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Next Steps for 5G
Survey Report
August 2020

ENTER

Telecoms Industry Shows Measured Optimism About 5G

Since the first commercial 5G services were switched on in the first half of last year, many more 5G networks have gone live throughout the world. According to the tracking by research house Omdia, by the end of Q2 this year over 70 mobile operators across more than 40 countries have launched 5G, bringing fast mobile or fixed wireless broadband connectivity to millions of consumers. Omdia forecasts that 5G is on track to reach mass market adoption faster than any previous mobile generation with close to 2 billion subscribers by the end of 2024. Meanwhile, the mobile industry has also started embracing the advanced phase of 5G, in particular the standalone mode, which will help operators realise 5G's potential of billions of additional value through serving industrial and other business use cases.

Such a background makes it a good time to take stock of 5G's performance in its first year and start looking ahead towards what should be expected, and what should be avoided, in the years to come. To this end, Telecoms.com has recently conducted an industry survey to gauge the sentiment towards 5G so far, and to gather the industry's views on the new technology's successes and challenges.

The enthusiastic response of the industry is encouraging. By the time the survey was closed in mid-July, a total of 344 participants had responded to the survey and shared their views on a range of questions related to 5G Technologies, 5G Security, and 5G Expectations.

The three biggest groups of companies represented in the survey are vendors and system integrators, each at 24%, followed by mobile network operators (MNOs) or mobile virtual network operators (MVNOs), at 21%. In terms of the participants' job functions, 22% of the total respondents were C-level executives and VPs, including those heading their organisations' IT departments. This was followed by mid-level management (19%), engineers and developers (18%), and sales and marketing personnel (17%).

The survey has attracted plenty of telecoms veterans. Over a quarter of all respondents (26%) had been in the telecoms industry for more than 25 years, and just under a quarter (23%) had been in the trade between 20 and 25 years. Geographically, the largest proportion of respondents are based in Europe (40%), followed by the group from North America and Asia Pacific, each at 21%. Incidentally, these three groups combined also represent the majority of the markets where 5G has gone live.
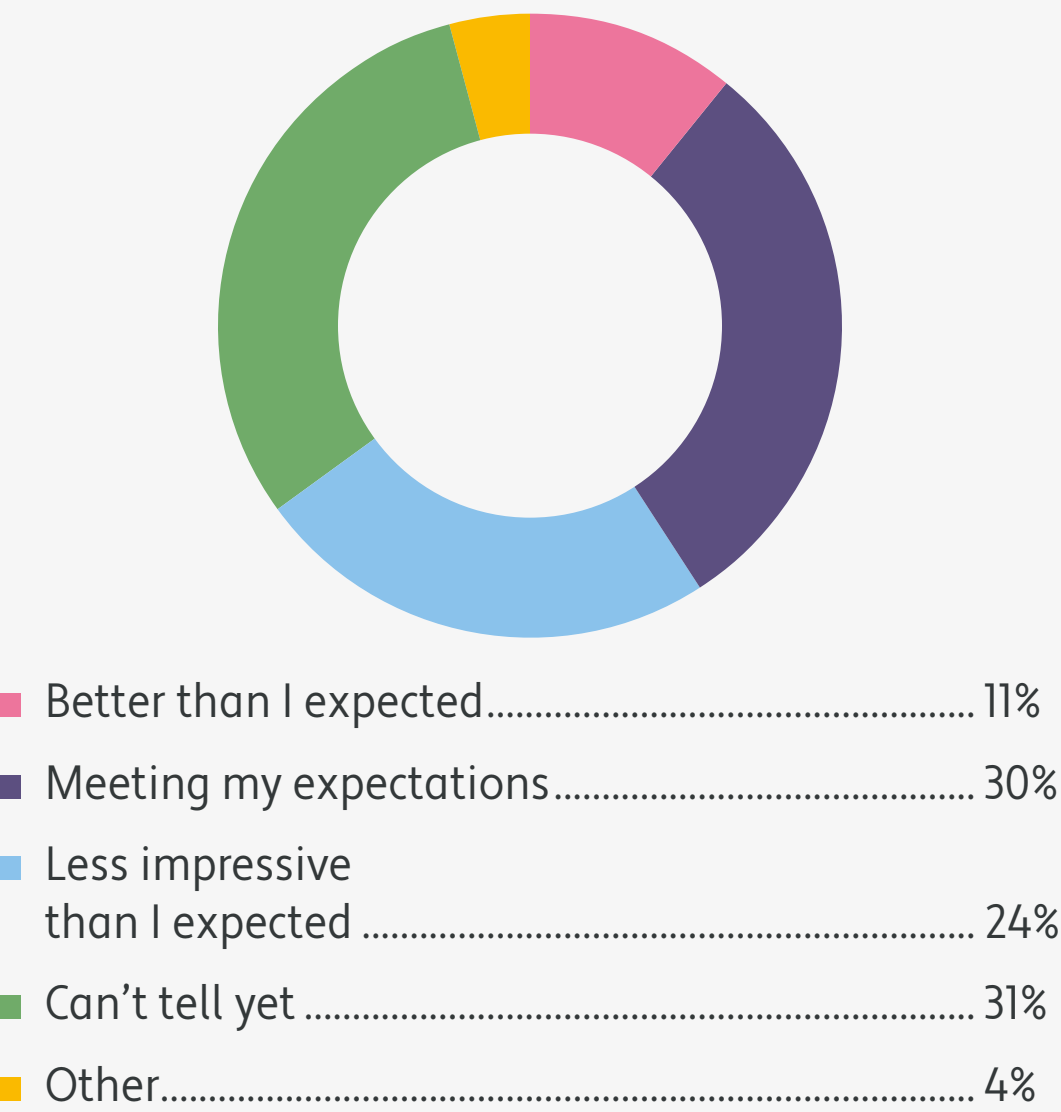
The demographics of the respondents showed that the large majority of the respondents have an intimate understanding of the technologies, a close relationship with the market and customers, and a rich experience in the telecoms industry. The responses to the survey can therefore be read with a high level of confidence as representing the true attitude of the telecoms industry towards 5G.

The survey opened by asking the participants to rate the overall performance of 5G so far against their expectations. The good news is 41% of all respondents felt that 5G has either met or exceeded their expectations. About a third of respondents, primarily from the markets where 5G is yet to launch, understandably said they could not tell. The less good news is that about a quarter (24%) of survey participants felt underwhelmed by 5G's performance.

Figure 1-1

5G's Overall Performance

How would you describe 5G's overall performance since the first commercial services went live in 2019?

- Better than I expected 11%
- Meeting my expectations 30%
- Less impressive than I expected 24%
- Can't tell yet 31%
- Other 4%

The rationale behind the mixed responses became clearer when the participants responded to questions on their greatest expectations for 5G and what leading challenges they see 5G facing. Three quarters (74%) of the respondents expected to see 5G enable new use

cases to generate additional value, for example high-quality video experience, or industrial automation. Fifty-six percent saw 5G delivering stronger network customisation capability for operators to meet new and unique customer demands, for example end-to-end network slicing, or deployment of private networks.

When it comes to challenges 5G is likely to face, over half (54%) of all the respondents believed the failure to deliver on 5G's high promises would be the biggest worry. There is a high degree of overlap between those choosing this option and those who felt 5G has been less impressive than expected. Which is understandable, considering, for example, consumers have not experienced anything close to "gigabit per second" speed. What the industry should pay heed to is that the gap between promises and what 5G actually delivers should not grow any wider, to further thwart customers' enthusiasm for 5G. The second biggest challenge for 5G, according to participants in the survey, would be the high cost of deploying and operating 5G networks.

Overall, the industry professionals who answered the survey were largely happy with what 5G has achieved in its first year of commercial operation, and confident in its prospect of success, but not without reservation, especially the concern over how well 5G will be able to deliver on its high promises to consumers and business users. All these questions are explored in more detail in the following sections of the survey.

Written by Wei Shi
Intelligence Content Manager
Telecoms.com

5G Technologies

All the 5G promises, be they targeted at businesses or end users, need to be underpinned by the technologies before they can be delivered. Meanwhile, precisely because of the different expectations by different customer types, 5G technologies need to be looked at by the use cases they enable.
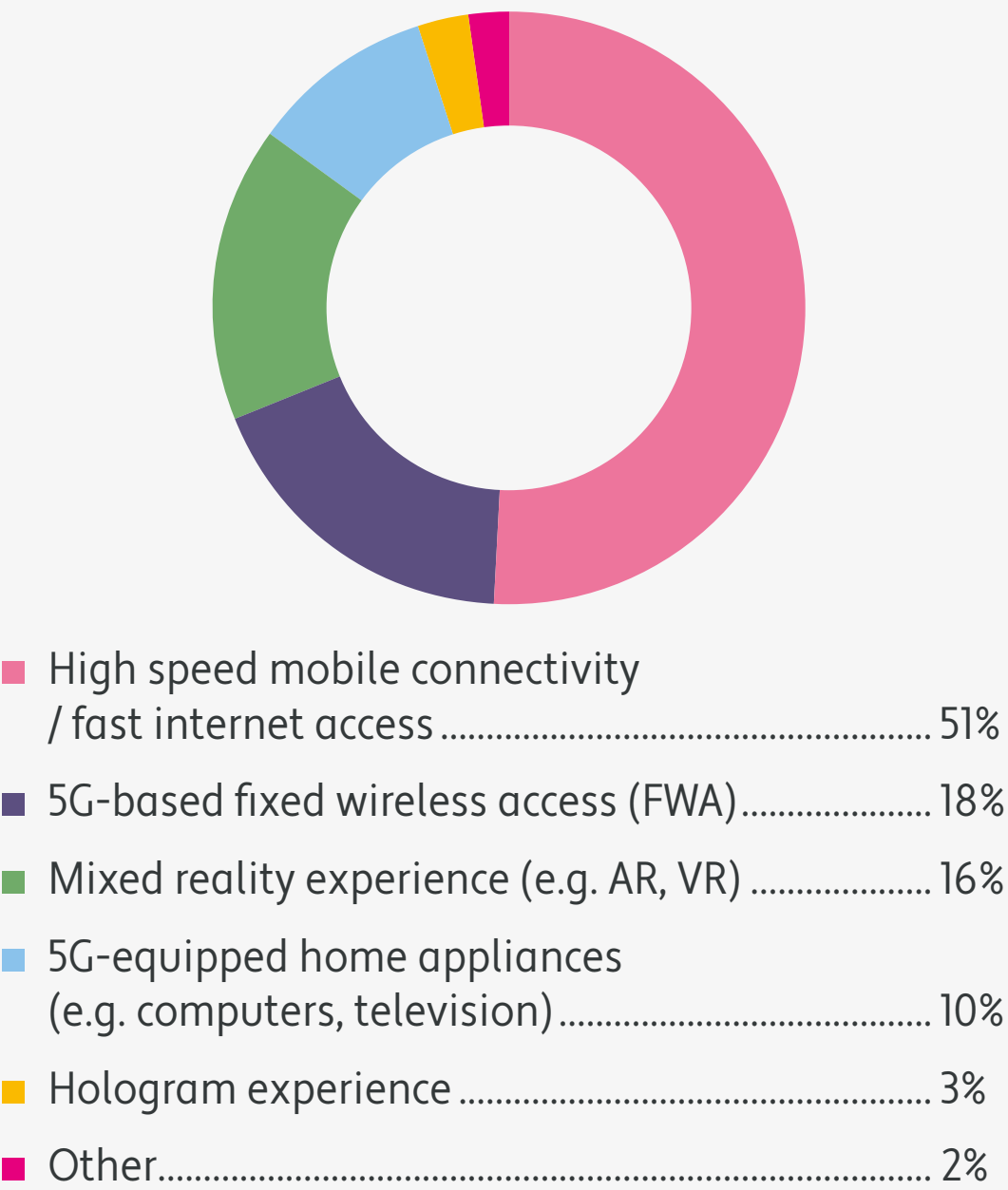
When asked to name the technology that will have the strongest consumer appeal, over half (51%) of the respondents chose "high speed mobile connectivity/fast internet access". In a distant second place is "5G-based fixed wireless access", selected by 18%. In other words, nearly seven out ten survey respondents believe fast internet access, be it mobile or fixed wireless, is the technology most appealing to consumers.

Such an overwhelming preference is by no means a surprise. The majority of the more than 70 live 5G networks rolled out by telecom operators around the world are consumer facing, and 5G benefits communicated to consumers are predominantly focused on high speed connectivity. We often see messages like "you can download an HD movie in a few seconds" in marketing materials. This no doubt is the most visible consumer benefit, but it is only part of the equation (not to mention missing the point that downloading has largely given way to streaming when it comes to digital content consumption). Sixteen percent of respondents also believed mixed reality experience (augmented reality, virtual reality, etc.) will have the strongest appeal, while 10% went for 5G-equipped home appliances.

Figure 2-1

5G Technologies Appealing to Consumers

Which of these technologies will have the strongest consumer appeal?

- High speed mobile connectivity / fast internet access 51%
- 5G-based fixed wireless access (FWA).................... 18%
- Mixed reality experience (e.g. AR, VR) 16%
- 5G-equipped home appliances (e.g. computers, television) 10%
- Hologram experience 3%
- Other.. 2%

While superfast internet powered by 5G may be appealing to consumers, the value that differentiates 5G from previous mobile generations lies more in serving business use cases. The difference between consumer market expectations and those in the business world is also clearly reflected in the survey results.

When asked to select which technology will have the strongest appeal to business customers, 47% of the respondents selected ultra-reliable low latency communications (URLLC), which can enable specialised industrial services, for example autonomous vehicles and manufacturing automation control. A quarter (25%) of the respondents believed massive Machine Type Communications (mMTC), in particular industrial IoT, has the best chance to win over business customers, while the third key pillar of 5G from the outset, enhanced Mobile Broadband (eMBB), came in a close third with 24% of the votes.

Figure 2-2

5G Technologies Appealing to Businesses

Which of these technologies will have the strongest appeal to business customers?

- Ultra-Reliable Low Latency Communications 47%
- Massive Machine Type Communications 25%
- Enhanced Mobile Broadband...24%
- Other..3%
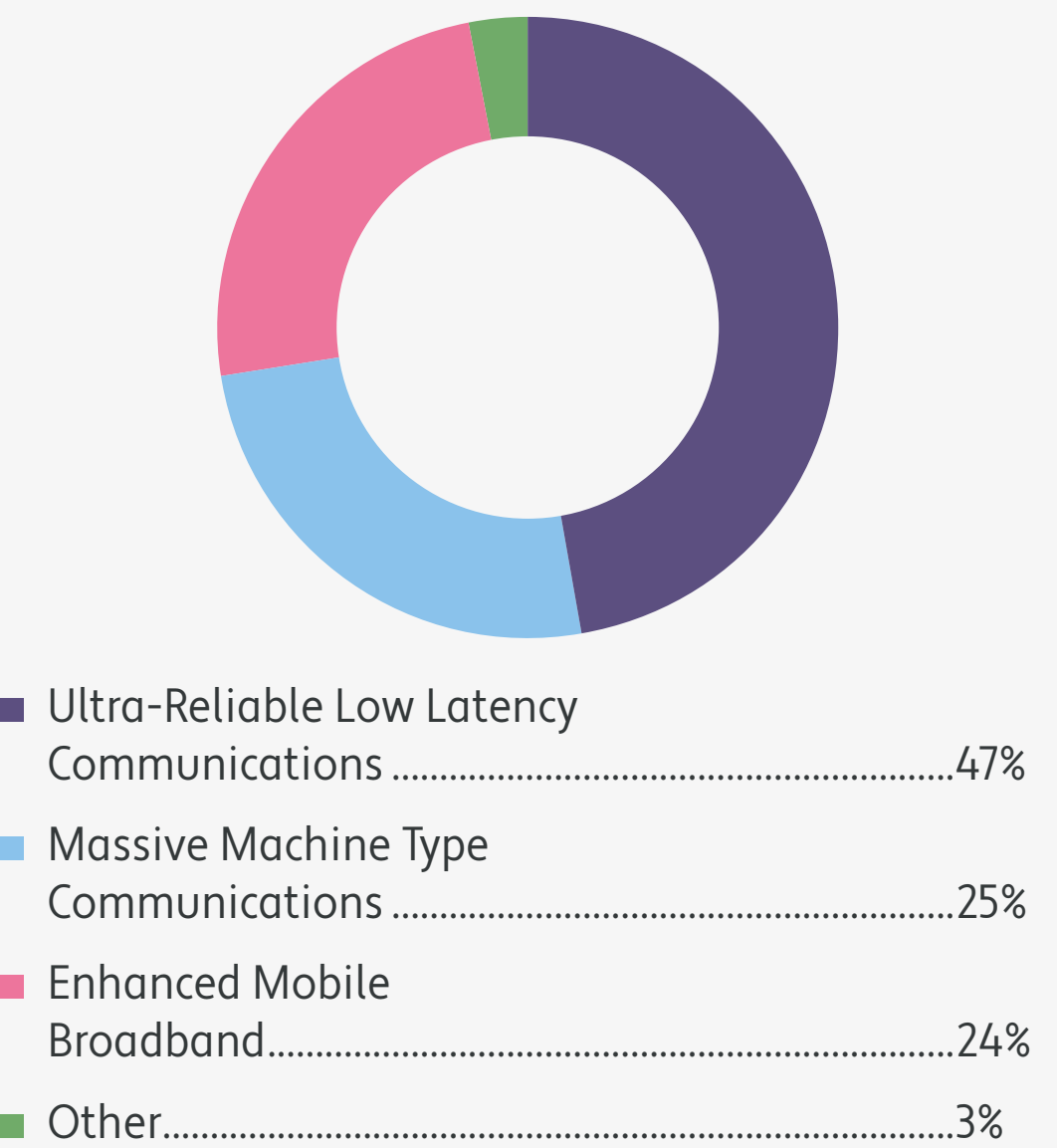
To deliver the benefits to business customers and end users, 5G operators have pledged and made huge investments in rolling out the networks and launching services, on which they expect return. When it comes to assessing which technologies are likely to make the biggest contribution to service providers' 5G businesses, the respondents' opinions are very varied, though the top three choices clearly reflected the strong trend for mobile networks to move towards software centricity and virtualisation. Forty-seven percent of respondents chose process automation as the biggest business contributor. This is closely followed by the migration to cloud native on 44% and next generation analytics on 43%. In addition to generating new values, all three factors have the potential to improve the efficiency of operators' network and business operations.

No one would expect 5G's customer benefits and business contributions to be delivered without challenges. The survey therefore also asked the industry professionals to pick the biggest impediments to the success of 5G. They came in two groups: technology challenges and market challenges.

Virtualisation was identified by 48% of the survey respondents as the leading technology operational challenge. It has been known to the industry experts that delivering virtualisation on telecom networks, for example network function virtualisation (NFV) and network slicing, is time consuming and expensive, and not always successful. As one of the leading operators in exploring virtualisation, Orange learned this the hard way. The operator's Spanish subsidiary spent nine months and €6 million to onboard one single virtualised function. This also helped propel the operator to adopt a different route by launching X by Orange Spain service suites on public cloud (in this case AWS). Virtualisation on advanced 5G, i.e. standalone mode on
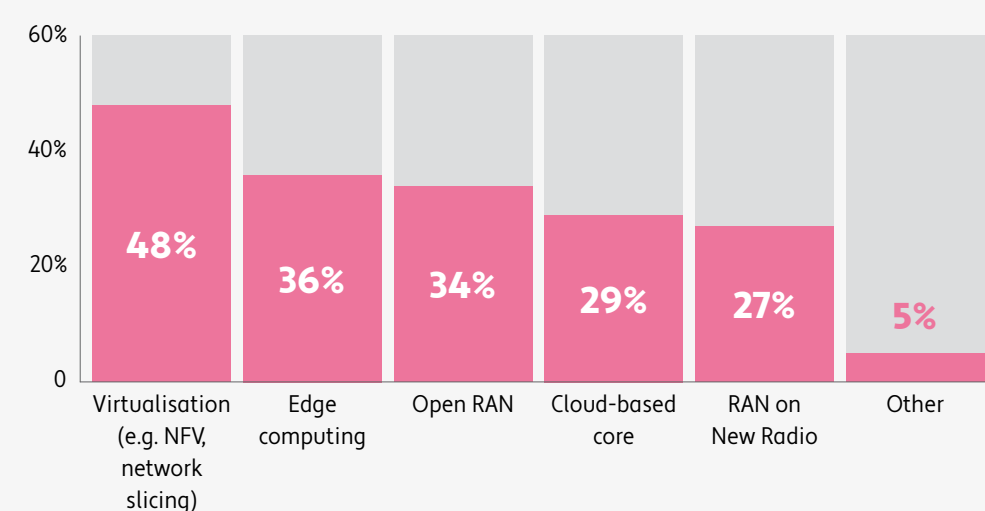
next generation 5G core, should be more straightforward. Contributions by industry bodies like IEEE, including the recently published fronthaul packet transport standard, will facilitate the implementation of scalable virtualised RAN (V-RAN). But clearly the survey participants are not taking it for granted.

Following virtualisation, in distant second and third positions on the technology operational challenge list are edge computing (36%) and Open RAN (34%). Each of these domains has seen concrete progress being made by the industry players in recent years, however question marks are still hanging over their prospect of complete success. For edge computing, although 5G operators have a strong motivation to aggressively promote it, there are plenty of challenges for them, from the lack of knowledge about enterprise edge to competition from public cloud and third-party companies. For Open RAN, despite the momentum it has gained recently, its success on commercial 5G networks is still untested.

Among the market impediments, 24% of respondents saw too much proprietary technology as a leading challenge as it results in vendor lock-in. This is understandable, as the 5G market is dominated by a small number of suppliers. In this sense, Open RAN, and lately Open Core initiatives are welcome news to the 5G operators, but they are still in their early days. Next on the list is the lack of affordable consumer devices, chosen by over 20% of the participants. Though an increasing number of 5G smartphones have hit the market, as well as many 5G-equipped customer premises equipment (CPE) devices such as home routers, they are generally priced with a premium.

We can only expect 5G smartphones to enter mainstream segments when plenty of products come with a retail price of below $500, leading industry analysts have told Telecoms.com Intelligence. And there is the all too obvious absence of Apple in the market, which is expected to change later this year.

Figure 2-3

5G Technology Challenges to 5G Success

Which are the biggest operational challenges in 5G technologies?

Figure 2-4

Next Steps for 5G Industry Survey

What is the biggest market impediment to the delivery of 5G services?
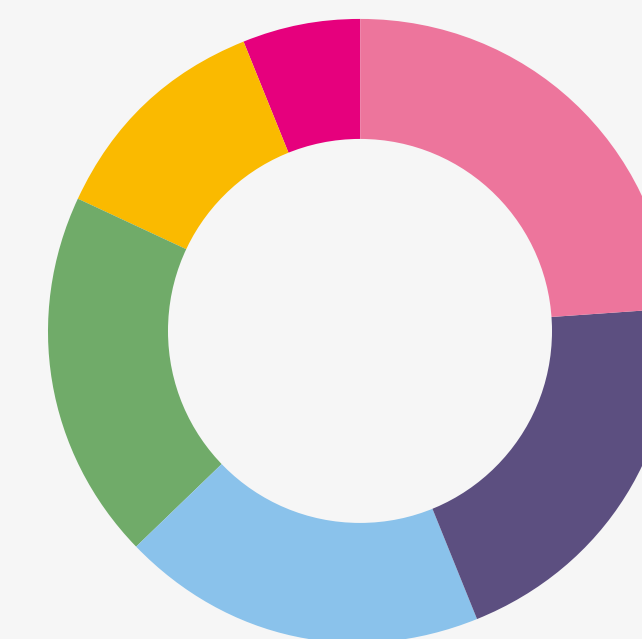
- Too much proprietary technology resulting in vendor lock-in.........................24%
- Lack of affordable consumer devices...................20%
- Delayed migration from non-standalone mode to standalone mode........................19%
- Spectrum availability 19%
- Fragmented standards..............................12%
- Other..6%

Therefore, in the context of high expectations and plenty of challenges coming in different shapes, it is hardly surprising to see that the survey participants are not desperate to talk about what will come after 5G. Though some operators and vendors have shared their 6G visions and two annual 6G Summits have been held, when asked about their expectations for next generation mobile technology, 27% of the participants in the survey believed it too early to think about next generation just yet. Additionally, nearly half of all the participants thought the next generation would either "largely deliver what 5G has promised but failed to deliver" (24%), or it would "only provide incremental improvement over what 5G can offer" (22%).

Last but not least, the survey also asked where the industry professionals get the information on the latest 5G trends and technologies, as effective and timely dissemination of information is important for all in the industry. As it turns out, nine of out ten survey participants (89%) received information from technology news sites and blogs, over half of the participants (52%) also saw trade events and conferences as a major means of staying updated with the latest technology, while 40% of participants read scholarly journals and trade publications.

In general, participants in the survey expected different 5G technologies to deliver value to consumers and business customers, though they clearly saw more value contribution coming out of industry use cases. They also had a sobering recognition that before 5G's potential can become reality, plenty of challenges need to be overcome, both by maturing new technologies and navigating new market dynamics.

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5G Promises to Power Industry Innovation

From smart cities to smart factories, e-health to augmented reality, many of the most promising emerging technologies rely on 5G. The new survey by Telecoms.com Intelligence finds that while consumer-facing innovations, like high-speed networks, have received the most attention thus far, many of 5G's unique benefits will impact businesses even more and drive industry innovation forward.

Survey respondents predict manufacturing, transportation and healthcare are the industries most likely to benefit from 5G. Among 5G technologies, they believe ultra-reliable low latency communications (URLCC), which could enable advances in autonomous vehicles and industrial automation, will have the greatest appeal to business customers.

With 5G enabling highly anticipated advances in "smart" technologies, it's no surprise respondents believe that industry will see significant value. Smart cities will manage transportation, lighting, waste, electric grids and many other essential functions via the 5G network. Smart factories will improve their energy and waste management to reduce their environmental impact, while implementing more advanced inventory tracking methods to prevent stock-outs.

In healthcare, wearable devices will continuously monitor patients, keeping doctors updated and speeding diagnosis and treatment. Retailers will use 5G to manage inventory, speed up mobile pay transactions, and expand mobile commerce. In addition, 5G will enable sophisticated traffic management systems for unmanned aerial vehicles, expanding their use in agriculture, package delivery, critical infrastructure inspection, and more.

A new era of connectivity is just beginning, and these survey results show that telecom leaders are excited about the many industry advances 5G will enable and the growth opportunities it will create for businesses worldwide.

5G Security

Security concerns are as old as telecom networks themselves. They range from something as innocuous as a hardware failure to a sophisticated cross-border coordinated cyber-attack. The impact of security compromise may not even be in proportion to the level of sophistication. In a recent high-profile case in December 2018, millions of users on O2 in the UK and Softbank in Japan were taken off the grid for hours, simply because the certificate of two pieces of software installed on the network SGSN had expired.

With 5G being rolled out throughout the world, telecom operators and other industry players are facing new security challenges. While the networks and tools to defend them are becoming more advanced, especially with the more important role software plays in network and business operations, vulnerabilities are also becoming harder to detect. Even nefarious players are getting smarter. Telecommunication networks are now increasingly under high scrutiny by state-owned agencies. Cyber-attacks have reached a new plateau during the COVID-19 pandemic. For example, artificial intelligence (AI) is increasingly being used to manage networks and optimise services, but it is also being used for cyber-attacks.

In parallel, the attack surface is growing exponentially in virtualised networks due to 5G architecture virtualisation and cloud transformation, the number of applications and services brought by 5G, and the increasing number of IoT devices connected.
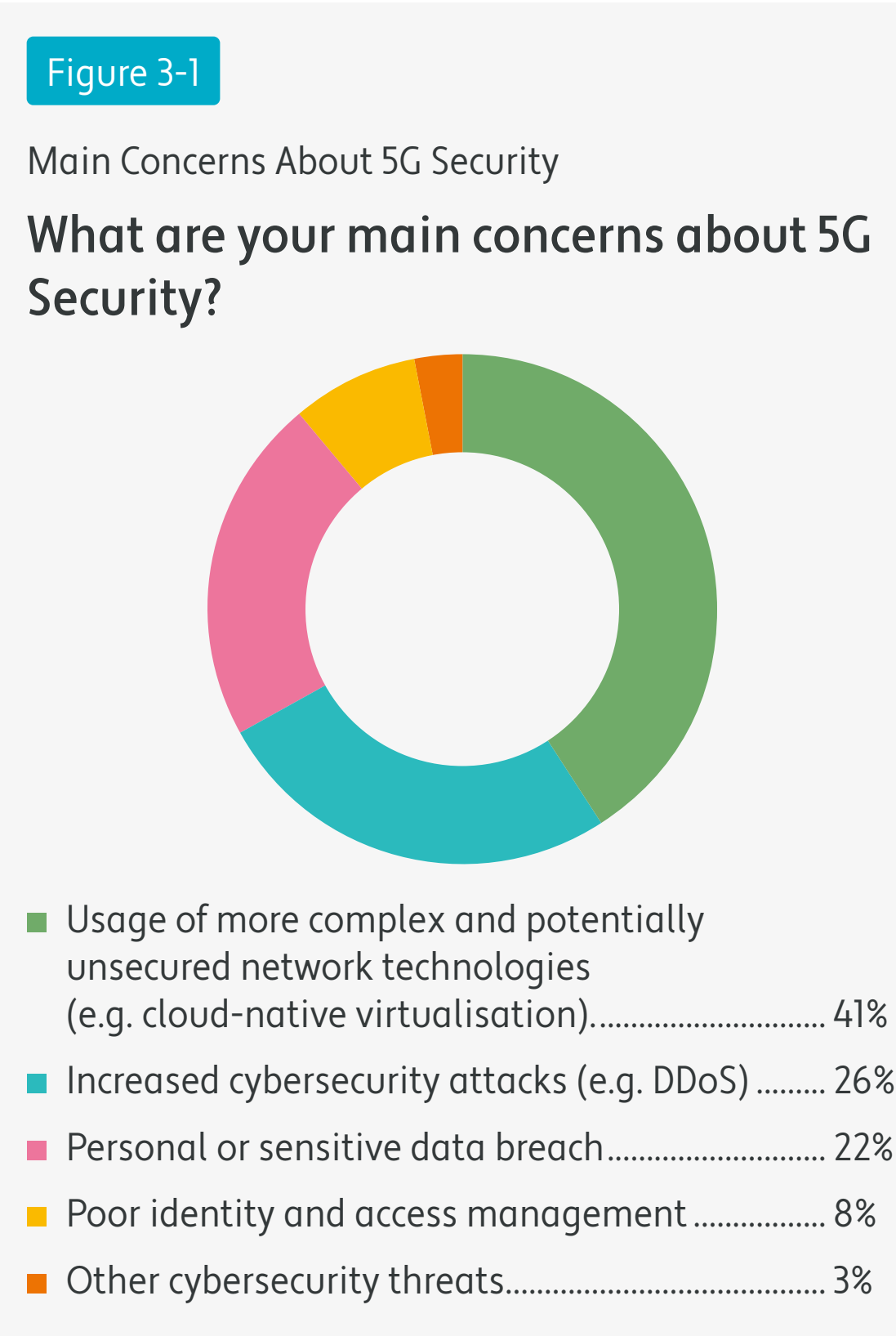
To cap it all, data protection regulations are getting stronger; the EU's GDPR is already shaping data protection globally (as it seeks to protect people's right to the collecting and sharing of their personal data) and the EU's ePrivacy Regulation is in preparation.

Focusing on the privacy of individuals as it relates to electronic communications, it will require organizations to take security measures regarding the pseudonymisation and encryption of personal data, and the confidentiality, integrity, availability and resilience of processing systems.

Therefore, it is no surprise that the industry's security concerns also change as we move into the 5G era. When asked to name their main concerns about 5G security, 41% of the survey participants selected "the use of more complex and potentially unsecured network technologies" like cloud native and virtualisation. This can be an indicator of the uncertainty the telecoms industry feels about the migration from an environment of monolithic networks supported by specially made software to one of more open architecture and software centricity.

In second place, chosen by 26% of the respondents, is the worry about increased cyber-attacks, for example DDoS. DDoS attacks may be based on an old trick, but that does not mean they are becoming less effective, or less popular. Recent network data released by Nokia showed that DDoS traffic went up by 40-50% during COVID-19, increasing faster than most other network applications. One key contributor was malicious online gamers paying for short spurts of DDoS attacks to take down opponents.

Coming up next was the long-term concern with personal and sensitive data breach, selected by 22%. Though neither DDoS attack nor sensitive data breach is unique to 5G, the trend to move to cloud native, more "IT-like" network architecture, and the elevated role of software, may have accentuated the concerns.

Figure 3-1

Main Concerns About 5G Security

What are your main concerns about 5G Security?

- ■ Usage of more complex and potentially unsecured network technologies (e.g. cloud-native virtualisation)............................. 41%
- ■ Increased cybersecurity attacks (e.g. DDoS) 26%
- ■ Personal or sensitive data breach........................... 22%
- ■ Poor identity and access management 8%
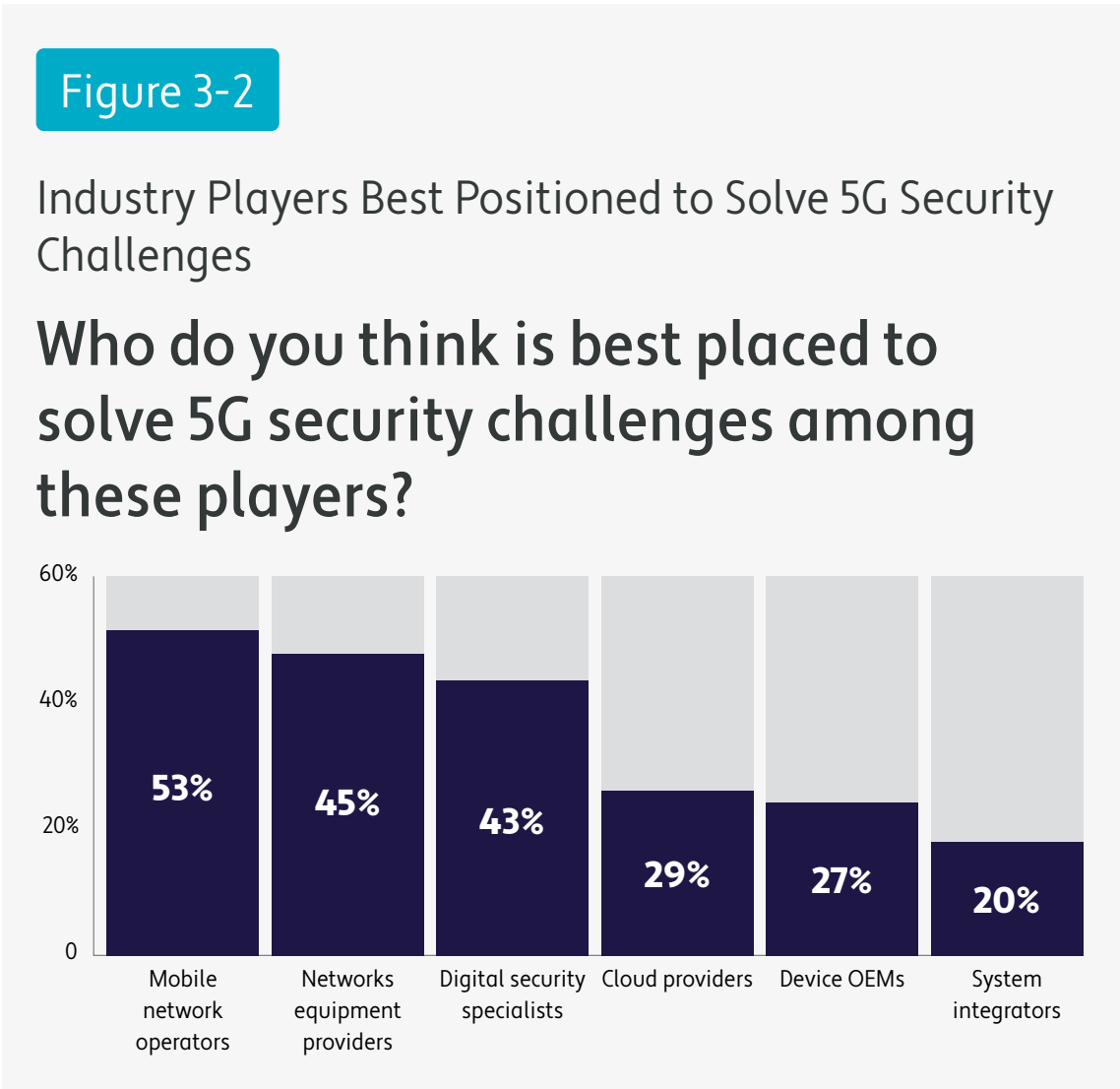- ■ Other cybersecurity threats... 3%

On the other hand, when it comes to the trust in security, half of the respondents (49%) chose core network as the network component that has their highest level of security trust, followed by tamper-resistant components, for example SIM cards and hardware security modules, selected by 22% of all participants. Meanwhile, cloud and radio access networks (RAN) won the least trust, selected by 6% and 9% of the respondents respectively. It seems that the further away from the core the network component is, and the bigger the role software plays, as opposed to hardware, the less trust it would win from the participants in the survey.

To shore up security, it is required that all players in the 5G ecosystem play their part, though their roles vary. Responding to the multiple-choice question to name the party that is best placed to solve 5G security challenges, over half of the participants (53%) went for mobile network operators, ahead of network equipment providers (45%) and digital security specialists (43%).

These top-three choices occupy unique positions in the security defence system. Network operators, as the owners of the networks, have the ultimate responsibility to safeguard the security of their customers, including both the end users and, increasingly important in the 5G era, the business users. Encouragingly, we have seen operators taking actions in this direction, including offering managed security services. This will be particularly useful for small and medium-sized enterprises (SMEs) which often lack dedicated resources for cybersecurity.

It is no surprise that network equipment providers and digital security specialists were also ranked high by the industry professionals as well positioned parties to tackle security challenges. The network equipment vendors probably know the network technologies better than anyone else, while the security specialists have focused expertise specifically called for to carry out the tasks.

Industry Players Best Positioned to Solve 5G Security Challenges

Who do you think is best placed to solve 5G security challenges among these players?
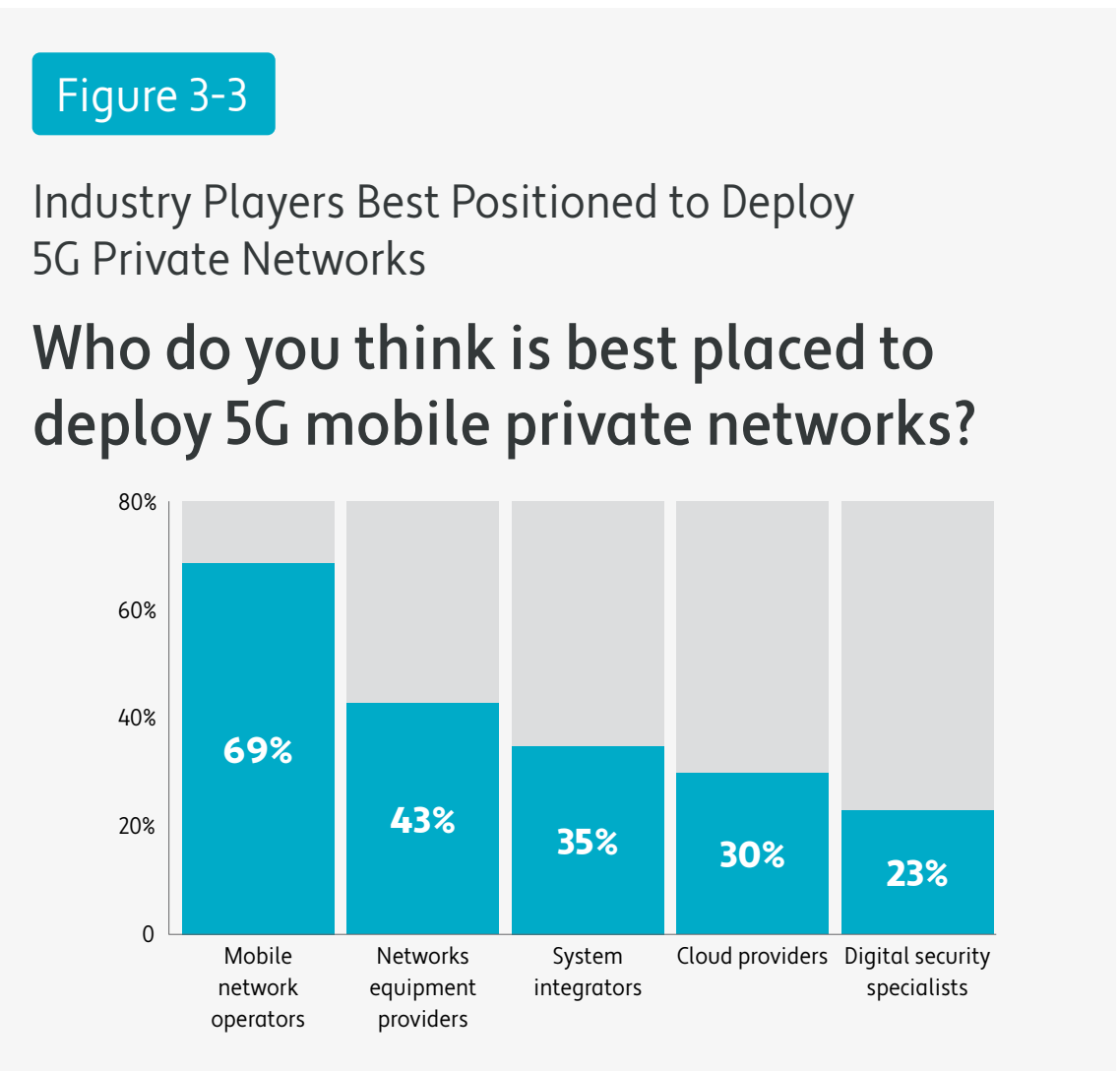

Two particular services will be greatly enhanced and made more accessible by 5G: one is private mobile networks, the other is multi-access edge computing (formerly mobile edge computing, but conveniently abbreviated MEC throughout). Security concerns for these technologies will also grow as their popularity increases.

Large enterprises, with both the demand and the financial resources, are expected to be the leading candidates to adopt 5G private networks, selected by 44% of the survey respondents, followed in a distant second by operators of essential services, for example utilities and airports, on 24%.

While the selection of leading 5G private network users largely reflected what has happened in the market, as in both 4G LTE and 5G private networks, when it comes to who is best placed to provide secure 5G private networks, the answers became more interesting. In this multiple-choice question, mobile network operators came top, chosen by 69% of the respondents. In second place, on 43%, was network equipment vendors.

That is interesting because while 5G operators are involved in many 5G private network trials and commercial rollouts, especially in Asia, where the operators in China and The Philippines are actively promoting 5G to utilities, manufacturing facilities and so on, in other cases they are not. This is more obvious in markets like Germany and Japan where private networks can also bid for 5G frequencies. In a few recent cases, for example Deutsche Bahn's automated rail, Brussels Airport's 5G-powered mesh WiFi, and Hitachi's industrial 5G on the so-called "local 5G" frequencies, mobile operators have been bypassed. They are developed by the utilities or enterprises together with their technology partners.

Figure 3-3

Industry Players Best Positioned to Deploy 5G Private Networks

Who do you think is best placed to deploy 5G mobile private networks?

Similar expectations for mobile operators also stood out when it comes to MEC. As by definition MEC moves the compute to the network edge, it was natural that the leading security concerns for MEC chosen by the survey respondents included the lack of end-to-end security (34% of responses) and the deployment of potentially untrusted applications on the edge that could harm the cloud or the network infrastructure (31%).

Again, the industry professionals turned foremost to mobile network operators for secure MEC capabilities, selected by 31% of all responses. This is followed by cloud providers (20%), digital security specialists and network equipment providers (17% each).

As is the case with private networks, mobile operators' role in 5G MEC is also not a given. Although they have every incentive to promote 5G MEC, as we have seen many trials between 5G operators and retail outlets, they are facing stiff competition. This may come from public cloud providers which are eager to bring webscale cloud functions to the edge. It may also come from other third-party entities, for example tower companies or IoT operators.

Figure 3-4

Industry Players Best Positioned to Deliver Secure MEC Capabilities

Who do you think is best placed to provide secure MEC capabilities?

- Mobile network operators...31%
- Cloud Providers 20%
- Network equipment providers...................................17%
- Digital security specialists...17%
- System integrators...13%
- Other...2%
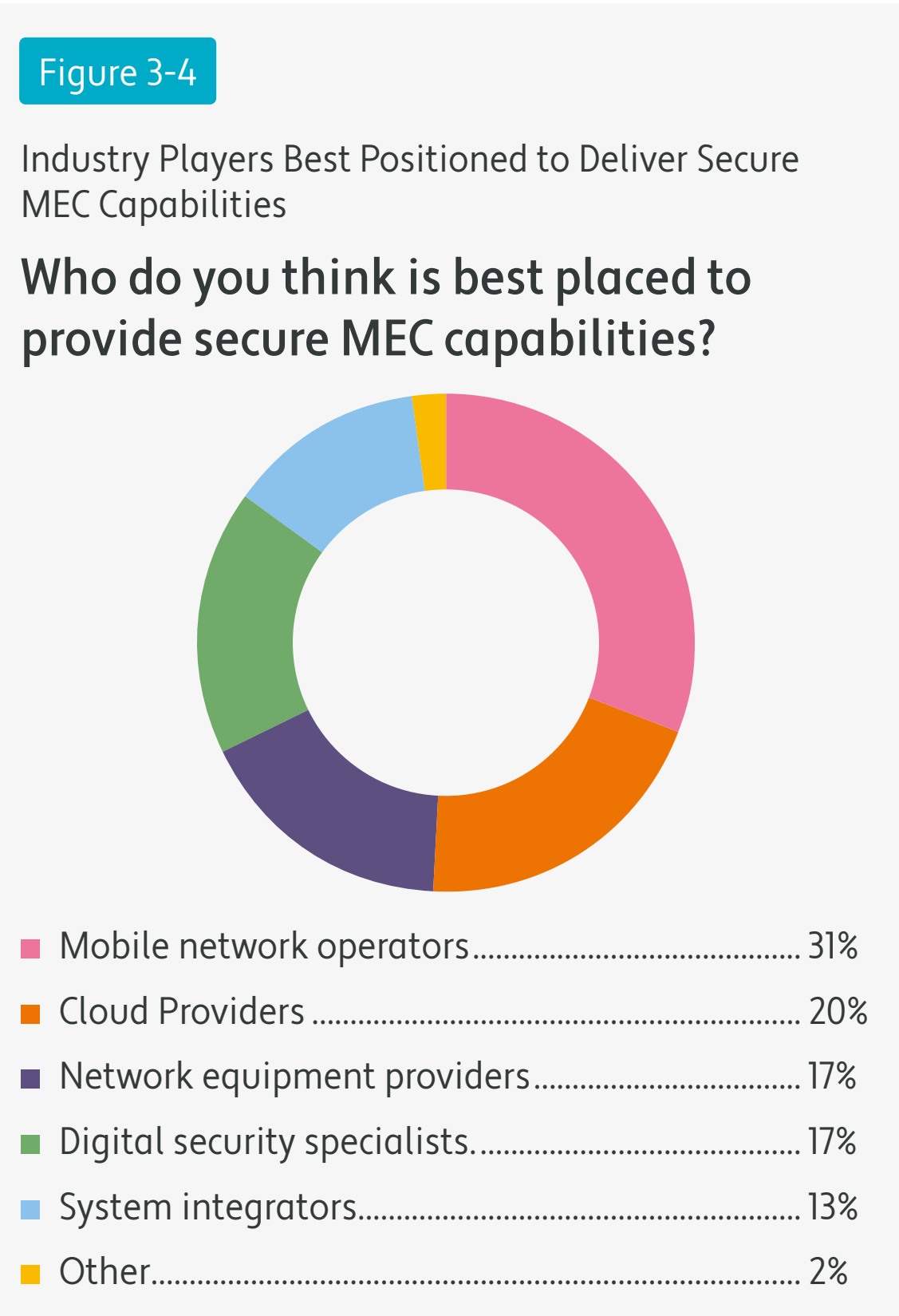
However, in general, participants in the survey have demonstrated strong awareness of new security risks that may come with 5G. Meanwhile they have placed high expectations on mobile network operators to play a key role in securing the networks and protecting their customers. This could be both a blessing and a curse for the 5G operators. While it is true that telecom operators continue to enjoy high level of trust from the industry professionals, they may also find themselves being taken to task for security challenges beyond their control, such as in private 5G networks or on the network edge.

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This survey brings unique insights to the strategic importance of security in **5G technology** – and its corollary, trust – for mobile operators. In 2020, their biggest challenges are to design new use cases and foster network customisation capability.

With skyrocketing cyber-attacks and tighter data protection regulations, the main 5G security threats relate mostly to confidentiality, integrity and availability being compromised by data interception or unauthorized access to unsecure network-based services. The combination of virtualised infra and increased amounts of data processed – both at the core and the edge – create a strong need for data segregation, data protection and eventually trust. Lack of end-to-end security is seen as a challenge for MEC deployment. And increased security is a must for private networks.

In this context, tamper-resistant components are increasingly perceived as the most trustable network communication components (after the core network itself), able to **create a chain of trust in 5G networks**.

Starting with a secure 5G network access, **5G SIM** can offer subscriber identity privacy (thanks to mobile user identity anonymization) and trusted environment resilience (via remote on-demand swap of the authentication algorithm contained in the SIM).

Then, at the heart of a trusted computing and networking environment, there should always be a root of trust, i.e. a set of functions that are inherently trusted by the operating system or systems. Leveraging data encryption – via **Hardware Security Modules (HSM)** – can ensure the integrity of the virtualised infrastructure and the confidentiality of the data flowing inside it. Forty-three percent of participants in the survey said digital security specialists are best placed to solve 5G security challenges and to create the required fabric of trust from the core to the edge.

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5G Expectations

This section of the survey asked the participants to cast a forward look at the prospects of 5G in the near to medium-term future. The first year of commercial 5G has been a success, though there are multiple reasons to expect even more excitement when the industry embarks on the next phase of 5G. Probably one of the most significant factors is 3GPP's Release 16, finalised in early July, a couple of months later than the original plan due to COVID-19. With R16 freezing what standalone (SA) mode 5G should comply with, many companies that have held out their investment in SA, anticipating R16 can go ahead with their plans.
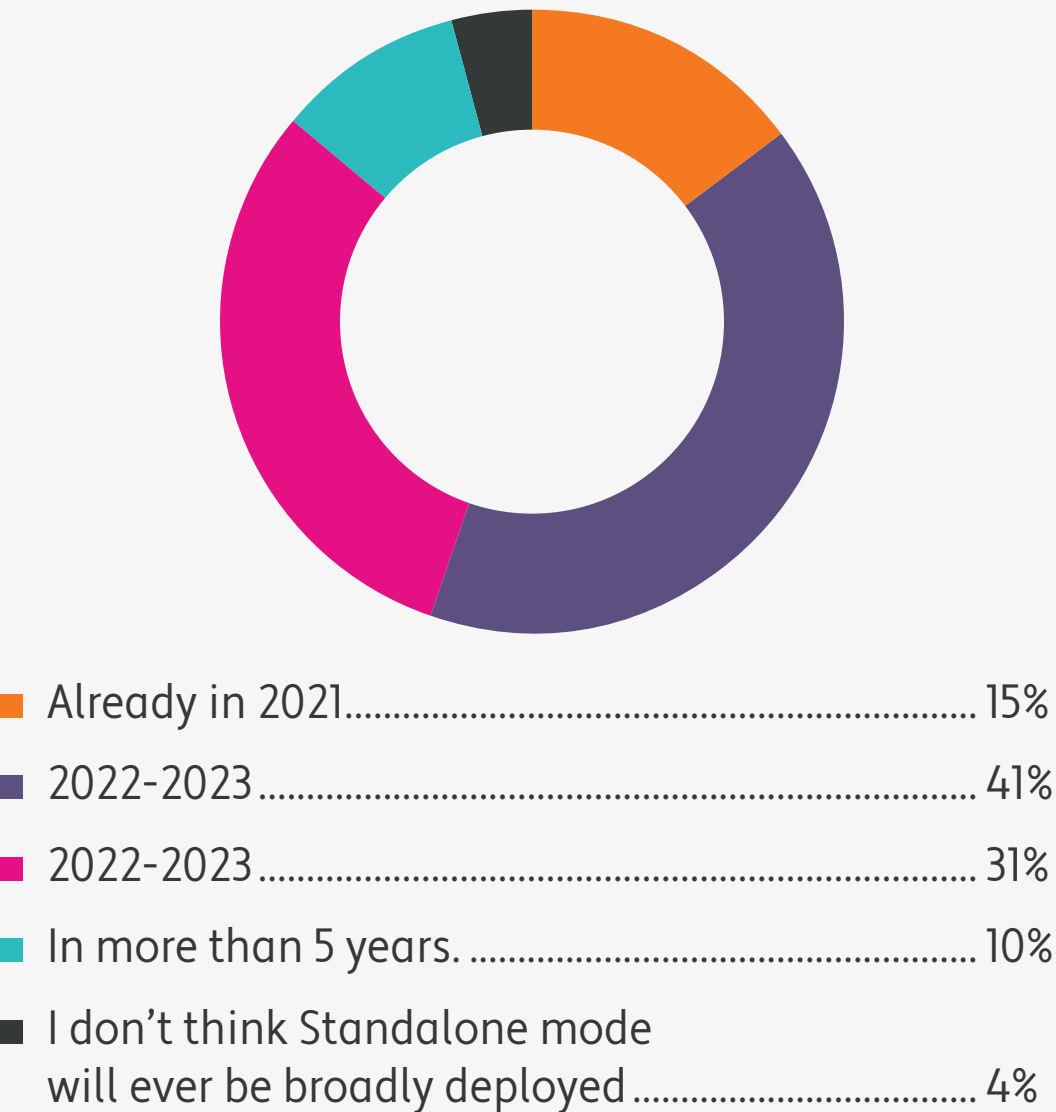
This does not mean that the SA front has been quiet. Far from it. In different parts of the world, in Asia and Europe in particular, plenty of trials have been conducted to test out SA 5G use cases. KDDI, SK Telecom, China Telecom, A1 Austria, and Telia Finland were among the first operators to either start rolling out SA networks or select partners to do so. They have since been followed by other operators like Telstra, Rakuten, BT, and Telefonica, among others. Many of these operators are also involved in building private 5G networks with vertical industry partners.

Therefore it should come as no surprise that the survey participants showed a measured optimism when asked to predict when SA 5G will be broadly deployed in their markets. Forty-one percent of them, the biggest group, believed broad SA 5G deployment will happen in the next two to three years. This is on top of the 15% of respondents, mainly from those markets that SA 5G has been actively trialled, who thought it will already be there this year. A further 31% of participants estimated that SA 5G will be broadly deployed in five years.

Figure 4-1

Expected SA Mode Deployment Timeframe

When do you expect standalone mode 5G to be broadly developed in your market?

- 🟧 Already in 2021.. 15%
- 🟪 2022-2023 .... 41%
- 🟥 2022-2023 .... 31%
- 🟦 In more than 5 years. 10%
- ⬛ I don't think Standalone mode will ever be broadly deployed 4%

Similar optimism was also on display when the respondents gave their estimates on how aggressive operators would be when it came to expanding 5G beyond dense urban geographies. Nearly a quarter (23%) of all respondents believed that 5G operators will

aggressively roll out nationwide 5G coverages in the next two to three years. A further 36% thought operators will adopt a more gradual approach, to deliver nationwide coverages in five to six years' time.

Meanwhile, 28% of the respondents believed 5G will continue to be mainly serving dense urban areas but operators will provide "spot" coverage to support specific use cases. A sizeable minority of respondents, 13%, believed the lack of strong business cases makes operator investment to expand 5G beyond dense urban areas unattainable.

Admittedly the doubt held by the minority of respondents was consistent with the sentiment when the respondents were asked to select the leading impediments to rolling out 5G NR networks. High cost, including both cost on the network gear and that of deployment, was cited by two-thirds of participants, the highest number in this multiple-choice question. This is followed at a distant second place, on 41%, by regulatory and other non-technical impediments, for example frequency availability. Deployment challenges (for example tower loading capability) came in a close third with 40% of responses.

Despite the optimism about the prospect of 5G, there are still doubts in the industry about what business returns the new technologies can generate. In this case, 37% of respondents pointed to the lack of solid business case as the leading impediment, despite it being the choice with the lowest percentage.

To look at 5G from another angle, to deliver on the technology's promises, for example the "gigabit per second" tagline, mmWave frequency band, a subset of the 5G "new radio" frequency, should be incorporated in operators' next phase 5G plans as much as possible. With the exception of the US and Japan, many 5G countries have either not made mmWave available to 5G or have delayed their frequency auctions. There is also encouraging news. In the European Union, a handful of member states have either already completed the mmWave auction (Finland) or have concrete plans to do so soon (the Baltic states, France, etc.).

The survey participants also had more consensus on who would be the first to benefit from 5G on mmWave. Sixty-eight percent selected manufacturing automation as the leading use case, followed in a distant second place by transport (50%), then healthcare (46%).

Figure 4-2

Industries to benefit from 5G on mmWave

Which industry sectors will be the first to benefit from 5G NR on mmWave frequency band?
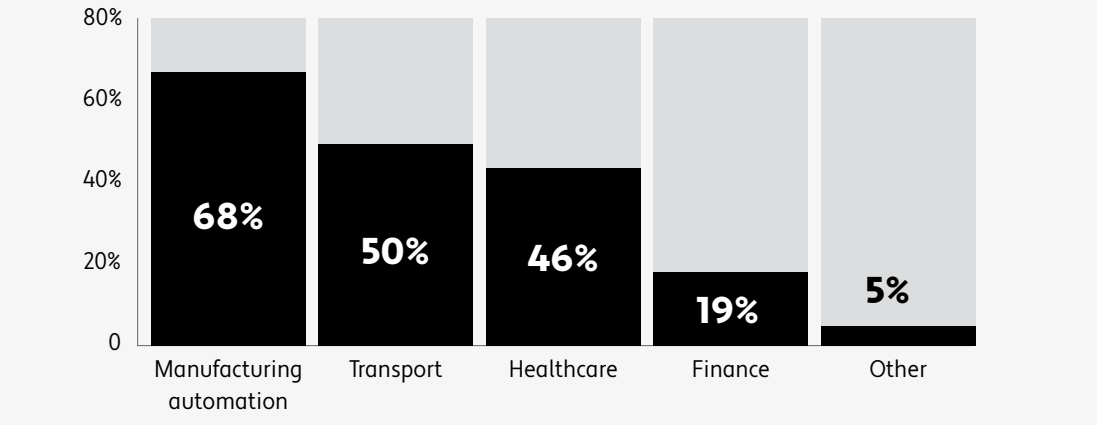
All the three leading sectors expected to benefit from 5G on mmWave selected by the survey participants have something additional in common: they all would involve high level of automation based on almost real-time analytics out of large volumes of data (for example remote control of manufacturing facilities, autonomous vehicles, medical diagnosis). Such tasks would go beyond human capabilities and would call for active support of artificial intelligence, including machine learning.
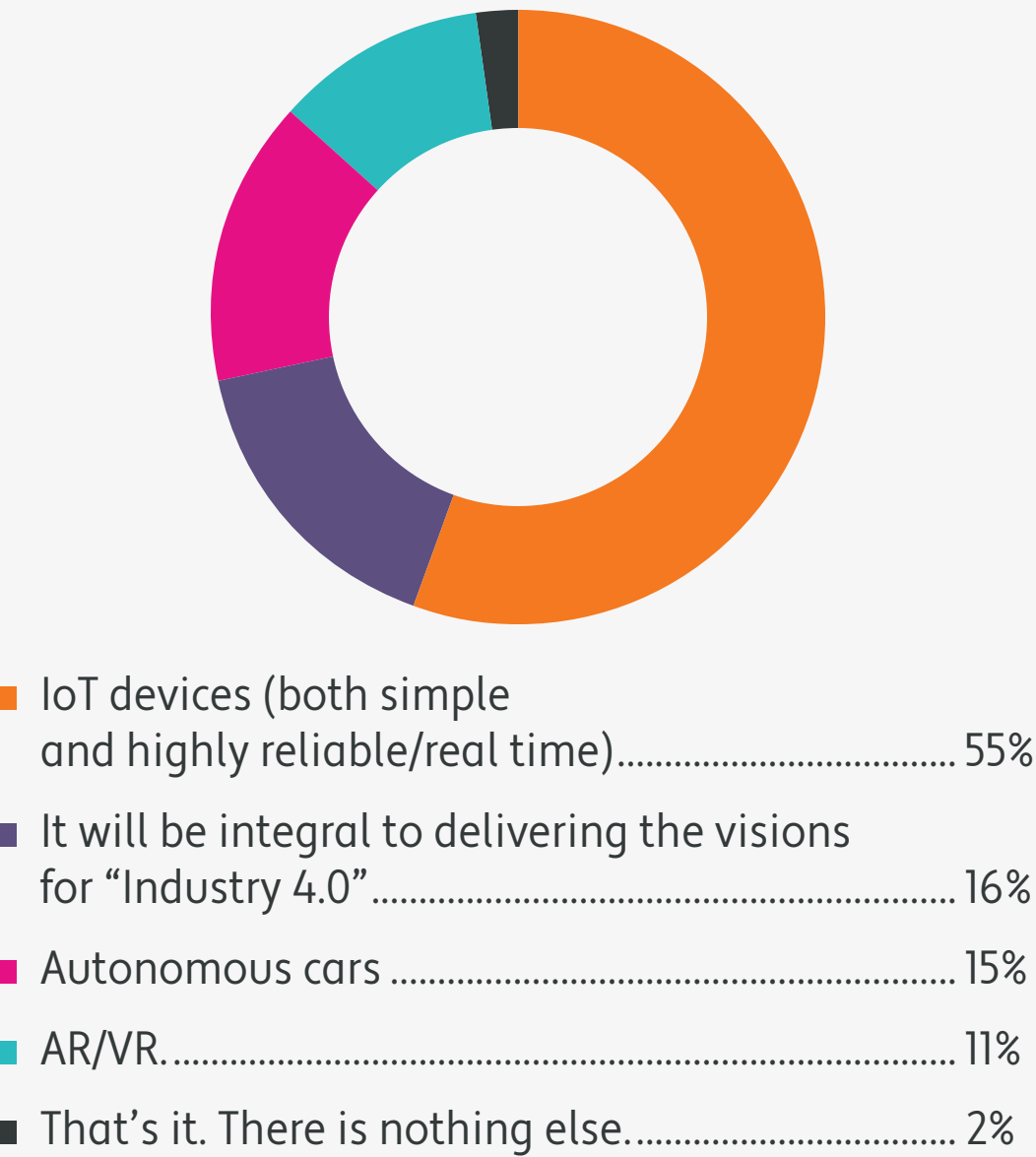
The telecoms industry is no stranger to AI and ML. As a matter of fact, telecom operators and their technology partners have been using AI on different aspects of their networks with varied degrees of sophistication, from the planning stage all the way through to operation and maintenance, as well as using AI to improve service offerings. Their role will only get more important as the industry moves into the advanced phase of 5G. When asked how they would estimate the impact of AI and ML on future mobile networks, nine out of ten respondents agreed that the impact would be profound: 55% of them believed that AI will enable full automation in multiple network activities, for example, network optimisation, power management, preventive maintenance. Another 35% believed that AI will be used to enable and develop new innovative services for network users.

The 5G ecosystem, like other ecosystems, will not be complete without available and affordable devices that end-users and business customers can connect to the networks and consume the services. Many types of 5G-based connected devices have been launched. GSA, an industry organisation, has recorded 16 form factors, ranging from the usual suspects like phones, tablets, indoor and outdoor customer premises equipment (CPE) and dongles, to more niche categories like drones and vending machines. According to the organisation's latest tracking, over 300 5G devices have been launched. However, among the 100 or so commercially available devices, the vast majority are smartphones, followed by CPEs and mobile hotspots. When asked to forecast if new devices categories may emerge to become a key part of the 5G ecosystem, over half (55%) of all respondents went for IoT devices, while another 16% believed new 5G devices will emerge as an integral part of Industry 4.0. This is a clear message that the industry professionals saw new device opportunities in the industrial domains, in line with the vision that 5G's true value lies in serving business use cases.

Figure 4-3

New Categories of 5G Devices

What new categories of devices do you expect to see growing rapidly to become part of the 5G ecosystem?

- IoT devices (both simple and highly reliable/real time)....................................55%
- It will be integral to delivering the visions for "Industry 4.0"..........................16%
- Autonomous cars 15%
- AR/VR..11%
- That's it. There is nothing else................................. 2%

Another key element in the 5G ecosystem is made up of partners outside the telecoms industry. Since the beginning of the 4G era, telecom operators and the so-called "OTT players" have had a love-hate relationship. These services, from social media and entertainment to business solutions and productivity applications, have helped accelerate the adoption of 4G, which in turn

helped operators increase their data revenues. On the other hand, operators have had to watch these internet-based services overtake them both in revenues and in customer relationship, all while using their networks to do so.

When looking ahead at the dynamics between 5G operators and the OTT service providers, half of the participants expected to see more competition between the two camps, but believed the competition will take place more on the network edge, following the new network ecosystem transformed by edge computing. One quarter of the participants thought the two types of businesses would continue to coexist as they do now. Another quarter of the respondents, however, saw the operators' role further diminished to infrastructure management as OTT players may eventually become virtual operators or even physical network operators. There are recent high-profile examples to support such suspicions, where internet companies are either entering into operator business (Facebook buying stake in Reliance Jio, for example) or launching their own MVNO (Google Fi). This trend has led to some industry observers to comment that the traditional concept of "OTT players" is becoming obsolete.

However it is not all doom and gloom for operators. There are also moves in the other direction. Not only have many telecom operators incorporated OTT entertainment services in their portfolio (with different degrees of success), some of them have also launched business-oriented OTT. For example, X by Orange is essentially an operator OTT service suite for enterprises launched on public cloud.

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Figure 4-4

5G Operators vs. "OTT Service Providers"

How do you see the future relations between mobile operators and the "OTT service providers" in the 5G era?

■ Edge computing will transform the networks ecosystem with distributed OTT/Cloud solutions at the edge of the network. More coopetition expected.. 49%

■ They will continue to coexist as they do today .. 26%

■ OTT providers will eventually become virtual operators and MNOs will simply manage the infrastructure 25%

Overall, participants in the survey have shown confidence in 5G's prospect to cover broader geographies and more population in the near future, and to provide industry and other business users with advanced network capabilities, especially 5G on mmWave band.

Meanwhile, the telecoms professionals also expected to see both a 5G ecosystem enriched from the IoT sector, and continued competitions from OTT service providers.

Sponsor's Comment...

This year it's become clear that telecoms infrastructure and broadband availability are even more critical in supporting the economy. Network operators are focusing on protecting existing investments and making critical decisions on building 5G networks.

As customers seek ways to package 4G and 5G together, they are reviewing which bands they own and deploy. Network implementation will be different depending on network operators' starting conditions. 5G might be rolled out across a country with low band spectrum while capacity may be the priority for densely populated cities with access to high band spectrum. This may be the reason that more than half of respondents expect 5G to be broadly deployed in their markets by 2023.

Although more than 25% believe it's too early to think about what the next generation technology will look like, the majority (nearly 75%) agree new use cases will generate additional value. Manufacturing automation will be one of the first to benefit from 5G on a mmWave frequency band, according to nearly 70% of respondents.

This is an exciting time for 5G across the wireless industry and for the world. In addition to smartphones, tablets and customer premise devices, more than half believe we'll see IoT devices increasing rapidly become part of the 5G ecosystem. Security and regulation will be critical elements in the deployment of 5G, making it vital for network operators, industry groups and regulatory agencies to collaborate on standards.

Advancing antenna design, tapping into open RAN interfaces and enhanced IoT management are just a few ways that operators can simplify 5G rollouts while growing their enterprise business. What will be enabled by 5G is almost unimaginable today.

Phil Sorsky
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