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

HEAVY READING
WHITE PAPER

The Journey to Virtualized RAN: Insights 2021

A Heavy Reading white paper produced for Red Hat

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INTRODUCTION

In 4Q19, Heavy Reading surveyed 77 communications service providers (CSPs) on their plans for virtualization overall, and virtualized radio access networks (vRANs) specifically. A lot has happened since then. A lot that could throw the carriers off course—like data centers and central offices going zero-touch and lights-out virtually overnight. Heavy Reading wanted to check in with the carriers and see how their plans had changed—either delayed or accelerated—during the intervening year. We also wanted to explore how their plans for virtual network functions (VNFs), including virtual firewalls, domain name systems (DNSs), session border controls (SBCs)/IP multimedia subsystems (IMSs), virtualized 4G network cores (or virtual evolved packet cores [vEPCs]), and vRANs, have evolved.

Today, in mid-2021, industry focus has turned to the transition to 5G standalone (SA) at the core with carriers such as Rogers, STC, Telefónica, Vodafone, Singtel, and T-Mobile deploying focused, commercial 5G SA services in portions of their networks. The transition to 5G SA will enable carriers to broaden their 5G vision from the Enhanced Mobile Broadband (eMBB) use case to the two other 5G use cases defined by the 3GPP: ultra-reliable low latency communications (URLLC) and massive machine-type communications (mMTC). To support these technologies and use cases, the 5G network transformation increasingly assumes a vRAN—one that is container-based and cloud-native.

How far down the path toward vRAN are the carriers today, what are the drivers and inhibitors, and how have these plans changed from Heavy Reading's 4Q19 survey? To answer these questions and more, Heavy Reading conducted a survey in April 2021 of 74 service providers broken down as follows:

- 40 converged fixed/mobile operators
- 20 mobile operators
- 14 others, including mobile virtual network operators and enablers (MVNOs/MVNEs) with infrastructure and hosting/cloud providers

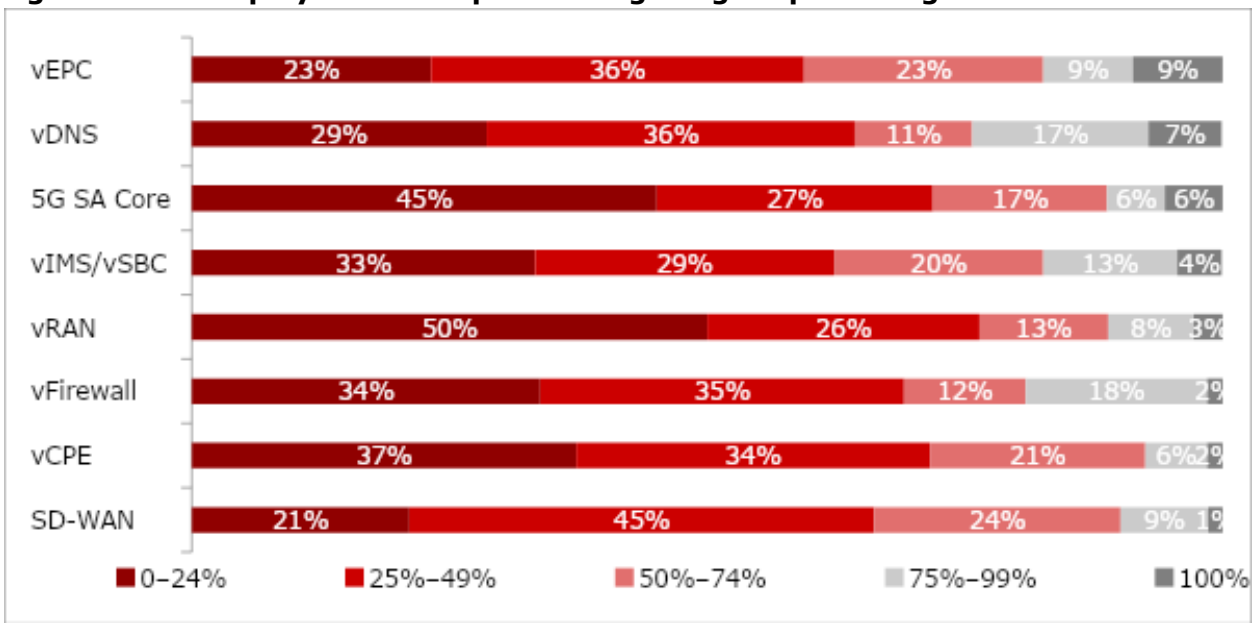
This survey was global: 55% were from North America, 18% were from Eastern and Western Europe, and 13% were from Asia Pacific. The remaining respondents were from Central and South America (11%) and the Middle East & Africa (3%).

Most respondents (77%) were in technical and networking roles, such as network operations, network planning and engineering, R&D, and technical strategy. Of the remaining respondents, 10% were in corporate management and marketing and 13% were on the data center side in IT and cloud domain roles.

VIRTUALIZATION IN CARRIER NETWORKS IN 2021

Heavy Reading wanted to understand the penetration of vRAN solutions today and how these compared to the deployment of other popular VNFs. We also wanted to assess how today's virtualization deployments and future plans had changed from the last time we queried CSPs. With this in mind, Heavy Reading asked respondents what VNFs they had deployed and to what percentage of their network (see **Figure 1** below).

Figure 1: NFV deployments are penetrating a higher percentage of the network



Question: Which of the following virtual network functions (VNFs) have you deployed? To what percentage of your network? (n=74)
Source: Heavy Reading

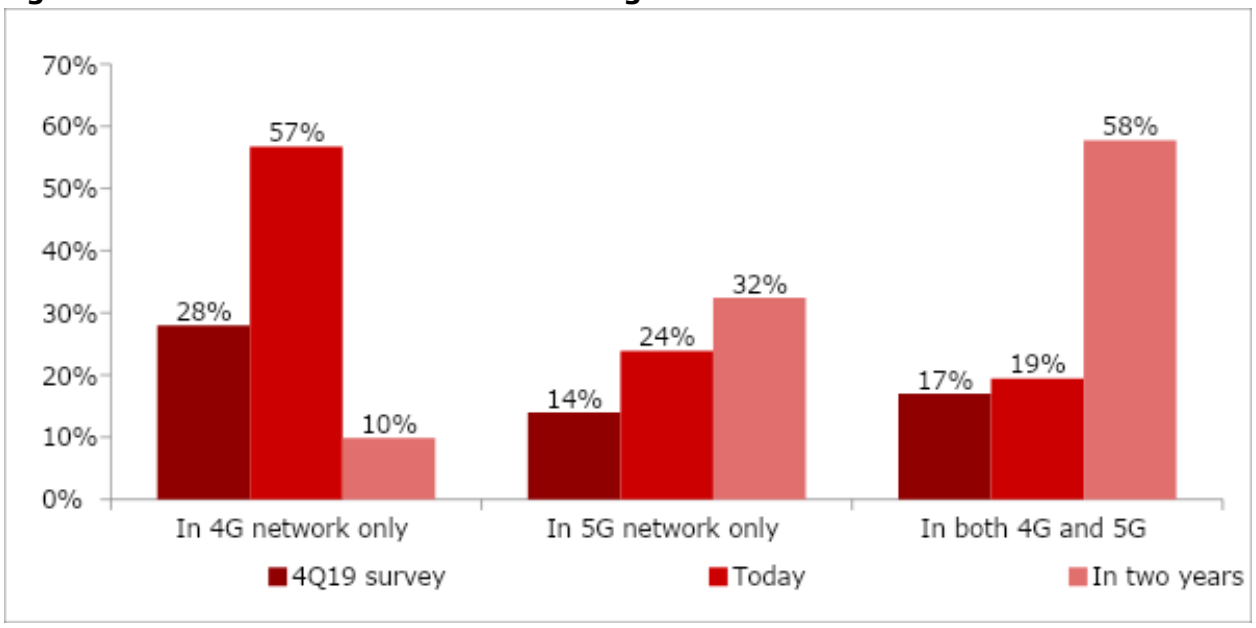
Heavy Reading asked the identical question in 4Q19 (with the exception of the addition of "5G SA core" to this year's survey). This year's results show progress across the board on the implementation of virtualized solutions. All applications, with the exception of vRAN and 5G SA core, have been deployed in more than 25% of the network by two-thirds or more of respondents. vEPC was again the most widely deployed virtual function, followed by vDNS and software-defined wide area network (SD-WAN). vEPC, vIMS/vSBC, and (authoritative) vDNS are centralized functions located in service provider central offices where they can be trialed and managed by onsite network operations. In the case of the vEPC, it is already a collection of discrete functions, lending itself to a virtualized solution. The vRAN, on the other hand, is highly distributed. *Nonetheless, vRAN showed the greatest change from 2019*. Among the respondents, 50% have deployed vRAN in over 25% of the network compared to 4Q19, when only 35% of respondents had achieved the same rollout.

Today, there are more than 7 million physical cellular base stations worldwide, according to Omdia. Multisector antennas account for many more logical base stations. Heavy Reading estimates that the implementation of 5G will increase this number by an order of magnitude over the next 10 years. How are carriers planning to deploy 5G to 2 million sites or more by the end of next year? How do they support that momentum in terms of capex, engineering, and management?

vRAN is an essential part of the answer to this question. It lowers carriers' costs and simplifies management by decoupling RAN hardware from software. In the case of 5G vRAN, it also splits RAN functionality between distributed units (DUs) and centralized units (CUs). As carriers moved first to distributed/cloud RAN and now to open vRAN, the pooling of baseband units (BBUs) or 5G CUs in a carrier-controlled data center has a double advantage. This pooling simplifies RAN management logistics and costs and creates an environment that can easily benefit from virtualized, shared resources.

The responses to Heavy Reading's survey reflect these considerations. vRAN implementation has accelerated noticeably over the past 12 months. **Figure 2** shows the results from both the 4Q19 survey and the current 2021 survey ("Today" and "In two years") when we asked respondents about their current deployments and those they expect to see two years from now.

Figure 2: RAN virtualization is accelerating



Question: Do you have a vRAN today? (n=71; 2019 and 2021)
Source: Heavy Reading, 2019 and 2021

When compared to Heavy Reading's 4Q19 survey, the 2021 survey results show a doubling of CSPs deploying vRAN in 4G-only networks and an increase of 66% in carriers deploying vRAN in 5G networks only. Two years from now, the respondent's numbers flip, with the majority (58%) deploying vRAN into both 4G and 5G networks and only 10% seeing vRAN in 4G networks, alone.

These percentages may seem high, particularly to those familiar with North American implementations of vRAN. It is important to note, however, that Omdia's quarterly carrier infrastructure analyses show North America trailing behind all other regions (Europe, Middle East, and Africa [EMEA], Asia/Oceania, and Caribbean/South America) in vRAN deployment. Another important note is that these numbers reflect virtualization in the CU, but not necessarily at the cell sites or DU locations. Early cloud or centralized RAN (C-RAN) implementations, mostly in 4G networks using baseband pooling in centralized locations, are included in these vRAN numbers. The virtualization of the DUs as part of 5G vRAN implementations is just now getting underway.

GREAT EXPECTATIONS FOR vRAN SOLUTIONS

Heavy Reading queried the service providers regarding what benefits vRAN would bring to the network. Over 50% of the respondents saw benefits in each of the following attributes (listed in order of percent of respondents):

- Reduced capex/opex/total cost of ownership (TCO)
- Simplified management and large-scale orchestration
- Faster time to market
- Improved performance

As carriers increase their number of cell sites dramatically over the next decade, they clearly see the advantages of a vRAN running on a white box platform and believe these will offer a significantly lower cost profile. White box solutions will also decrease the number of stock-keeping units (SKUs), speed up service introduction, simplify spare parts sourcing and logistics, and improve mean time to repair (MTTR). Improved and simplified management that leverages artificial intelligence (AI) and machine learning (ML) for proactive management is also a clear advantage of emerging vRAN solutions.

However, carriers do not expect vRAN implementations to solve all their challenges. Only 32% believed vRAN would improve customer retention and 28% believed it would increase revenue. Nevertheless, if vRAN meets the expectations of the above four bullet points, those attributes are very likely to result in better customer retention and increased revenue.

These perceived benefits translate neatly into the attributes that carriers expect from a vRAN platform. In choosing vRAN solutions, carriers have indicated they care most about the attributes listed in **Figure 3** (in order of importance, from most to least important).

Figure 3: Top six attributes: 2021 vs. 2019

Attribute	2021 order	2019 order
Performance	1	2
Reliability	2	4
Security	3	1
Cost efficiency	4	3
Easy to manage	5	6
Energy efficiency	6	5

Source: Heavy Reading

This order is a bit of a shake-up compared to last year, when security earned top marks. Performance and reliability are now ranked as most important. Meanwhile, security and cost have both moved down in the rankings. When looking at carriers with revenue of less than $5bn, the rankings hold steady for the most part. Performance is still the most important. However, cost and reliability have switched places—not surprising among the cost-conscious smaller carriers.

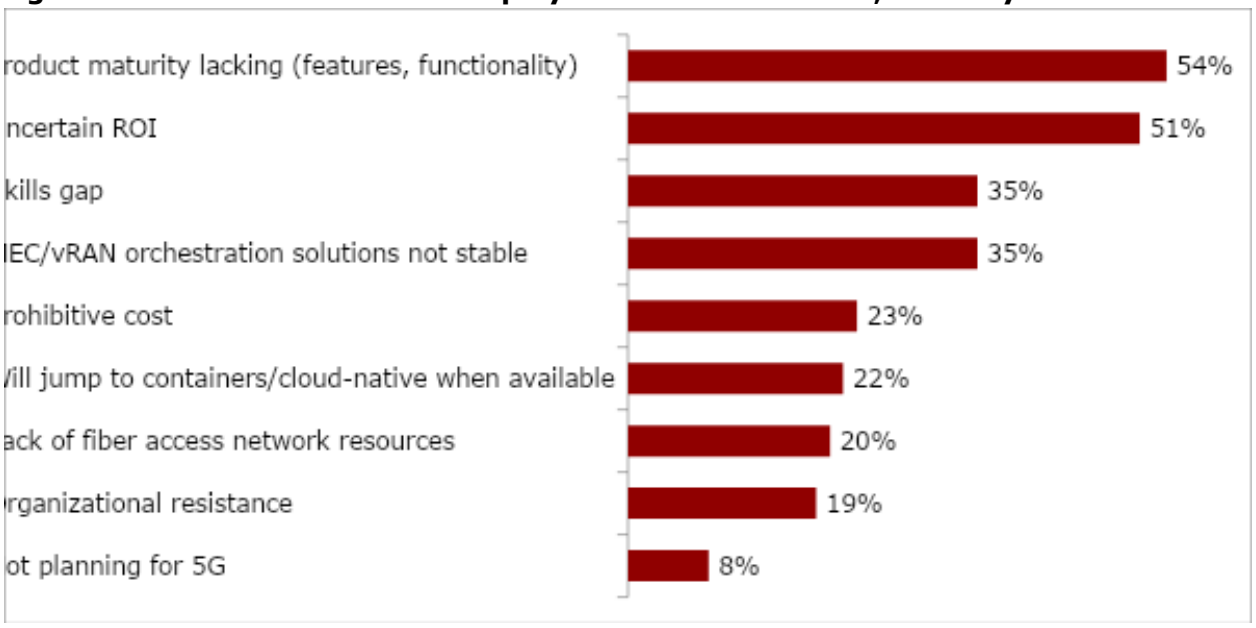
Despite sustainability goals and some carriers aiming to be carbon neutral by 2025, energy efficiency is the least concern for respondents. Energy efficiency goals certainly figure in requests for proposal (RFPs) issued by the carriers, according to Omdia data, but these goals appear to be taken for granted and do not translate to platform concerns on the part of respondents.

Heavy Reading continues to be intrigued that "management" is not of concern to the respondents. It appears that respondents are satisfied with the current management of their RAN and they expect the vRAN to be similarly well managed at the component level, with incremental improvements as management systems leverage AI and ML and as carriers move more into vRAN overall and 5G vRAN specifically.

Barriers and speed bumps to vRAN deployment

Heavy Reading's survey base shows remarkable consistency when it comes to anticipated barriers to deploying vRAN. The top five barriers are identical to the 4Q19 survey. However, the gap between the top two concerns and the rest of the field has broadened. "Uncertain ROI" is the only barrier to post a heightened concern, increasing 6 percentage points compared to last year. Barrier 4 (MEC/vRAN orchestration) and barrier 5 (cost) have swapped places. "Not planning for 5G" remains the barrier of least concern and fell 3 percentage points in this year's survey (see **Figure 4**). It is important not to read too much into minor shifts in percentage points in responses. However, "prohibitive cost" dropped 12 percentage points, which is significant. These results suggest that carriers are further along in their preparations for vRAN. Capital budgets have been reviewed, but the business justification side of the ledger still needs some work—with concerns about ROI growing while concerns about "prohibitive costs" and "skills gap" are diminishing.

Figure 4: The barriers to vRAN deployment have not fallen, but they are lower



Question: What barriers do you see to vRAN deployment? Check all that apply. (n=74)
Source: Heavy Reading

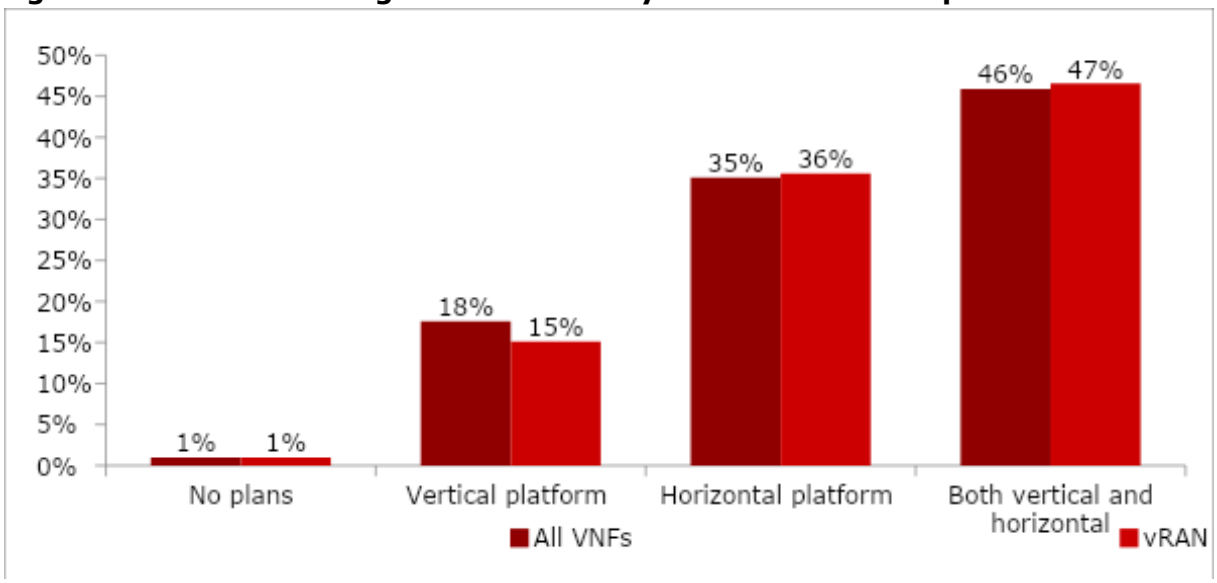
MOVING FORWARD TO CLOUD-NATIVE COMPUTING

Carriers are gathering momentum in their shift to network functions virtualization (NFV) and cloud computing—at least when it comes to how they choose their platforms. Heavy Reading asked respondents whether they favored a horizontal platform (NFV infrastructure supporting multi-vendor VNFs) or a vertical platform (integrated, single vendor), or both.

As Heavy Reading forecast last year, both vertical and combination vertical/horizontal platform preferences (and also "no plans") have declined in favor of horizontal solutions (see **Figure 5**). Last year's 30 percentage point gap between "horizontal" and "both" for "all VNFs" has narrowed to a gap of 11 percentage points this year. Heavy Reading expects "horizontal" to pull within five percentage points of "both" next year and to surpass it the following year, as CSPs adopt cloud-native computing with lightweight containers and loosely coupled microservices.

From a carrier perspective, some of the most attractive aspects of cloud-native applications are an ability to scale horizontally and, perhaps most importantly, the ability to avoid vendor lock-in. While avoiding vendor lock-in is a fundamental goal of the CSPs, some continue to choose a single vendor (or vertical) solution for the frictionless implementation enabled in terms of management and interoperability. This is particularly the case with smaller Tier 2 or Tier 3 carriers that are unlikely to have the personnel and skill sets needed to be their own integrators in a multi-vendor environment. When looking at responses from carriers with annual revenue over $5bn, only 4% choose a vertical platform for all VNFs compared with 26% for carriers with annual revenue under $5bn. The results are similar, but not as dramatic, when looking specifically at vRAN, where 8% of >$5bn carriers chose a vertical platform compared to 19% of <$5bn carriers. CSPs typically limit their set of vendors to one or two when it comes to the RAN and it appears that this mindset is not likely to change in the near term.

Figure 5: CSPs are turning more definitively toward horizontal platforms



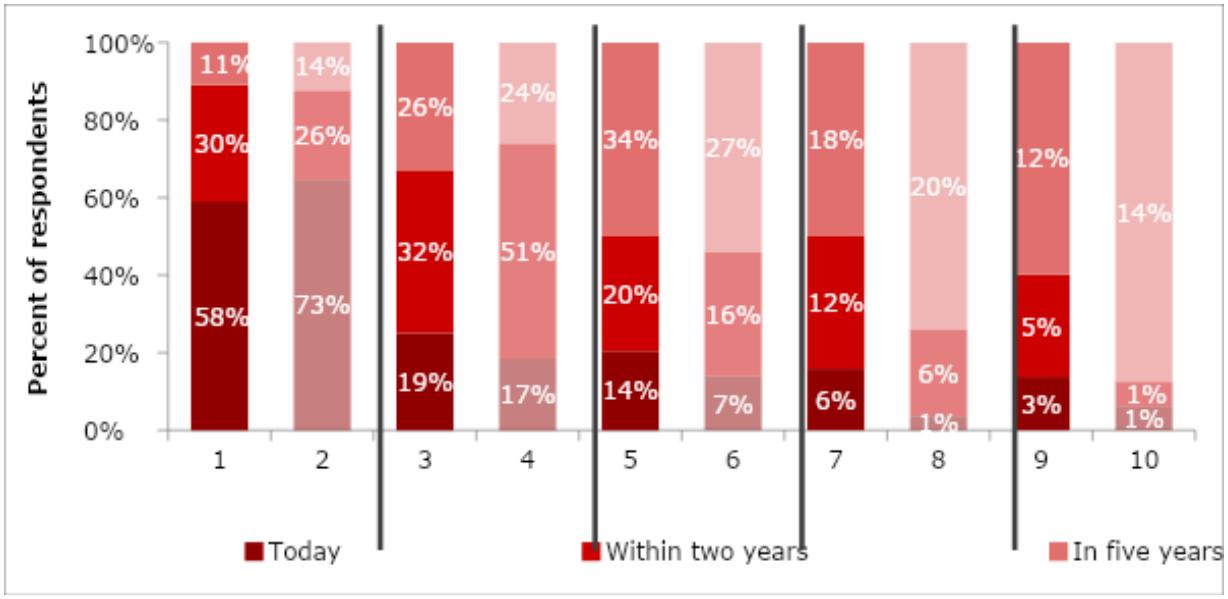
Question: Are you implementing or do you plan to implement a horizontal or vertical solution for your VNFs overall? For vRAN specifically? (n=74)
Source: Heavy Reading

According to Omdia's *1Q21 5G Service Provider Tracker*, 154 commercial 5G services have been launched globally as of the end of 1Q21. This is sharply up from 69 5G commercial services as of year-end 2019. Omdia forecasts that 553 million people will subscribe to 5G services by the end of 2021 (80% will be from the east/southeast Asia & Oceania region). With the pace of 5G deployments accelerating, service providers will also be trialing and implementing cloud-native and container-based solutions at an increased rate.

Looking beyond VNFs to cloud-native network functions (CNFs) and containers, Heavy Reading asked respondents for details about their rollouts of 5G services overall and about the percentage of the 5G infrastructure that would use container technology. The responses to the two questions were very much in sync, indicating that the 5G rollout will be container-based. We also queried the survey base about the pace of the transition to containers for the core network versus the RAN. Heavy Reading expected to see a more decisive turn to containers in the core; however, the use of LTE EPC at the core in early 5G rollouts has delayed the adoption of container technology in the core enough so that the timing for the transition to container technology in the core is in sync with the transition to containers in the RAN.

Despite the impact of the global pandemic, carriers have moved forward with their adoption of container technology in the RAN (see **Figure 6**). Comparing this year's results to those from the 4Q19 survey, Heavy Reading sees the maroon and crimson tide (indicating less than half of the network has transitioned to containers) gradually receding over time. In 4Q19, almost three-quarters of survey respondents stated that only a small percentage, 25% or less, of their RAN used container technology. This year, that figure dropped 15 percentage points. Again, this year's results show the carrier community keeping pace with the cadence of container adoption that they forecast in 2019. If the momentum holds, Heavy Reading expects to see next year's numbers flip from 4Q19, with three-quarters of respondents deploying containers in *over* 25% of their networks.

Figure 6: The use of containers in the 5G RAN is moving beyond the trial stage



Question: What percentage of your 5G RAN infrastructure will use container technology in the following timeframes? (n=79)
Source: Heavy Reading

SUMMARY FINDINGS

Despite—or perhaps due to—the near chaos of the past year in terms of the pandemic, fires, Brexit, elections, and so on, the carriers have stayed the course in executing their plans for 5G, virtualization, and vRAN. Their predictions from Heavy Reading's 4Q19 survey have held remarkably true, as demonstrated not only by our 2Q21 survey, but also by Omdia's market analysis of and forecasts for 5G rollouts and subscriptions.

As carriers start their transition to 5G SA at the core and move to low latency and Internet of Things (IoT) use cases, the next survey may find that they have underestimated their rate of change to vRAN. The next few years will also see a rapid increase in the autonomous vehicle market as it accelerates from its current campus-focused market and moves toward fleet cars. Further advances in AI and ML, potentially through partnerships with hyperscale providers, will also improve network management and troubleshooting, as well as expand the portfolio of services that carriers are able to offer to enterprises.

These are only a few landmarks along the way to 5G and beyond. However, carriers continue to show a strong commonality of opinion that the transition to 5G is a transition to containers and cloud-native network applications, particularly vRAN, and that horizontally focused vRAN implementations will displace vertical implementations.