THE STATE OF 5G 2021

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INTRODUCTION

The great act of faith is underway. From Cape Town to Helsinki, from Taipei to Mexico City, deployment of 5G networks is shifting into high gear. As of this writing, over 100 operators have launched mostly 5G Non-Standalone networks in 48 countries. These operators – mostly, but not exclusively in developed markets – account for 40% of the global mobile subscriber base. Over the next five years, the industry is expected to allocate around $890 billion of capex to 5G roll outs. For context, that is nearly as much as the entire mobile industry generates in revenues annually.[1]

An act of faith? It's not too much of a stretch to describe it that way.

No doubt, historical precedent suggests that when carriers make 5G available, customers will come. It's also true that the industry has participated in a seemingly endless discussion about use case scenarios. Behind the scenes, consultants have laboured long and hard to attach numbers to those scenarios.

Yet no battle plan survives contact with reality. We asked our respondents how they would describe the level of difficulty involved in eight broad challenges of transition, from running 4G alongside 5G to securing their new networks.

Out of all the options, many identified a non-technical challenge as one of the most acute: delivering on the promise of 5G and enabling accelerated deployment of new services for customers.

In one sense, of course, this is simply an indication of progress. To have arrived at the point where technical challenges no longer necessarily loom largest is in itself an achievement. Slowly but surely, over the next year or two, we can expect the business model to start eclipsing the technology as a topic of debate.

Yet before we arrive at the point where faith is rewarded, there are still technical challenges to address, vendor strategies to refine and deadlines to meet. As 5G transition hits its stride, this report lays out the mobile industry's perspective in each of these areas.

40%

40% of the global mobile subscriber base run on mostly 5G Non-Standalone networks

1 GSMA, Global Mobile Trends 2021 (December, 2020). The industry's annual revenues stood at $1.03 trillion in 2019.

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PART 1
STRATEGIES & TIMEFRAMES FOR DEPLOYMENT

PART 1: STRATEGIES & TIMEFRAMES FOR DEPLOYMENT

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The potential pathways between 3G, 4G and 5G are many and various. We asked respondents to describe their network's current status.

THE PRE-4G MARKET

The end is nigh. Nearly 20 years after NTT DoCoMo launched the first network of its kind, 3G networks are being switched off. Only 10% of the mobile network operators we surveyed still have operational 3G networks. Only a very small minority – 2% overall – described themselves as having no 4G network (all said they are either planning or deploying 5G). The majority have 4G in operation alongside 3G, and most are in ongoing transition to 5G Non-Standalone (NSA). Approximately one-quarter are deploying 5G Standalone (SA).

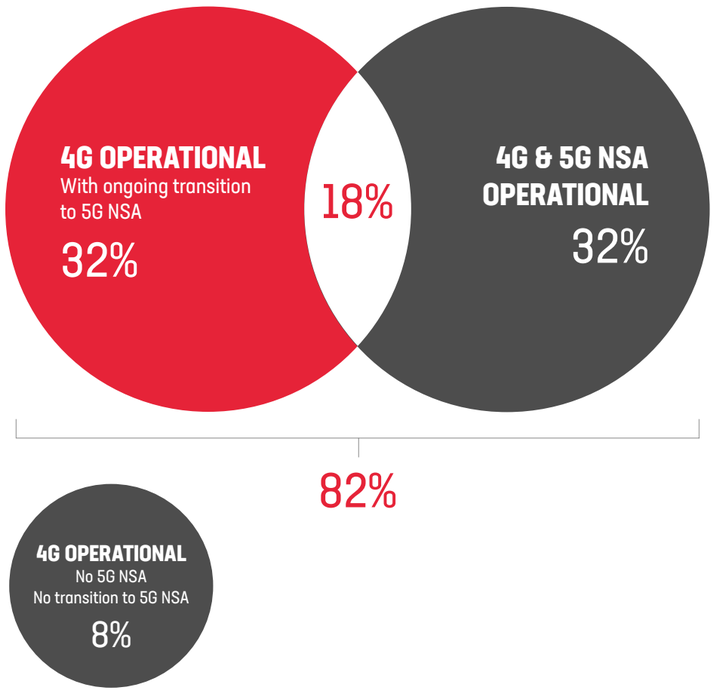
10% of mobile network operators surveyed still have operational 3G networks.

THE TRANSITION FROM 4G TO 5G NON-STANDALONE

4G is the near-universal baseline. But from the operator's perspective – if not yet for users – 4G is a baseline that has started to recede. In 2021, LTE subscriptions will peak at 4.8 billion worldwide, and start to decline thereafter. 5G Non-Standalone will emerge as the new standard for most operators, with 5G Standalone launches continuing to grow in number.[2] Only 8% of the operators we surveyed described themselves running a 4G network without either a planned transition to 5G NSA or 5G NSA already operational.

We allowed respondents a wide degree of freedom to describe their networks. A substantial number described themselves as running a 4G network and managing an ongoing transition to 5G NSA. A nearly equal number described their 4G and 5G NSA networks as operational. Around 18% – visible in the graphic at the intersection in the Venn diagram – subscribed to both categories. Our interpretation is that these operators have their 5G NSA networks up and running (and in that sense operational), but are still working on the final elements of transition.

Q When is your organization likely to complete the transition to 5G New Radio (NR)?

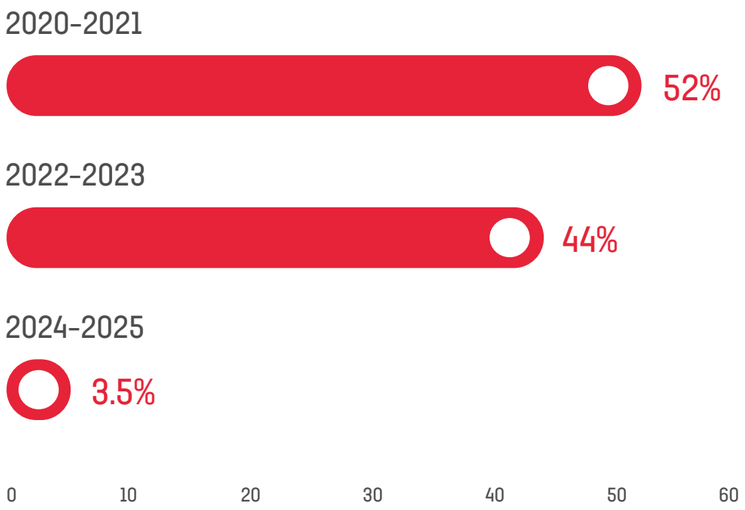


2 Ericsson, Ericsson Mobility Report (November 2020)

TRANSITION TO 5G NEW RADIO

By the end of 2021, a slim majority of our respondents expect to have completed the transition to 5G New Radio. Deployment is moving somewhat faster than core network transformation

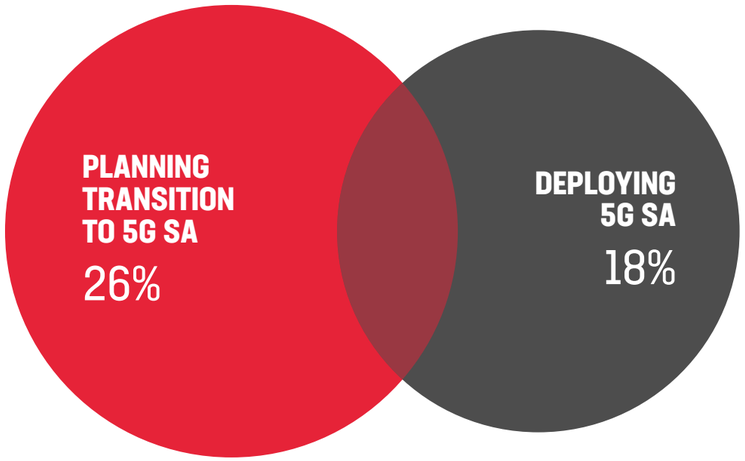
Q When is your organization likely to complete the transition to 5G New Radio (NR)?



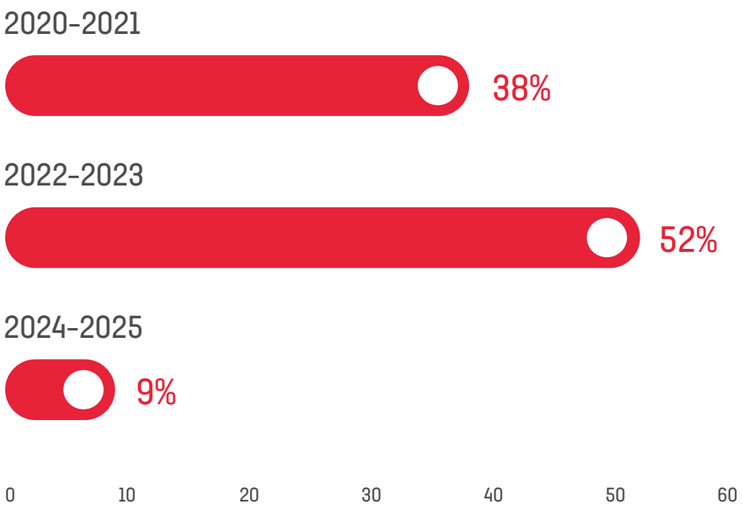
TRANSITION TO 5G SA CORE

We asked respondents about the transition to 5G Standalone in their core networks. Some 18% say they are now deploying 5G SA. A further 26% say they are planning the transition. (As with the transition to 5G NSA, a small number – in this case 2.4% – chose to describe themselves as both planning and deploying.) In addition to this population of planners and deployers, of course, a substantial number of MNOs have already launched 5G SA networks.

Q How would you describe the current status of your organization's mobile network?



Q When is your organization likely to complete the transition to 5G Standalone (SA)?

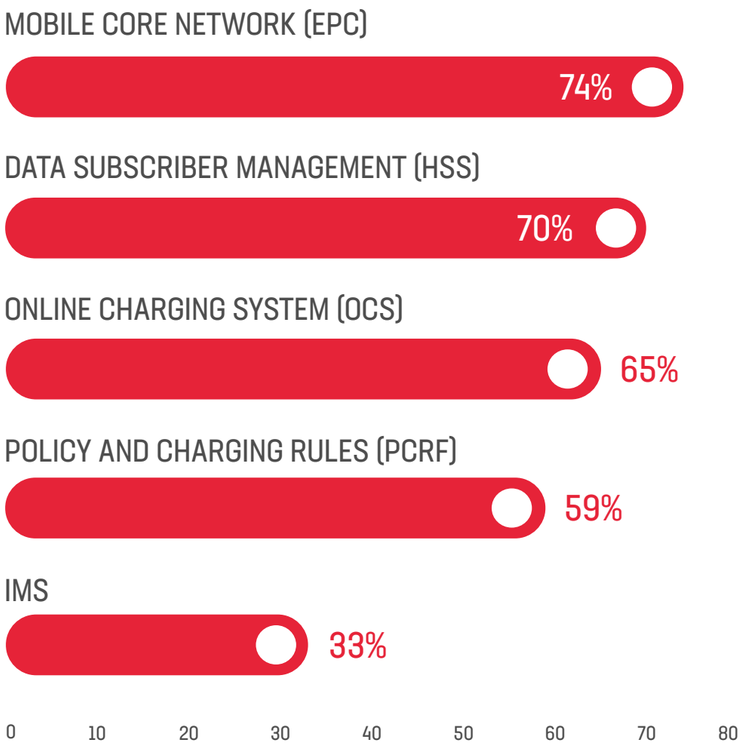


THE PERSISTENCE OF LEGACY SYSTEMS

We offered respondents a list of five 4G systems and asked them to select three that their organizations would continue to support and operate for the longest period of time after 5G deployment. We also asked respondents to rank these three systems in terms of their importance.

By some margin, the two systems most frequently selected for retention and described as “most important” were the 4G Evolved Packet Core (EPC) and Data Subscriber Management (HSS) – a clear reminder that the need to use and operate 4G will persist for a long time. Respondents also identified Policy and Charging Rules (PCRF) and Online Charging System (OCS) as significantly important. IP Multimedia Subsystem (IMS), the 20-year old technology standard, may well be set for a lengthy afterlife supporting voice, but was defined as “important” by only one-third of respondents.

Q Of the 4G functionality your organizations is likely to continue supporting longest after 5G deployment, which do you regard as most important?



NETWORK ARCHITECTURE: VERTICAL OR HORIZONTAL STACKS?

The telecoms industry is traditionally vertical: operators use standards-based technologies from a small group of vendors, arranged in silos, to address more or less regulated national markets. 5G has the potential to disrupt this pattern. Disaggregation, automation, DevOps and APIs have the potential to turn the network into a platform for innovation, defined by agility and ability to scale.

But how will the operators build these networks? Will they be largely based around technology sourced from a single vendor? Or will operators emulate enterprise IT and hyperscale cloud, building stacks that mix and match the best functionality for the job at hand?

The single most important determinant here seems to be size. 78% of the smaller operators we surveyed (those with fewer than 5,000 employees) said that their organizations are most likely to pursue a vertical strategy. Among larger operators, this preference for single-sourcing declines. The preference for a horizontal approach drawing on different suppliers reaches a peak among large, mid-sized operators in our sample (5,000-24,999 employees).

Q **For 5G, is your organization likely to build out a vertical stack, mostly using infrastructure and software from a single supplier? Or are you more likely to build a horizontal stack containing best of breed components from multiple vendors?**

ARCHITECTURAL STRATEGY	ALL RESPONDENTS	SMALLER MNOS < 5K EMPLOYEES	LARGER MNOS > 5K+ EMPLOYEES
Vertical stack / single supplier	73%	78%	52%
Horizontal stack / best of breed	27%	22%	48%

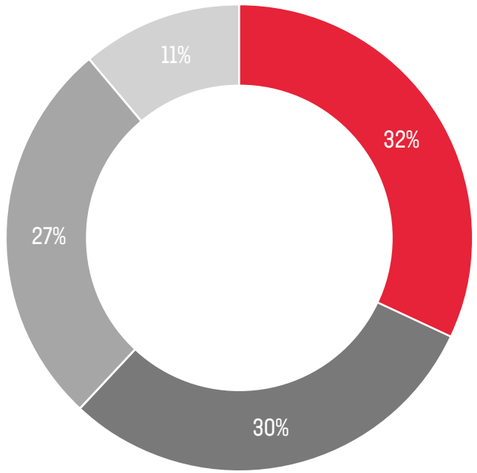
Overall, in the case of operators that employ over 5,000 employees, roughly half are more likely to pursue a vertical strategy, and half are more likely to adopt a horizontal, best-of-breed, approach. One explanation for this contrast may be the work involved in building out a best-of-breed stack. Deployment, integration, operation and maintenance all require a substantial in-house engineering team with the appropriate skills.

But organizational size doesn't explain everything. There are also significant regional variations on display here. Across all respondents, willingness to pursue a horizontal strategy is highest in Asia Pacific Japan (35%) and North America (36%). Horizontal strategy scores lowest and preference for a single-sourced stack reaches a peak in Middle East and Africa (18%). European operators sit somewhere in the middle of the range (24%).

PART 2
VENDOR & PLATFORM STRATEGY

INTEGRATION & DEPLOYMENT: HOW MUCH WILL CARRIERS RELY UPON VENDORS AND SYSTEM INTEGRATORS?

Q To what extent will your organization rely on vendors and system integrators for integration and deployment?



- **32%** Minimal reliance
- **27%** Significant reliance
- **30%** Somewhat reliance
- **11%** Substantial reliance

On balance, the data suggests that a modest majority (62%) of operators will mostly do integration work in-house, with vendors and system integrators playing a minimal or specific role.

But the role of vendors and system integrators differs around the world. In Europe, a general tendency to keep integration work in-house is visible. However, in both APJ and NA, this tendency intensifies, with over one-third of operators saying they will only use vendors and system integrators to a “minimal” degree. In the Middle East and Africa, dedication to in-house integration is weakest. Four out of 10 operators in the region say they will rely upon third party integration to a significant degree.

The smaller the operator, the more likely they are to integrate their systems in-house, with only minimal assistance from third parties.

Larger mid-sized operators take the opposing view. We’ve already seen how a preference for best-of-breed deployment peaks this part of our sample (5,000-24,999 employees). Predictably, this preference is accompanied by a strong willingness to rely on vendors and system integrators (75% of these respondents say they will rely on third party integration to a significant or substantial degree.)

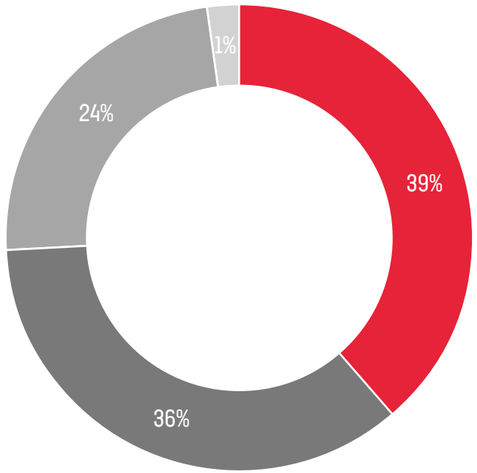
By contrast, the very largest operators (25,000+ employees) adopt what looks like a more balanced approach. Most say they will rely on third parties “somewhat” (46%) or “significantly” (38%). Only 15% of the largest operators say they will “largely” integrate their own systems.

Q To what extent will your organization rely on vendors and system integrators for integration and deployment?

	GLOBAL	ASIA	EUROPE	MIDDLE EAST & AFRICA	NORTH AMERICA
Minimal	32%	39%	32%	22%	36%
Somewhat	27%	20%	37%	29%	21%
Significant	30%	29%	24%	37%	32%
Substantial	11%	12%	8%	12%	11%

EDGE NETWORKS: GO IT ALONE OR COLLABORATE?

Q What is your organization's strategy for edge deployment?



- **39%** Go it alone: we will build our own edge networks
- **24%** Pragmatists: build or partner depending on circumstances
- **36%** Partners: we will ally with public cloud platforms
- **1%** We have no plans to build edge networks

We asked respondents to pick one option from three: are they likely to build their own edge networks, partner with the big cloud platforms or respond to the market pragmatically by doing both? These responses should be seen as a broad index of intent to either compete with, or collaborate with the big cloud platform providers.

Many of the larger operators may have the capacity to go it alone. 46% of the very largest carriers in our survey say they will build their own edge networks. But the data also suggests that the major cloud platforms might meet with some success if they seek to selectively pick off carriers in the middle of the market. Fully 65% of operators with 5,000-24,999 employees say they are willing to partner with the big cloud platforms. Not for the first time, an insurgency might begin among middle-ranking players. Quite clearly, there's also a substantial amount of pragmatism in the air: one-quarter of small operators and nearly one-third of large operators say they are willing to pursue a mixed strategy, both building their own capacity and negotiating partnerships depending on the circumstances.

The regional differences here are intriguing, too. Very clearly, carriers in the Middle East and Africa are a good deal more willing to partner with the hyperscalers than their peers in Asia Pacific, Europe or North America, where the go-it-alone impulse is significantly stronger.

Nevertheless, the cloud platforms will be mildly encouraged by signs of pragmatism in Europe and North America. Although enthusiasm for partnering with public cloud providers is muted in both regions, one-third of European and North American carriers (i.e. 32%) suggest they will mix and match in-house projects with external alliances. In Asia Pacific, sentiment looks more polarised. Half of operators will build their own edge networks. Most of the remainder will opt for partnerships, with only one in 10 adopting a mixed strategy.

PART 3
THE CHALLENGES OF TRANSITION

DEGREES OF DIFFICULTY: THE MOST CHALLENGING ASPECTS OF 5G TRANSITION

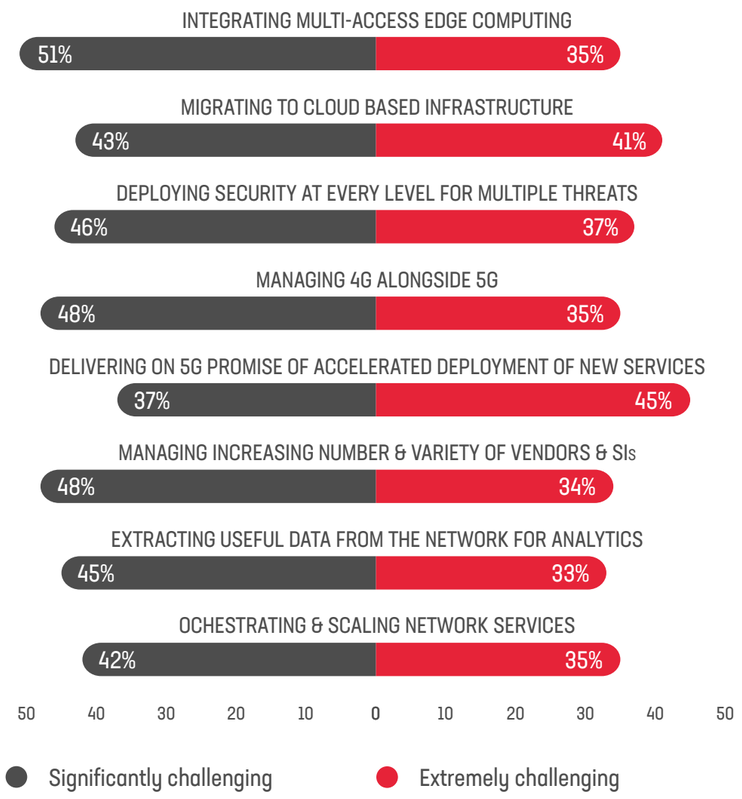
We asked our respondents to score eight high-level challenges of 5G transition according to the level of difficulty involved. Their response might well be summarized as: “Everything is difficult”. From cloud native infrastructure at the top of the list, to analytics at the bottom, differences in the perceived level of challenge were relatively small.

There’s a note of concern visible in the responses to the question that asks whether 5G will allow operators to deploy new services in an accelerated fashion (arguably, one of the major aims of deployment). Fully 45% of respondents described this as “extremely challenging”. At the other end of the scale, Virtually all of our respondents describe themselves as working within IT Operations. But if we dive down into more detailed job functions, it’s clear that different groups of executives are animated by slightly different concerns.

- The C-Suite executives (CIO, CTO, CSO) scored three challenges higher than the others: migration to the cloud, extracting useful network analytics and – perhaps predictably – managing an expanded universe of vendors and system integrators.

- Vice-presidents (EVP, SVP, VP) tended to score one challenge higher than all the rest: delivering on the promise of 5G and enabling accelerated deployment. Next on their list was integrating edge networks. In third place: securing the network. In all three cases, VPs described these broad tasks as significantly more challenging than CIOs, CTOs and CSOs. It may well be proximity to operational reality that triggers these different perceptions. In the case of security, for example, EVPs, SVPs and VPS are more likely to be more aware of the reality of day-to-day threats. By contrast, CIOs and CTOs may find themselves being briefed in the event of a crisis, but not on a daily basis.

Q Please rank the following challenges of 5G transition according to level of difficulty



WHAT ARE THE PRIORITIES FOR A SMOOTH TRANSITION?

We asked respondents about a more defined subset of technical challenges related to F5's product functionality. Specifically, we asked them to rate a series of challenges in terms of their importance in ensuring a smooth transition from 4G to 5G. What's striking here, once again, is the different emphasis employed by different types of decision-maker.

Q Which of the following challenges are most important to resolve in order to ensure a smooth transition from 4G to 5G?

CIO, CTO, CSO

MOST IMPORTANT	VOTE
4G/5G signaling interworking	77%
Unified security policy across 45/5G	66%
Managing both 4G VNFs and 5G CNFs	61%
Migrating S/ Gi-LAN services from/to N6-LAN	45%
Integration with 4G billing systems	44%

The fact that 77% of C-level technical executives believe that 45/5G interworking is so important to ensuring a smooth transition shouldn't come as a surprise. In any hybrid system, the point at which data is traded between different ecosystems becomes a potential point of failure. However, it's notable that the VPs aren't in total agreement (they regard managing virtualized and cloud-native applications in parallel as the most important factor for a smooth transition to 5G).

EVP, SVP, VP

MOST IMPORTANT	VOTE
Managing both 4G VNFs and 5G CNFs	65%
Migrating S/ Gi-LAN services from/to N6-LAN	60%
4G/5G signaling interworking	55%
Unified security policy across 45/5G	50%
Integration with 4G Billing Systems	30%

A note on security: we've seen how VPs tend to score security more highly than C-suite executives as a challenge in the transition to 5G. But just because C-suite executives rate other challenges as more difficult doesn't mean that they don't understand the importance of security. Clearly, they do: in fact, they rate a unified security policy across 4G and 5G as the second most important requirement in transition after interworking.

MANAGERS

MOST IMPORTANT	VOTE
Unified security policy across 45/5G	63%
Managing both 4G VNFs and 5G CNFs =	61%
4G/5G signaling interworking =	61%
Integration with 4G billing systems	41%
Migrating S/ Gi-LAN services from/to N6-LAN	39%

Right down at the operational level ("managers"), priorities jostle for prominence at the top of the list. As a result, this operational audience finds it hard to identify a clear priority for successful transition.

SECURITY PRIORITIES IN 5G STANDALONE NETWORKS

We asked our respondents to rate nine categories of security functionality according to their importance for deployment and initial operation of a 5G Standalone network.

Q Please identify the most important categories of security functionality for deployment and initial operation of 5G Standalone (SA) networks incorporating New Radio (NR)?

CIO, CTO, CSO

MOST IMPORTANT SECURITY ISSUES	VOTE
5G core network signaling =	73%
Edge & IoT services =	73%
Core network configuration services =	65%
Managed service delivery for enterprises =	65%
Cloud RAN security	63%

CIOs, CTOs and CSOs are paid to make judgements about architecture, platforms and ecosystems. On security, their priorities are clear: in order to deploy and operate successfully, carriers need to ensure that the network, from the core to the edge, is uncompromised. By contrast, both VPs and (to a lesser extent) operational managers clearly find it somewhat harder to articulate leading security priorities. In both groups, top priorities diverge significantly from those of CIOs, CTOs and CSOs.

EVP, SVP, VP

MOST IMPORTANT SECURITY ISSUES	VOTE
DDoS defenses / intrusion prevention =	65%
Firewall protection for access network and data centers =	65%
Edge & IoT services =	65%
5G core network signaling =	65%
Core network configuration services	60%

As might be expected, carrier size greatly affects security priorities. Size begets complexity, and complexity can generate a different perspective on vulnerabilities. As we move up the scale in terms of organization size, the security priorities of VPs and managers more and more resemble those of CIOs, CTOs and CSOs. So, for example, in all operators with more than 5,000 employees, secure core network signalling becomes the number one priority. The bigger the carrier, the greater emphasis placed upon it.

MANAGER

MOST IMPORTANT SECURITY ISSUES	VOTE
5G core network signaling =	67%
Managing exposure generated by APIs open to third parties	63%
Cloud RAN/ Security	61%
Roaming network signaling including GTP security =	59%
DDoS defences and intrusion prevention =	59%

There's also the question of infrastructure. For the largest carriers, data centers bulk large in their estate. Accordingly, 70% of respondents in operators with more than 5,000 employees describe securing the access network and data centers as extremely important. Further down the scale in terms of size, this is seen as less of a priority.

CONCLUSION

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5G presents an array of challenges, and operators are choosing to solve them in a variety of different ways. In one sense, this simply reflects the nature of engineering. As Ove Arup, the Danish engineer who led design work on the Sydney Opera House, once said: "Engineering problems are under-defined, there are many solutions, good, bad and indifferent. The art is to arrive at a good solution."

What we can say for certain on the eve of widespread 5G deployment is that many choices are being made. For example, this survey suggests that a majority of operators are sourcing most of their infrastructure and software from single vendors. Among the ranks of larger operators, however, the balance changes, with many more operators open to a horizontal, best-of-breed, approach.

Only a small minority of operators are relying upon vendors to deliver fully-integrated solutions, ready for production. Among the rest, a three-way split is visible, with operators relying on vendors and system integrators to a minimal, limited or significant extent. Larger operators are planning to rely upon these partners partly, but not entirely.

In the case of edge networks, a similarly diverse range of strategies exists. Four out of 10 operators say they will build their own edge networks. One-third will partner with the big cloud platform providers. The remainder will act pragmatically, building and partnering as circumstances dictate.

When we asked our respondents about challenges, priorities were for smooth transition and security threats, and job function visibly affected the pattern of their responses. Overall, however, executives clearly found it hard to prioritise one or two challenges above everything else. The range of perceived obstacles is substantial. Most, if not all, are regarded as significant and highly challenging.

Today, 5G Non-Standalone networks built on top of 4G are starting to become commonplace, with over 100 commercial launches announced by the end of 2020. The next five years will see widespread 5G SA rollouts, and a subscriber adoption curve steeper than that recorded by 4G nearly a decade ago. Only in five to 10 years' time will we properly be able to assess the quality of decisions being made today, which have the potential to reshape the entire industry.

RESEARCH METHODOLOGY

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In November and December 2020, IDG Connect interviewed 164 respondents on behalf of F5 Networks. Respondents were qualified to include those with a job role in IT operations (99%) and security (1%). 20% of respondents worked for large operators, defined as those with over 5,000 employees at both headquarters and overseas offices. 30% worked for organizations with between 1,000 and 4,999 employees. 50% worked for operators with 100 to 999 employees.

17% of respondents were based in North America, 23% in Europe, 30% in Asia Pacific Japan (APJ) and 30% in Middle East and Africa (MEA). (The group of respondents in MEA were substantially recruited from the Gulf and North Africa. As a result, data for MEA in this survey should not be interpreted as offering authoritative guidance to 5G deployment in sub-Saharan Africa.)

38% of respondents had the job title CIO, CTO or CSO. 12% worked as executive vice-president, senior vice-president or vice-president. 50% were directors or managers.

30% respondents worked for organizations with between 1,000 and 4,999 employees.

50% respondents worked for operators with 100 to 999 employees.

17% of respondents based in North America

23% of respondents based in Europe

30% of respondents based in Asia Pacific Japan

12% of respondents worked as executive vice-president, senior vice-president or vice-president

38% of respondents had the job title CIO, CTO or CSO

50% of respondents worked as directors or managers

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