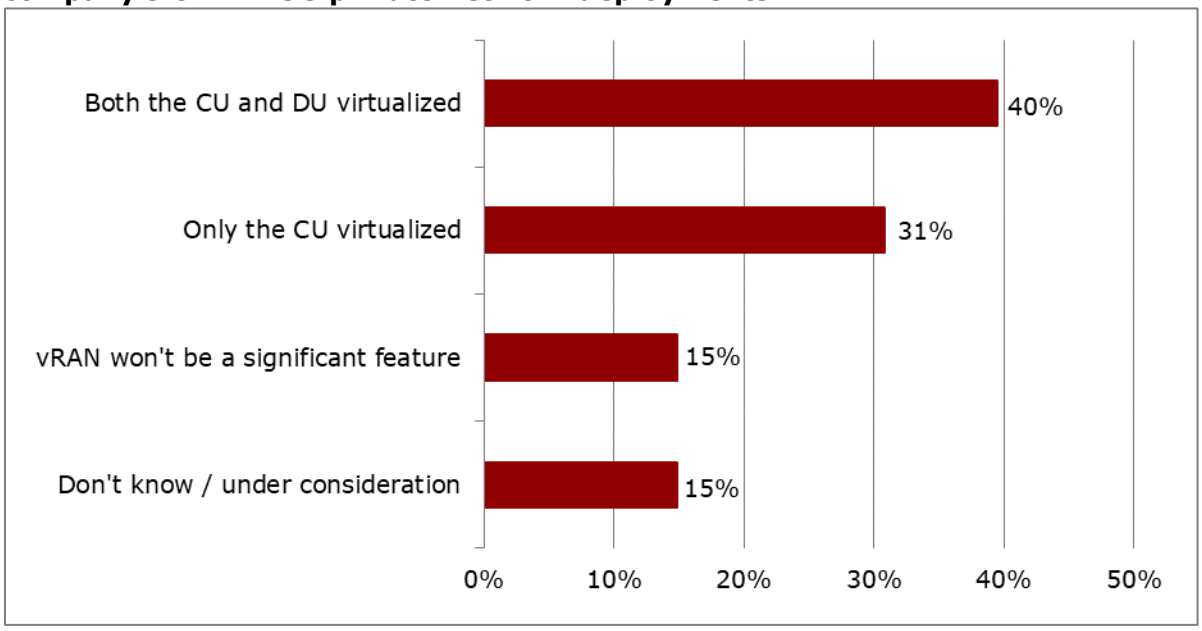
Source: Heavy Reading

Virtualized RAN for private networks

Setting aside the question of open RAN interfaces, **Figure 19** shows the extent to which operators think private network solutions will be virtualized. This is important because virtualization enables better integration with edge-cloud infrastructure deployed at the enterprise location, which, in turn, can enable a simpler operating model and closer integration with enterprise applications. A large 40% expect "both the CU and DU to be virtualized" ahead of 31% that expect to see "only the CU virtualized." Overall, a combined 61% do not expect to virtualize the DU in private 5G open RAN networks.

The difference between virtual CU and virtual DU is significant. In simple terms, a hardware DU (i.e., a DU based on an SoC) trades higher performance for lower flexibility; only virtualizing the CU is simpler but reduces the potential gains from edge-cloud integration. Note, however, that this is a fast-evolving area of technology, and there are many performance enhancements to edge cloud infrastructure and open RAN silicon in development that may change the picture in the next year or two.

Figure 19: To what extent will virtualized RAN (vRAN) be present in your company's O-RAN 5G private network deployments?



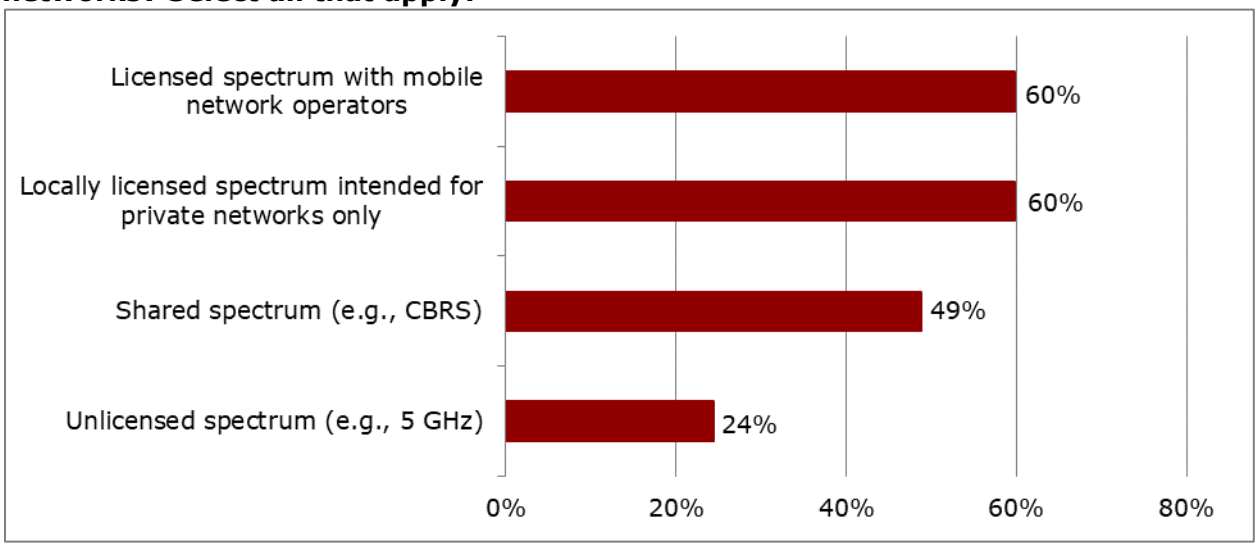
n=81
Source: Heavy Reading

Private network spectrum

The question on spectrum is orthogonal to open RAN but highly relevant to private networks in general. **Figure 20** shows that operator respondents prefer spectrum licensed to mobile operators (60%) and spectrum licensed for local area enterprise networks (also 60%) over shared spectrum (49%) and unlicensed spectrum (24%) for private 5G networks. This is the expected result from an operator survey—after all, these organizations have unique or preferential access to spectrum and want to use it. If it is available to you, licensed spectrum is attractive for high performance private networks.

It is worth a reminder that enterprises often do not have access to licensed spectrum and, in these cases, unlicensed may be relatively more attractive. In fact, in other Heavy Reading 5G technology surveys, there is an appetite for unlicensed spectrum and NR-U technology among enterprise end users. Note also that this "select all that apply" question received 193 responses from 82 respondents, for an average of two per respondent. This indicates that operators are likely to consider more than simply their own licensed spectrum for private 5G networks.

Figure 20: What types of spectrum would your company support for 5G private networks? Select all that apply.



n=82
Source: Heavy Reading

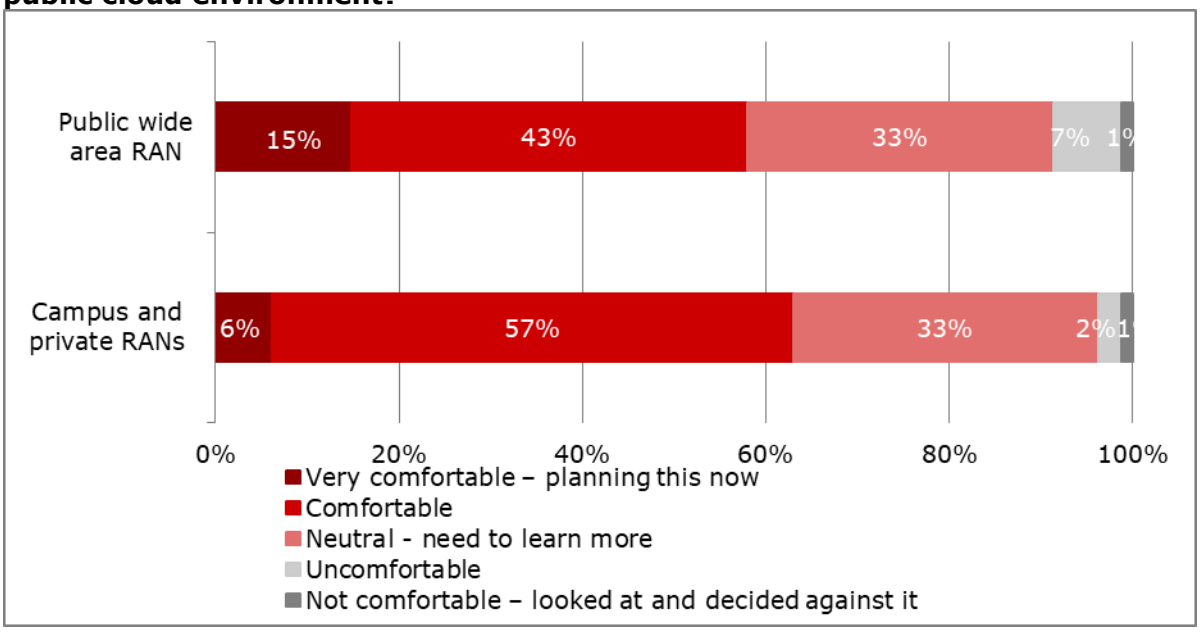
OPEN RAN AND THE PUBLIC CLOUD

A relatively new area of interest for mobile network operators (MNOs) is the potential to host parts of their networks in hyperscale public cloud environments. To oversimplify, the logic generally is that these hyperscalers have a technology stack and developer ecosystem that cannot be matched by a national-scale telecom operator; therefore, it might make sense for operators to leverage these capabilities to further their own network objectives. Open RAN is potentially "open" to deployment on diverse platforms, so it is worthwhile to ask how interested and comfortable operators are in deploying parts of their RAN in the public cloud.

Figure 21 shows that there is interest in this public cloud model, but that only a minority (15% for public networks and 6% for private networks) are currently "very comfortable" with the idea and planning to use this model. Even though this is a small percentage, it is higher than Heavy Reading had anticipated and perhaps is an early signal that major changes could be coming to RAN deployment models.

A much greater percentage are "comfortable" (43% for public networks and 57% for private networks, again, surprisingly high percentages) but do not yet have plans for deployment, while 33% are "neutral – need to learn more" about both types of networks. Very few respondents are categorically against the idea.

Figure 21: How comfortable is your company with hosting parts of your RAN in a public cloud environment?



n=81
Source: Heavy Reading

There is more enthusiasm from US respondents about deploying public network functions in the public cloud, with 21% "very comfortable – planning this now" versus just 7% in the rest of the world. This probably reflects a faster adoption of the cloud, in general, in the US, and the fact that there are more public references of operators starting to work with hyperscalers to host network functions (in some cases, including RAN) in this market.

Other than the small delta between public RAN and campus/private RANs, this survey's results do not reveal much about which RAN functions might be deployed in the public cloud, nor does it reveal if this will be a minor mode of operation or something more substantial. It does, however, show there is sufficient interest to look more closely at this model in future research.

ABOUT THIS STUDY

The 2021 Heavy Reading *Open RAN Operator Survey* was conducted in August 2021, and this analysis was written in October and November 2021. The online survey generated 82 responses from individuals working at comm SPs with mobile businesses after non-qualified responses were deleted from the survey. Respondents were asked to self-assess their knowledge about mobile RAN strategies; those that reported "no direct knowledge" or only "a little knowledge" of their company's RAN strategy were also excluded from the survey, and their responses are not considered in this analysis.