



TELECOMS.COM
INTELLIGENCE
**ANNUAL
INDUSTRY
SURVEY
2018**

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THE ELASTIC NETWORK



Confidence, Change, Continuity

Dear fellow telecoms professionals,



Wei Shi

Intelligence Content Manager
Telecoms.com Intelligence

Welcome to the 2018 Telecoms.com annual survey report. Every year this survey offers a great opportunity to take the pulse of the industry and provide valuable insight into its direction of travel.

There has been plenty to cheer about in the telecoms industry over the last year. The majority of respondents to this survey seem relatively content with the performance of their own businesses and are looking towards an even better 2019. Probably more importantly they indicate distinct pleasure with what the industry as a whole has come through in 2018 and are showing strong confidence in what 2019 has to offer.

We titled last year's survey summary "Change Is The Only Constant" and this statement still holds true. We have seen much change taking place in the telecom industry over the past year, including the status of 5G. Multi-billion-dollar auctions for 5G spectrum have been conducted in different countries, and commercial 5G networks in different parts of the world are almost ready to switch on. The stronger momentum in 5G will also mean that Test & Monitoring is playing an increasingly critical role than ever before, not the least because of the complexity of the 5G technologies and use cases.

Much progress has been made in IoT as well, where we have seen dozens of projects in smart cities and smart buildings kickstart, boosting the momentum of the sector. There have been significant changes in the regulatory environment, and the shift in net neutrality rules in the US may have significant impact on the competition landscape. GDPR in Europe and similar laws and regulations in other parts of the world will force companies to treat Security in a new way, both in technology solutions and in operating processes, and these are far from the only new security challenges businesses are facing.

Amid all this change we are also seeing plenty of continuity. Companies continue to believe in increased automation in general and, as 5G gets closer to reality, they are showing more belief in NFV in particular. Businesses, especially operators, continue to show strong enthusiasm about Digital Transformation and are striving to embrace it. On the other hand, the industry continues to come under price and profit pressure, and there is no sign of the webscale giants relenting on their relentless disruption.

All in all, telecoms continues to be an exciting industry, not the least because it never stands still. It is our privilege to share the journey with you and we hope you find the 2018 Telecoms.com Annual Industry Survey useful and enlightening.

“THE STRONGER MOMENTUM IN 5G WILL ALSO MEAN THAT TEST & MONITORING IS PLAYING AN INCREASINGLY CRITICAL ROLE THAN EVER BEFORE, NOT THE LEAST BECAUSE OF THE COMPLEXITY OF THE 5G TECHNOLOGIES AND USE CASES.”

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The large majority of respondents believed IoT would be either important or critical, as the industry expected tens of billions of IoT devices to be connected in the coming years. Smart cities, utilities, and industrial IoT are viewed as the most important markets.

SECURITY: SAFEGUARDING THE FUTURE 25

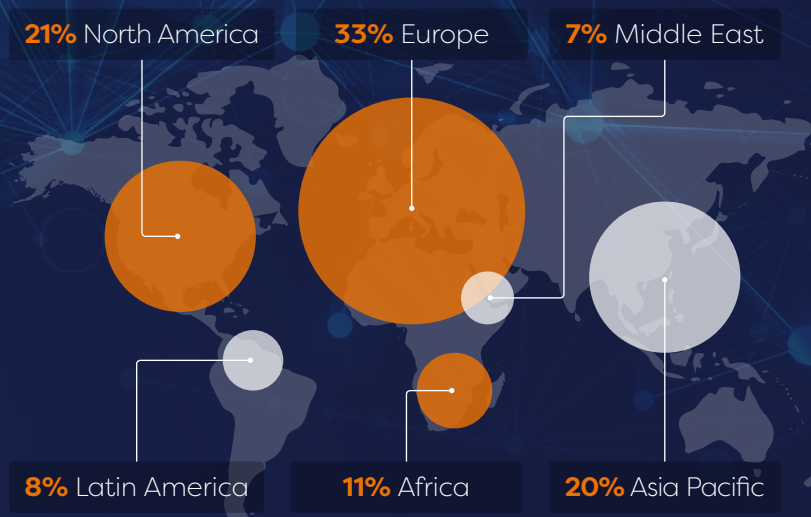
Cyber-attacks are showing no sign of abating, and telecoms businesses have realised they need to embrace new generation of defence, including artificial intelligence powered solutions, to win tomorrow's tug-of-war with new types of attacks.

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Test & Monitoring is critical to assure and improve network reliability and quality of experience. Its role will be more important in the 5G era. T&M suppliers should consider packaging value-added services to support customers' innovation demands.

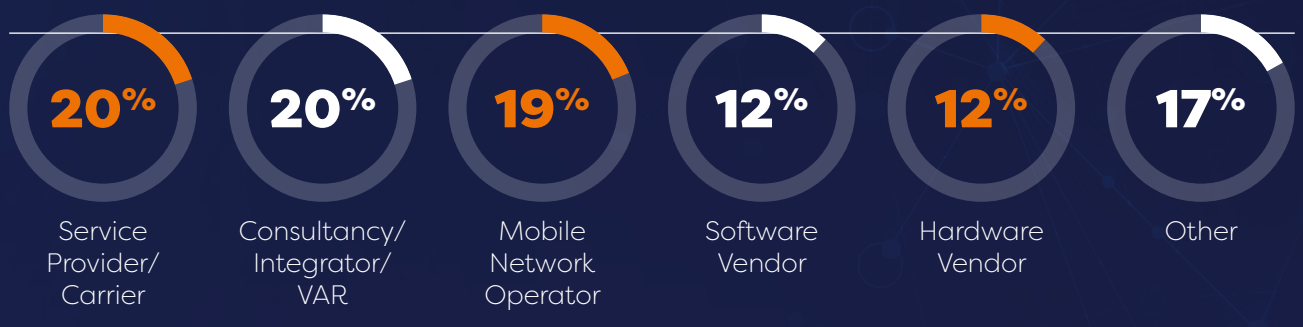


1,500 Survey Participants Worldwide



61%

believe emerging technologies and services are critical to telecom's long-term success, and companies that do not embrace them will go out of business.



☆ **60%**
describe the telecom industry's overall business performance so far in 2018 as excellent/good

+ **75%**
feel positive about the telecom industry's business outlook for 2019

✓ **79%**
believe NFV is critical to their companies overall strategy over the next five years

✗ **62%**
believe the benefits of 5G have not been effectively communicated to consumers

Top 3 threats to long-term business success

- ! Increased pressure to lower prices and profit margins **33%**
- ! Competition from Webscale giants (Google, Amazon, Microsoft, etc.) **14%**
- ! Inability to adopt agile service model **12%**

75% of companies think digital transformation is highly important

74% of companies have seen an increase in cyber-attacks to their customers over the past year



Headline Sponsor's Comment

The ever more competitive digital economy sweeping across both B2B and B2C segments requires that applications and services be delivered with unprecedented speed, scale, and agility. Enterprise IoT, smart home, general consumer IoT, and TV/video will generate most revenue for operators. Providers need to continue to optimise their data and video network traffic to maximise network efficiency, generate revenues, and maintain and improve subscriber quality of experience.

As the digital transformation continues and IoT grows – providing B2B opportunities in particular – service providers are deploying Network Functions Virtualisation (NFV) to create new services and business models to increase service agility and flexibility. It is not surprising to see that greater network and services flexibility, automation for increased operational efficiency, and reduced OPEX are the main reasons to implement NFV. To simplify deployments in their networks, service providers should consider vendors that can help overcome these problems, for example by providing packaged Virtualised Network Function (VNF) services.

5G is coming. Most respondents think that commercial services will be launched within two years, led by Asia Pacific. However, not all new 5G enabled services will happen at the same time. Rather, there will be an evolution of services becoming available as service provider networks evolve over time. High speed mobile access, massive IoT, and rich media programs will be enabled first. Lower latency dependent Industrial IoT and autonomous vehicles will come later as they require wider, end-to-end 5G coverage. Service providers should work with trusted vendors who can scale and simplify existing networks and help

evolve to 5G with automation, protocol fluency, and high-performance virtualised software solutions.

Security is a top concern for both consumers and enterprises. Over half of the respondents identified four different types of security solutions – DNS blacklisting / firewalls, IP/domain blacklisting, antivirus solutions, and deep packet inspection. Service providers need security capabilities that are high performance and multi-layered. They should adopt targeted measures to secure every potential vulnerability, including the data center, control plane, and applications.



INDUSTRY LANDSCAPE

The telecoms industry continues to herald the technological advancements and strives to bring benefits to consumers and businesses. Despite the competitions from internet heavyweights, the telecoms industry has by and large weathered the storm well.

Most of the industry professionals are confident in both the growth perspective of the telecoms industry and in the performance of their own businesses. IoT, 5G and cloud services are ranked as priority technologies for investment.

KEY TAKEAWAYS

- 60% of the respondents thought the industry performance in 2018 has been good or excellent; 75% of them had positive or very positive outlook for 2019;
- IoT, 5G, and cloud infrastructure and service were identified as the industry's investment priority;
- Pressure on price and profit and competition from internet giants were seen as biggest threats to the respondents' long-term business success.

Industry Landscape

Well over a thousand telecoms industry professionals answered this year's survey, giving us confidence that the results are a credible reflection of industry views, trends and attitudes. Here are a few snapshots of the demographics:

- More than three quarters (76%) of the respondents have worked in the telecom industry for more than 10 years, including a quarter (24%) of veterans with more than 25 years of experience.
- Nearly 40% of respondents were from service providers and mobile operators, and a quarter were from hardware and software vendors.
- 17% of respondents were C-suite executives, with a further 21% mid-level management, and 18% engineers and developers.
- Geographically, Europe lead the panel with 33% of all the companies represented, Asia Pacific (20%) was closing on North America (21%), and, for the first time in our long history of annual industry surveys, companies from Africa went above the 10% mark.

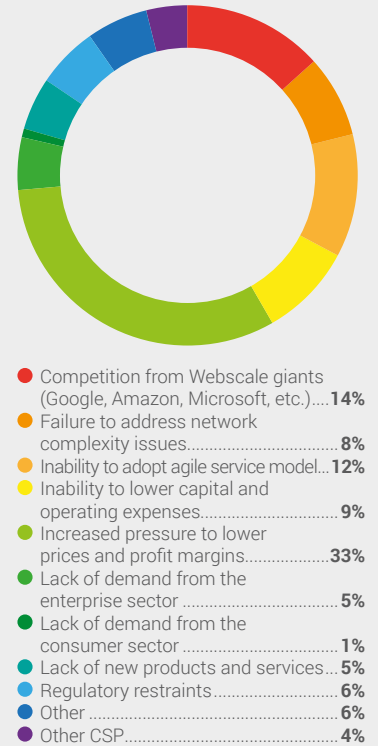
We aimed to gauge the overall sentiment of the industry in this first section of the survey before delving into more specific technology and business domains. As the results showed, the respondents were overwhelmingly positive towards how the telecom sector has performed so far in 2018 and the prospect of 2019, and there is strong consistency to compare with what the industry told us a year ago. 60% of the respondents thought the industry performance in 2018 has been excellent (11%) or good (49%). This is very

much in line with the results of our survey at the end of 2017. When it comes to their expectations for 2019, three quarters of the respondents felt positive (51%) or very positive (24%). Again, this is very similar to what the industry told us in our survey last year.

There was also plenty of optimism among respondents in their own business. Over 50% of the respondents were happy with their business performance, claiming their companies outperformed the industry. Only 13% of respondents said their companies underperformed the industry average. When asked about their expectations for the segment that represents the biggest revenue growth opportunity, 54% of the respondents selected enterprise while 32% chose consumer. The rest saw their biggest opportunity in the public sector. This breakdown is largely in line with the choices made by the audience of this survey a year ago.

Looking forward we asked the respondents to identify the single biggest threat to their business. Again, we see consistency with past answers but also difference. Coming on top, by a big margin, is "increased pressure to lower prices and profit margins" (34%). The same choice came the first in last year's survey, but it looked the angst among the professionals has visibly gone up (from last year's 26%). Coming in second and third places on the threat scale were competition from webscale giants like Google, Amazon, Microsoft, etc., chosen by 14% of the respondents, and the inability to adopt an agile service model, by 12%. These two occupied the same positions on the survey a year ago, but the percentages came down (from last year's 18% and

Which of the following is the greatest potential threat to your company's long-term business success?



15% respectively), an indication that the industry is in a better shape weathering the competition storm from the internet giants and seeing companies more agile at adopting to change. Interestingly, the worry for a "lack of demand from the consumer sector" came at the bottom, selected by only 1% of the respondents, a sign of confidence from the respondents that the industry is offering what consumers would like.

We then asked the respondents to identify their investment priorities. Over a half (51%) of all those that took the survey chose Internet of Things (IoT) as their priority, closely followed in second place (48%) by 5G and in the third place (45%) by cloud infrastructure and services. Big data / analytics, artificial intelligence (AI), and Network Functions Virtualisation (NFV) have also been selected by large numbers

of respondents. Given the fact these areas have been on the centre stage of technology discussions as well as seen considerable implementation, either in trials or in commercial rollout, there is no surprise in seeing them high on the list.

What makes an interesting reading is a comparison between the top choices of investment priority and what the respondents thought were the most overhyped technology of today. Topping the widely distrusted list were AI (22%), 5G (20%), and IoT (17%). The high degree of commonality between the investment priority and overhype lists may go down to the fact that all these are yet to become mainstream technologies, therefore a sizeable number of audience is not convinced of their revenue and profit contribution potentials.

However, this does not mean the industry is sceptical of new technologies. On the contrary, when asked to express their

views towards emerging technologies and services, over 90% of respondents agreed that they will either provide good business opportunities (31%) or they will be critical to the industry's long-term success and the companies' survival (61%)

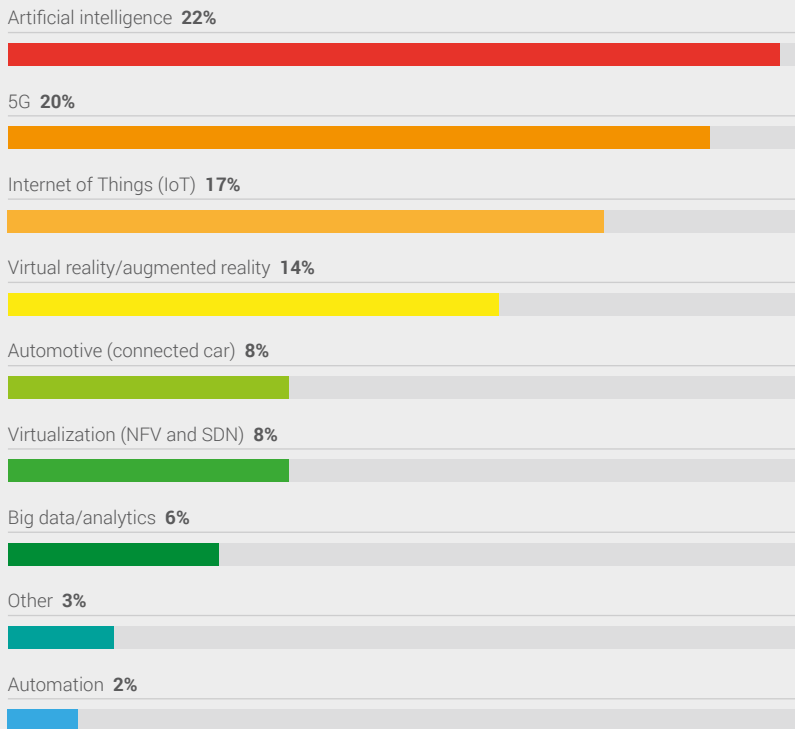
In general, we see that the optimism about the prospects of the telecom industry expressed in the past continues. Most companies are also happy with their performance in 2018 and are confident with the way it is moving in 2019. Despite some reservation towards

a couple of headline technologies, the large majority of the industry players recognise the criticality of embracing new and emerging technologies and services. We are likely to see significant investment pouring into these sectors.

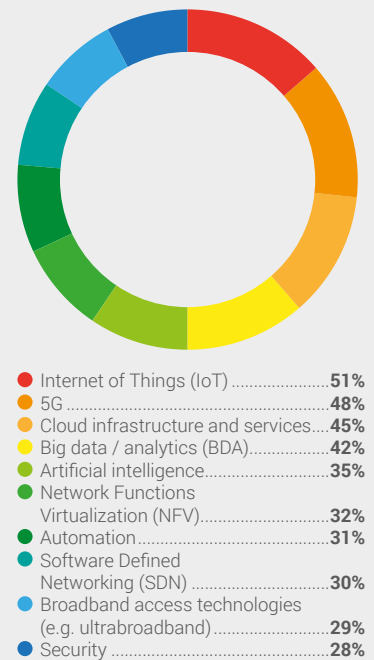
In the following sections of this report we will take a closer look at six selected sectors that are highly pertinent to the stakeholders on the telecom industry value chain: NFV, 5G, Digital Transformation, IoT, Security, and Test & Monitoring. ●

“WELL OVER A THOUSAND TELECOMS INDUSTRY PROFESSIONALS ANSWERED THIS YEAR’S SURVEY, GIVING US CONFIDENCE THAT THE RESULTS ARE A CREDIBLE REFLECTION OF INDUSTRY VIEWS, TRENDS AND ATTITUDES.”

What is the most overhyped emerging technology today?



Which of the following are likely to be priority investment areas for your company in 2019?





NFV

Despite that the industry would have loved to see NFV growing faster, there is no doubt that its importance and benefits are being recognised by more and more companies. Nearly all the survey respondents believe their investment in NFV will either increase or maintain. Flexibility, operational efficiency, and cost saving are viewed as NFV's biggest contributions to their business.

KEY TAKEAWAYS

- Close to 80% of respondents viewed NFV as either important or critical;
- Increased flexibility (48%), improved operation efficiency, and OPEX optimisation were identified as the most important contribution NFV would make to the industry;
- NFV onboarding was still generally seen as challenging. Only 8% of survey participants felt it easy to implement.



GATHERING MOMENTUM TO CROSS THE CHASM

Network Functions Virtualization (NFV) has been one of the emerging technologies that, despite its slower than expected progress, has continued to be cheered by technology evangelists and to enjoy support from the industry.



The industry believes in automation in general. When they were asked to assess the importance of automating their network processes, a third of the industry professionals participating in the survey agreed that it was very important, and they have already begun to automate. More (36%) answered that they were looking into it seriously.

When asked how important NFV in particular will be for their companies in the next five years, close to 80% of respondents agreed either it would be critical (29%) or important (50%), and only 8% thought it unimportant.

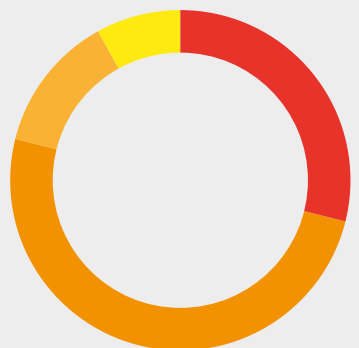
When it comes to priority functions and processes to virtualise, services and applications layer (video, IPTV, VoIP, optimisation, etc.) and core services, e.g. voice core (IP Multimedia Subsystem (IMS) and Softswitching functions) was selected by 36% of respondents each. Closely following were IoT and Machine to Machine (34%) and Evolved Packet Core (EPC) (32%).

What NFV could potentially do for the industry has been extensively discussed and it is no surprise to see the respondents largely agree with each other on the most important benefits. The top three benefits identified include greater network and services flexibility (48%), enabling automation therefore increased efficiency of operations (44%), and reducing OPEX (40%). Considerable number of survey participants also selected the benefits to reduce CAPEX (36%) as well as to improve network performance and reliability (35%).

The recognition of NFV's importance and benefits is also backed by the respondents' investment expectations. More than 95% of the respondents believed that, in 2019, their companies' investment in NFV will either increase or maintain. However there did exist a certain degree of doubt on how to spend the money. >

“THE ENTHUSIASM IN INVESTING IN NFV CAME FROM THE INDUSTRY’S BELIEF THAT NFV WILL BE ABLE TO BOTH HELP IMPROVE THE OPERATION EFFICIENCY AND TO OPEN NEW BUSINESS OPPORTUNITIES.”

How important is NFV to your company's overall strategy over the next five years?



● Critical.....	29%
● Important, but not critical.....	50%
● Marginal.....	13%
● Not important at all.....	8%



More than 60% of respondents felt they were not entirely on top of their purchasing methodology for NFV solutions. For example, one third of businesses surveyed felt that they should simplify the solution process to size their bandwidth needs, and a comparable number of respondents felt they needed to reduce costs of their purchasing methodologies by looking into or implementing automated systems.

The enthusiasm in investing in NFV came from the industry's belief that NFV will be able to both help improve the operation efficiency and to open new business opportunities. When

asked to name the priority business service and application challenges they must address in 2019, nearly half of the respondents selected time to market (48%), customer experience improvement (46%), and efficiency of operation (45%).

On the flip side of things, because of NFV's slow progress, the hesitation and uncertainty expressed in last year's survey did not go away, and one cannot help but smelling a tinge of frustration from the industry.

The percentage of respondents who self-assessed as falling behind competitors in implementing NFVs

has remained at a similar level as the results of last year, down 2 percent to 27%. Meanwhile, fewer companies were confident they were doing a great job: those who considered themselves among the leaders in NFV deployment has gone down by 5 percent to 14%.

The level of difficulty experienced by the businesses when implementing NFV is also a fair reflexion of the industry sentiment towards the technology. Only 8% of respondents felt it fairly easy to implement, and they were meeting the schedule, while nearly half of the respondents (48%) felt it as difficult as they expected, plus 22% either experiencing more difficulty than expected or feeling it extremely difficult and having major issues with NFV.

The biggest barriers to successful implementation of NFV are already well known to the industry, and there is no surprise seeing them on top of the list identified by the survey respondents. 36% selected high cost and complexity of deployment as the leading challenge, followed by the lack of clear business cases, selected by 32%. No clear industry roadmap for NFV (including lack of standards) and, related, the lack of vendor interoperability both chosen by more than a quarter of the respondents.

How will your company's spending on NFV change in 2019?

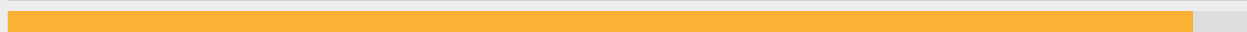
Spending will increase significantly (10% or more) **23%**



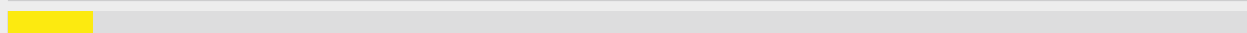
Spending will increase modestly (less than 10%) **31%**



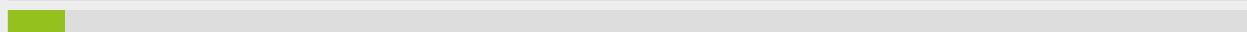
Spending will remain about the same **42%**



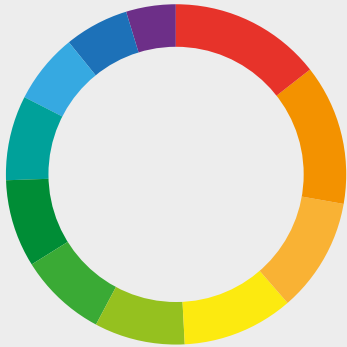
Spending will decrease slightly (less than 10%) **3%**



Spending will decrease significantly (10% or more) **2%**



What are the biggest barriers to success for your company regarding NFV? (choose all that apply)



- High cost and complexity of deployment35%
- No clear business case for NFV32%
- No clear industry roadmap for NFV (i.e. lack of standards)26%
- Lack of vendor interoperability resulting in difficulty to deploy25%
- Lack of internal commitment to NFV21%
- Complexity of NFV operations (e.g. on-boarding)20%
- Security concerns20%
- Lack of confidence in product/vendor solutions for NFV19%
- Assuring NFV service quality16%
- Difficulty of managing NFV's15%
- Other11%

Overall, we continue to see high enthusiasm for NFV and companies expecting to increase their investments in implementing the technology to address an array of issues. However, in order for NFV to live up to the expectations, the industry must overcome the fragmentation of standards from different vendors.

In its current shape, service providers and verticals planning to implement NFV will need to test and certify

every virtualised function, which does not only prolong the process but also increases the costs. More importantly, it also defeats the very purpose of NFV to operate across vendors. Recently we have seen promising signs in facilitating NFV onboarding, for example standardisation bodies like ETSI getting more engaged in endorsing standards. This is not only critical for NFV, but important for the fulfilment of the promises of 5G. ●

“MORE THAN 95% OF THE RESPONDENTS BELIEVED THAT, IN 2019, THEIR COMPANIES’ INVESTMENT IN NFV WILL EITHER INCREASE OR MAINTAIN. HOWEVER THERE DID EXIST A CERTAIN DEGREE OF DOUBT ON HOW TO SPEND THE MONEY.”

Sponsor’s Comment

Service Providers are beginning to deploy Network Functions Virtualisation (NFV) to create new services and business models to increase service agility and flexibility, and to increase network efficiency. The large majority of respondents think that NFV is important or critical to their network, and that spending in 2019 will be maintained or will increase compared to this year. Most also think automation is very important or are looking at it seriously.

Our feeling is that NFV has not yet “crossed the chasm”. Challenges clearly remain. Only 8% of respondents think NFV is easy to implement while the large majority feel it's difficult or extremely difficult. Respondents also pointed out that purchasing methodology could be simplified. Indeed, two thirds thought that the process could be simplified and that automated systems for purchasing could help.

Service providers should consider vendors that can help overcome these problems, for example by providing packaged Virtualised Network Function (VNF) services with ready-to-install solutions. To ease purchasing, planning, and sizing, service providers might look for consumption- or throughput-based models that align better with the services that the provider sells.



5G

The race to 5G is gathering pace, with Asia Pacific and North America broadly recognised as leaders to commercial launch of 5G services. More than half of survey respondents expected 5G to be launched in their own markets by 2020. High-speed mobile broadband and massive IoT are leading use cases with more sophisticated cases to follow.

KEY TAKEAWAYS

- 45% of respondents saw 5G's greatest commercial potential in high-speed mobile broadband;
- Lack of spectrum availability was identified as the biggest impediment to the success of 5G
- Nearly half of the respondents believed consumers would pay more for 5G service, but not by too much



THE ELASTIC NETWORK

COMMERCIAL ROLLOUT IMMINENT

If you had to name one technology that has defined the telecoms industry in the past year, it would have to be 5G. Not only have we seen numerous trials of one kind or another and different claims of “world’s first” from North America to South Africa, commercial networks are all but switched on in South Korea, US, and Qatar, to name but a few. Frequency auctions have also been conducted and concluded in markets like Finland, UK, and Italy.

While a repeat of a bonanza the size of the 3G auction at the turn of the century is not anticipated, large sums have been paid by mobile operators to secure the radio spectrums they need to roll out 5G services. More auctions and beauty contests are expected in the near future in many more markets.

This perceptible optimism has not been lost on our survey respondents either. When they were asked to estimate when commercial 5G would be launched in their market, more than half of the respondents expected it to happen within two years by 2020. 8% of them expected 5G to launch already by the end of this year. A further third of industry professionals expected to see commercial 5G in their market within five years.

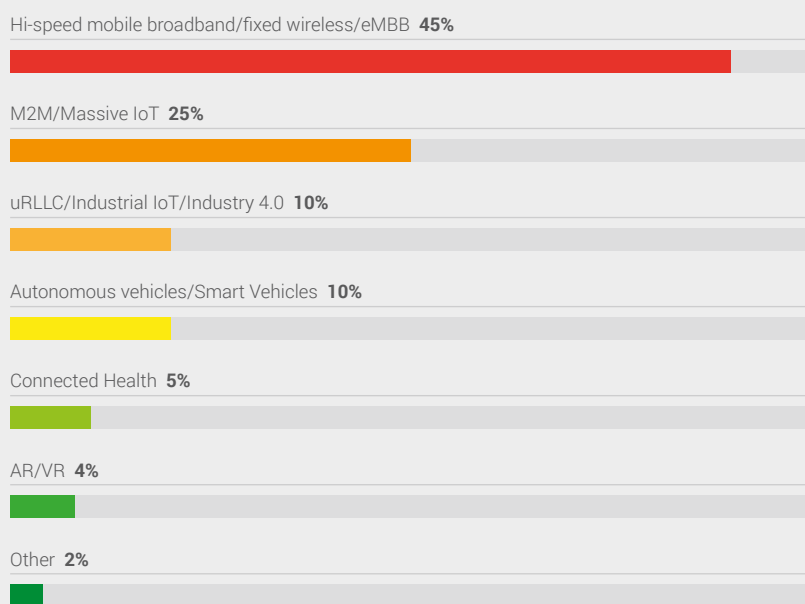
When it comes to which market will win the race to 5G, half of the respondents see Asia Pacific leading the charge, with 30% going for North America. This is in line with what we have seen and heard. Vying for the leadership, mobile operators from Korea, Japan, China, Singapore, and US are among the most vocal ones in their ambition to offer 5G services as fast as possible. Europe, which led the world in 3G and 4G, is a distant third at 16%.

When it comes to what 5G can offer, it is broadly agreed by the industry that the leading use cases include enhanced mobile broadband, massive IoT, and low latency communications. The answers to the question on 5G services that have the greatest commercial potential also reinforced the consensus. 45% of respondents selected high-speed mobile broadband, followed by massive

IoT (25%), while ultra-Reliable Low Latency Communications (uRLLC) and autonomous vehicles tied at 10% each.

This list also confirms the industry’s recognition that not all services will happen at the same time, and those that can happen early are viewed as capable of generating more commercial return. >

Which 5G services do you expect to have the greatest commercial potential (i.e. generate the most revenue)?



For example, the significantly enhanced bandwidth required to provide high-speed mobile broadband access and to enable richer media applications, such as UHD video streaming, will already be realised at the beginning of 5G deployment, supported by smart edge computing implementation. Massive IoT will mainly demand high capacity but limited bandwidth, therefore it can also be realised relatively early in the 5G era. On the other hand, the mission critical applications that need extremely low latency, for instance industrial IoT or Industry 4.0 applications and autonomous vehicles, will come later, as they require wider end-to-end 5G coverage.

Meanwhile, it is also reassuring to see that the industry is not getting too carried away by the 5G euphoria.

When projecting by what time would 5G subscribers overtake those on other cellular technologies, 38% of respondents estimated that it would take up to 5 years, while 42% thought it would be more likely to happen in 10 years. A minority of respondents (8%) were more optimistic, believing 5G would be the dominate cellular technology for consumers within 2 years, but a slightly larger number of people (11%) thought it would take more than 10 years for the cross-over to happen.

In order for 5G to take off as hoped, the industry still needs to overcome a few challenges. When asked to name the biggest impediments to the success of 5G, the feedback was rather broadly distributed. Topping the list, on 17%, was the concern over spectrum availability, followed by the lack of compelling business cases,

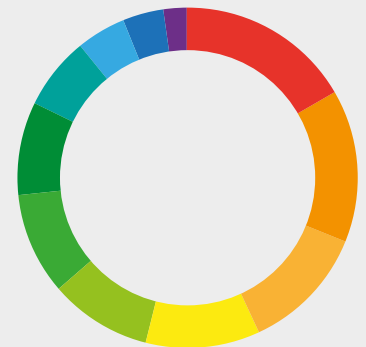
chosen by 15% of the respondents. Also high on the list are worry about cost, on 12%, and the increased number of base stations (therefore more difficult and more expensive site acquisition), on 11%.

The industry also conceded that the consumer communication of 5G can be improved. Equal numbers of respondents (19% each) either believed the benefits of 5G have been effectively communicated to consumers or were not sure. But the majority of the respondents, 62% of them, did not think the communication was effective.

Related to, or probably because of, the less than optimum benefit communication, the expectation for consumer enthusiasm to pay more for 5G service is more muted. When asked if they believed 5G would generate higher



What are the biggest impediments to the success of 5G?



● Spectrum availability	17%
● Unclear ROI/ Lack of compelling business case	15%
● Costs	12%
● Increase in the number of base stations	11%
● Network Transformation/ Slow progress in network virtualization ...	10%
● Standardization	10%
● Device/handset availability	9%
● International spectrum harmonization	7%
● Weak market demand	5%
● Operator hesitation	4%
● Other	2%

“MASSIVE IOT WILL MAINLY DEMAND HIGH CAPACITY BUT LIMITED BANDWIDTH, THEREFORE IT CAN ALSO BE REALISED EARLY IN THE 5G ERA.”

ARPU, 40% of the respondents did not believe this would happen. Nearly half (48%) of all respondents believed consumers would not pay more than 10% for 5G over what they pay now.

As investment cases are largely built on ARPU expectations, as well as market share and subscriber targets, the sober view on the prospects of consumer spending increase also influenced the estimates of return on investment for the mobile operators investing in 5G. A quarter of respondents believed operators would be able to break even on their 5G investment (including spending on spectrum as well as network deployment and upgrades, etc.) within 5 years, but more than half (53%) of all respondents believed it would take up to 10 years. This dominant view is considerably longer than what some industry players have pronounced, presumably calculated

with much more optimistic ARPU estimates. A significant minority (17%) expected breakeven to happen between 10 and 20 years.

Overall, the solid progress in 5G over the past year has instilled the industry with increased confidence. The commercial potential of 5G is well accepted by the industry, though it also recognises the technology and business obstacles that need to be overcome, including winning consumer buy-in among other things, before 5G can serious move from labs to real life. ●

Sponsor's Comment

5G promises to change the way we live, offering unprecedented services and an unparalleled user experience, but 5G goes beyond capacity. It is not just another G, nor is it simply about radio, rather it will change networking as we know it!

5G will drive significant growth in mobile bandwidth and an exponential surge in end-end-connections driven by IoT. While mass implementation is expected in 2020 and beyond, many operators are already beginning to introduce 5G NSA (non-standalone) network solutions using new 5G radio specifications in tandem with a 4G core network.

The survey results align well with a maturing industry vision and understanding that the evolution to 5G will require quite a few years, and perhaps as many changes in the telecoms infrastructure. Operators are more cautious about how quickly they will recoup investments, and a few are still questioning the 5G business case. So it is safe to say that operators are embarking on this passage with 'open eyes'.

It's no surprise that the majority are betting on enhanced Mobile Broadband's commercial potential in the short term, but like ECI, believe that 5G's long term potential lies in advanced services requiring assured, dynamic networking enabled by slicing and automation.



DIGITAL TRANSFORMATION

Most industry professionals agreed that digital transformation is important and expect the benefits to both deliver customer value and improve internal operational efficiency. Most of the survey participants prefer evolutionary modes of transformation.

KEY TAKEAWAYS

- The ultimate goals of digital transformation included faster product development and delivery, improved operational efficiency, and greater organisational agility;
- Insufficient business case, over-reliance on legacy technology, and CAPEX constraints were identified as major impediments to successful digital transformation;
- A “digital first” corporate culture is seen as taking more time to take hold than new technologies to roll out.

 OPENET®

SEARCHING FOR USEFUL OUTCOMES

Digital transformation is arguably the defining buzzword of our time for the telecoms industry, but it's a very broadly-defined concept. The imperative to transform becomes more pressing with operators having to watch internet companies overtake them, both in customer relationships and in overall revenues, all while using their networks to do so.

Operators are constantly told how slow, inflexible and backward they are in the way they do business, but at the same time face demands from the market to offer more for less. Therefore, the remit of digital transformation covers almost every corner of operators' business landscape from product development to customers service, from internal operation to network architecture, and everything in between.

This section of the survey aims to check on the current status of digital transformation, as well as to provide foresights into the ambition level and readiness of the industry players to make themselves more agile and efficient. One clear message from the respondents is that there is no lack of awareness or desire to make the change. When they were asked how important digital transformation is for their companies, 75% of the respondents agreed it is highly important. >

“TECHNOLOGICAL UPDATING IS MORE STRAIGHT-FORWARD, WHILE CULTURAL TRANSFORMATION TAKES MUCH MORE TIME. OPERATORS HAVE LARGELY GOT THE MEMO THAT THEY NEED TO TRANSFORM, BUT ACTUALLY DOING SO IS ANOTHER MATTER.”

What do you see as the ultimate goals of digital transformation?

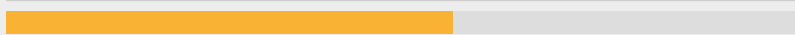
Faster product development and delivery **33%**



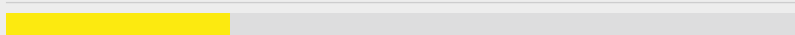
Improved operational efficiency **25%**



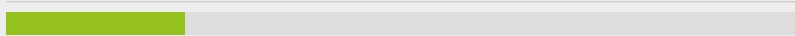
Greater organisational agility **20%**



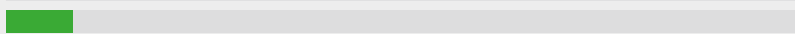
Reduced network costs through virtualization **10%**



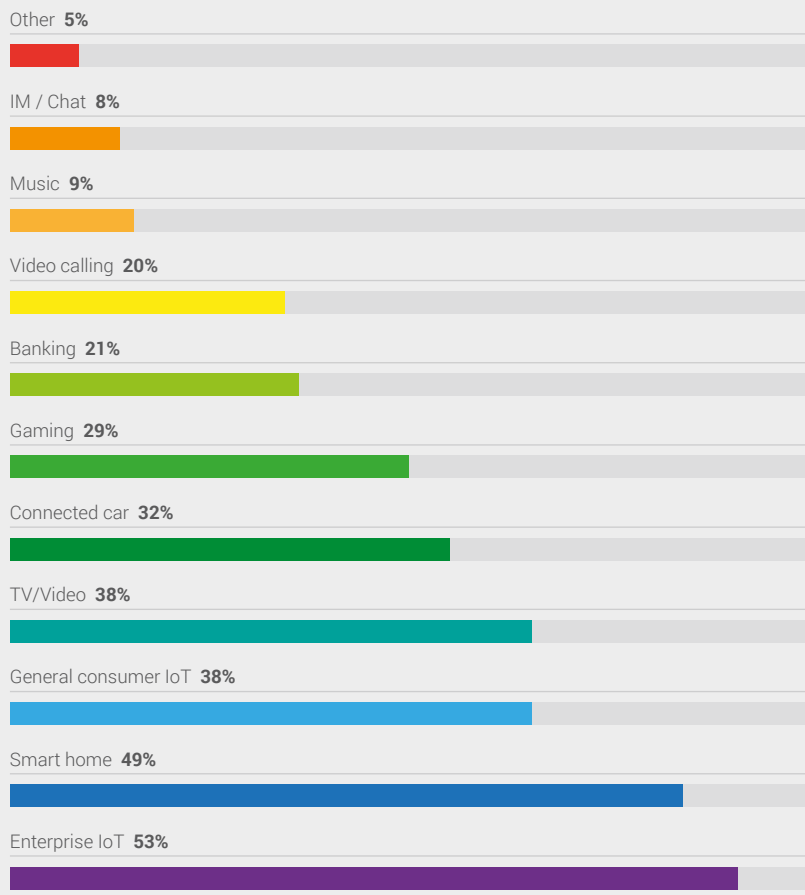
General Cost / OPEX savings **8%**



Fighting off competition from OTTs **3%**



Which types of products and services, enabled by digital transformation, will generate most revenue for operators? (please choose the top 3)



distributed across both B2B and B2C domains. Leading contenders include enterprise IoT, selected by 53% of all respondents, followed by smart home at 49%. General consumer IoT and TV/Video both won considerable number of votes, tied at 38%.

Meanwhile, there is also a realistic recognition that these products and services would not be able to overtake the business incomes generated from traditional voice, text messages and data traffic any time soon. When they were asked to compare the percentage of revenues expected to be derived from the new digital products and services in one year's time with four years down the road, the largest number of correspondents (44%) believed the contribution would be less than 25% in 2019, but the largest group (34%) believed the contribution could go up to 50% by 2022.

When comparing the routes to implementing digital transformation, there is a mild but perceptible preference among the respondents for evolutionary rather than revolutionary approaches. A sizeable group (29%) thought the "big-bang" approach (swapping out legacy systems for digital systems in one large project) a disastrous idea, with only 4% seeing it an excellent idea. In comparison, more than 70% of respondents thought both "greenfield" approach (new digital systems to support new lines of business, e.g. IoT, 2nd brand, etc.)

When they were asked to name the ultimate goals of their digital transformation investments, three choices stood out, and it is an encouraging sign to see the industry professionals seeing digital transformation an opportunity for both customer facing activities and for optimising internal operation. The highest number of people, 33% of the total, selected faster product development and delivery, with a quarter of the respondents going for improved operational efficiency, and 20% prioritising greater organisational agility.

So, naturally, the respondents also saw the benefits from digital transformation serving both internal

and external purpose. When asked to select the most important business benefits to drive from digital transformation, three options were almost neck and neck. More efficient customer care and self-service through automation was selected by 22% of the respondents, closely followed by network cost savings through virtualization and increased customer satisfaction through personalised offers and services, at 21% each.

When it came to the specific products and services, enabled by digital transformation, that the respondents looked to generate the most revenues for operators, the selections are well

and “phased” approach (step-by-step replacing legacy solutions with digital solutions) fine ways, with more than 16% seeing them as excellent. More than 18% thought “add-on” approach (adding new digital systems as an overlay to existing legacy systems and phasing out over time) an excellent way of implementing digital transformation, with 65% thinking it a fine idea.

The industry recognised there were still a number of factors standing in the way of successful digital transformation undertaking, with 20% of the respondents seeing insufficient business case as the most significant,

closely followed by their companies’ over-reliance on legacy technology and CAPEX constraints (18% each) and general corporate inertia (17%).

This recognition is also reflected in the survey respondents’ estimate of the scale and speed of change they foresaw coming. To compare what they expected would change next year with four years down the road, the number of people seeing complete or nearly complete transformation in network virtualisation grew by 32%, digital product sets by 31%, and digital internal processes by 30%. On the other hand, the number of people

seeing a complete or nearly complete shift to “digital first” corporate culture increased by only 25%.

This is further proof that digital transformation consists of a hugely diverse and complex set of technological, cultural and strategic challenges, and that not all the necessary changes can take place at the same time or with the same degree of difficulty. Technological updating is more straightforward, while cultural transformation takes much more time. Operators have largely got the memo that they need to transform, but actually doing so is another matter. ●

Sponsor’s Comment

In 2019 operators expect to see around 28% of their revenues come from digital services. Fast forward to 2022 and this jumps to an average 42%. The GSMA reports global mobile services revenue of \$1.05 trillion for 2017. This roughly equates to \$294 billion of revenues from digital services in 2019 going up to \$462 billion in 2022.

This new revenue will come from more services – from entertainment to smart homes to IoT to gaming and beyond. Therefore it’s no shock that faster product delivery and development is the main goal for digital transformation. What was quite surprising was that Enterprise IoT would be the main revenue earner as a result of transformation. Perhaps the influence of 5G is looming large.

Turning these digital visions into revenue is the job of BSS. How to transform old legacy systems into digital platforms that deliver on the promise of fast time to market and agility is an on-going discussion. However, this argument is now being put to bed. This survey showed that a sizeable group sees the ‘big-bang’ approach to transformation as ‘disastrous’. The more pragmatic (and less risky) approach of greenfield sites and phased transformations is much more sensible.



IoT

With tens of billions of IoT devices expected to be connected in the coming years, most of the survey respondents see IoT as either important or critical. Smart cities, utilities, and industrial IoT are viewed as the most important segments.

KEY TAKEAWAYS

- 56% of respondents saw IoT as an important driver to expand their service portfolio, 46% saw it as significant channel to deliver new revenues;
- Application platform, access infrastructure, and security solutions were identified as key investment areas in the coming years;
- Security topped industry's list of concerns for IoT business



CONNECTING PEOPLE TO THINGS

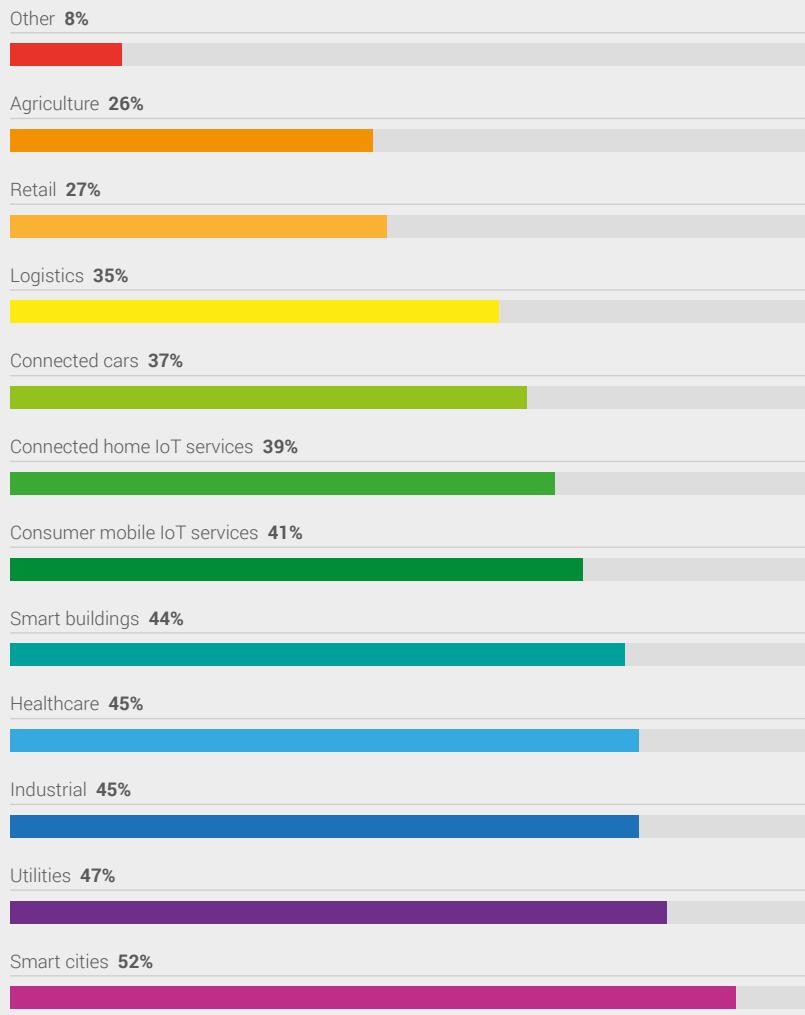
Estimates for the number of IoT connections there are expected to be in five years range from billions to tens of billions, and the value of the IoT market is expected to reach trillions of dollars. So, there is no surprise that IoT has captured the communication industry’s imagination. Recently, the level of enthusiasm has risen fast, thanks both to the growing number of IoT programmes implemented in different parts of the world and to the new promises by the imminent rollout of 5G.

In general, very few in the industry would deny the importance of IoT. Only 3% of all the respondents to the survey thought IoT insignificant. More than 80% saw it either as important (57%) or as critical (28%) to their companies’ overall strategy over the next five years.

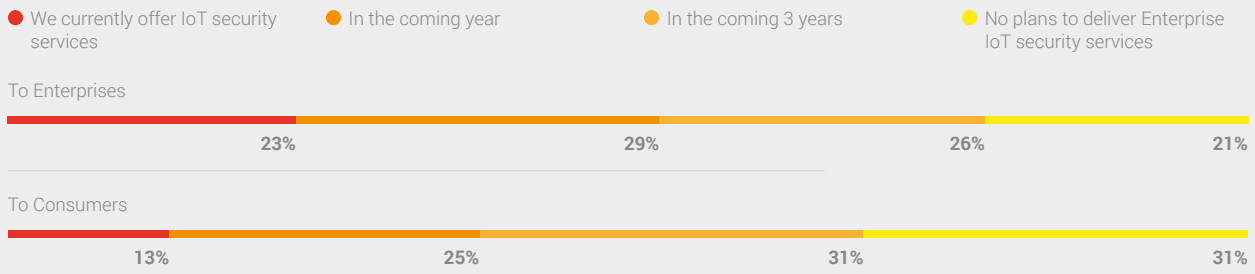
On the other hand, depending on their business realities, companies see IoT playing different roles for them. 56% of respondents saw IoT as an important driver to expand their service portfolio, followed by those seeing it deliver new revenue sources (46%) and the expectations to provide a clear direction for the company’s future growth (42%). A significant number of companies (37%) also saw IoT as an important means to enable them to beat or at least to match competition offerings, while a sizeable number of them viewed IoT as a means to ensure their ability to survive in the market.

When considering the technology areas to invest in over the coming five years, four areas stood out and enjoyed almost equal support. Application platform was selected by 50% of all the respondents, access infrastructure at 49%, security solutions 48%, and connectivity platform at 47%. >

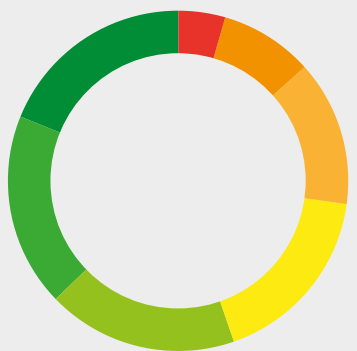
Which of the following IoT markets are the most important for your business to address? (choose all that apply)



Are you / when are you planning to deliver IoT security services



Which of the following IoT technology areas is your company likely to invest in over the next five years? (choose all that apply)



- Other12%
- Separate core network infrastructure for IoT24%
- IoT visibility and analytics solutions.....37%
- IoT connectivity platforms47%
- IoT security solutions.....48%
- IoT access network infrastructure49%
- IoT application platforms50%

Together with the next option on the list, analytics solutions (37%), these areas would together form the key monetisation mechanisms for IoT business, though most researches have pointed out that not every mechanism would have equal weight on the value chain. For example the percent of income going into platforms, applications, and sector specific applications would be considerably higher than that going into connectivity.

At this stage IoT is still more B2B focused (smart cities, utilities, logistics etc.), but with the ascendancy of smart homes and more intelligent wearables, B2C opportunities will become more pronounced in the coming years. This message could also be read from the well distributed selections of the most important market segments for the companies, covering both market segments. Despite smart cities leading by

a comfortable margin at 52%, five other verticals were picked by over 40% of the respondents, and three more by over 30% selections. This result is very much in line with other predictions we have seen, which largely agree with each other that a dozen or so services will be responsible for 80-90% of the total IoT market. Also, there is no surprise that smart cities top the list. Cities in Asia and the Middle East actively rolling out projects have not only provided the scale that is critical to the business viability, but also helped put smart cities under media spotlight and raise the awareness of IoT in general.

When it comes to concerns voiced towards IoT services, the industry professionals believed security would top both enterprise and consumer customers' list. According to the respondents, 39% of enterprise clients have raised security concerns, followed by the cost of deployment (27%).

On the consumer front, 75% of respondents selected privacy as the key concern of consumers living in a highly connected smart-home. This is followed by identity theft, fraud, and vandalism through hacking into connected devices, all closely related to security.

In view of the security concerns, the industry professionals are planning to actively deliver IoT security services. Right now and in the next few years, more companies will still focus on delivering security service to enterprise clients than those serving consumers, 23% over 13%, and 29% over 25%, respectively. But three years from now, the number of companies serving consumers (31%) will exceed those serving enterprises (26%). The dip in the percentage of businesses delivering security services to enterprises should not be read as a reduced motivation but rather it is more to do with the front-loaded investment

in the first years that most enterprise clients are already being served, while consumer segment is still only picking up.

Respondents are also cautiously optimistic with consumer willingness to pay for smart-home cyber-security service. To compare with the low expectation for increased ARPU for 5G service we see in the relevant section of this report, nearly 90% of all respondents thought consumers would be willing to pay for smart-home cyber-security service, including 74% thinking consumers would be happy to pay up to \$10 a month.

Most of us agree that IoT will be very big, but knowing exactly how big is another matter. The industry is optimistic about its prospects and potential, if not for rapid growth then at least for survival. In short term, the investment focus will be on the enterprise market, though the consumer market is expected to catch up in the next few years. Customers of both segments share the concern for security, which would both serve as a mandate and present new opportunities to IoT service providers. ●

“AT THIS STAGE IOT IS STILL MORE B2B FOCUSED (SMART CITIES, UTILITIES, LOGISTICS ETC.), BUT WITH THE ASCENDENCY OF SMART HOMES AND MORE INTELLIGENT WEARABLES, B2C OPPORTUNITIES WILL BECOME MORE PRONOUNCED IN THE COMING YEARS.”

Sponsor’s Comment

Life has become phygital, where the boundaries between the physical and digital world are blurred in almost all aspects of life. Never before has the digital world impacted the physical world as it does today. IoT drives autonomously driven cars, turns on lights, controls the quality of water, and lets you know who is standing at your front door. This requires ubiquitous connectivity and security. With 5G mobility, wireless technology, and Fiber to the X (FTTx), connectivity is sorted. But, security is lagging far behind.

When mobile operators needed to adapt quickly to the smartphone explosion, Allot was there for them with the right technology and expertise. We are here, again, for IoT.

To help service providers plan their IoT deployments, manage their growth, and monetize IoT connectivity with value added services. Our IoT-focused solutions include, IoTSecure for enterprises and HomeSecure for service providers and deliver three pillars:

- IoT analytics and analytics as a service,
- IoT behavior-based profiling and behavior assurance, and
- IoT security to protect infrastructure and services.

Allot Communications is a provider of leading innovative network intelligence and security solutions for service providers worldwide, enhancing value to their customers. Our solutions are deployed globally for network and application analytics, traffic control and shaping, network-based security services, and more.

To learn more about Allot’s security portfolio and network intelligence solutions, visit www.Allot.com.

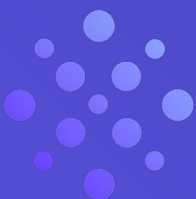


SECURITY

Cyber-attacks are showing no sign of abating, and telecoms businesses have realised they need to embrace new generation of defence, including artificial intelligence powered solutions, to win tomorrow's tug-of-war with new types of attacks.

KEY TAKEAWAYS

- Three quarters of survey respondents said they saw increase in cyber-attacks over the last year;
- The most widely deployed security solutions are reactive technologies including DNS blacklisting, firewalls, and antivirus;
- Budget constraint and lack of expertise were identified as the top obstacles and concerns facing new security solution deployment.



CUJO AI

SAFEGUARDING THE FUTURE

Security is a top concern for both consumers and enterprises, as we saw in the IoT section of this report, and is highly relevant to all stakeholders of the telecom industry. Over the past year or so, a few high-profile cases have highlighted the impact of security breaches, but probably none more so than the abuse of Facebook’s user data by Cambridge Analytica. The truth is social networks are far from being the only type of business being targeted, or compromising personal data being the only objective of security attacks. Presently, home networks are hardly protected, end user data is at risk. When there is a breach, the operators and ISPs are normally the first to be blamed.

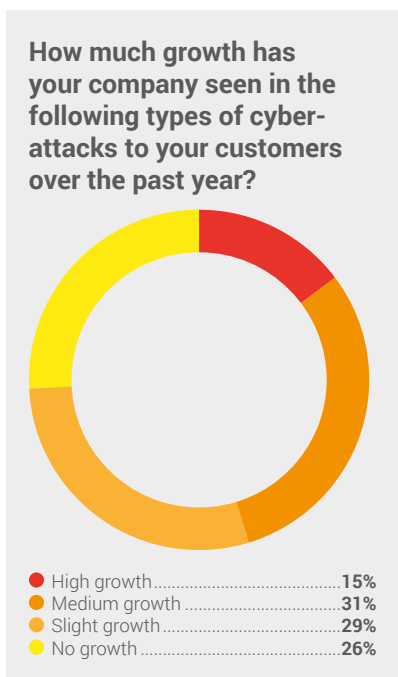
As industry professionals told us in the survey, the trend of increasing cyber-attacks we have seen in previous years has shown no sign of abating. We asked the respondents how much growth their companies have seen in different types of attacks to their customers over the past year. The good news is 26% of all the

respondents have seen no obvious growth of any kind of the attacks. The bad news is 45% of them experienced medium to high growth in attacks. Malware / drive-by downloads and unwanted content / malicious websites were the types of attacks growing the most, being cited by 34% of the respondents, followed by phishing, selected by 20%.

To defend against the attacks, telecom companies have deployed different kinds of solutions, and more likely than not every one of them will have deployed more than one solution to shore up their defence mechanism. According to the survey respondents, the most popular solution deployed was DNS blacklisting / firewalls, chosen by 63% of the respondents. Three more solutions were also selected by more than half of the respondents: antivirus solutions (59%), IP/domain blacklisting (54%), and deep packet inspection (DPI) (52%).

There would be no surprise that the respondents considered greater network security for customers to be the biggest benefit of offering new cybersecurity solutions, selected by 52% of all the respondents. >

“THE GENERAL DATA PROTECTION REGULATION (GDPR), WHICH CAME INTO EFFECT IN MAY IN THE EUROPEAN UNION, DEMANDS THAT BUSINESSES SHOULD ALSO ASSESS THEIR SUPPLIERS’ SECURITY RISKS.”



This shows a recognition from the industry that earlier defence solutions, e.g. DNS blacklisting and firewalls, may not be as effective as the new solutions, e.g. predictive defence powered by AI. After all, this directly addresses the biggest concerns by consumer and enterprise customers alike. Ensuring customer privacy also ranked high, selected by 50% of the respondents, and to ensure legal compliance ranked third at 40%.

The survey also provided an interesting comparison of the industry's confidence levels in their traditional territory versus new businesses with regard to the tug-of-war between attack and defence. The industry is much more confident in providing satisfactory security for mobile data users on 3G and 4G networks than it is in IoT. The level of confidence in managing security requirements of broadband users (on Wi-Fi and LAN) falls between the two.

This indicates a higher level of confidence, the closer a service is to the

core. IoT on the other hand is new even for those telecom operators which have ventured into this business. They may have been good at connecting people, but when expanding into connecting things they will face very different security challenges.

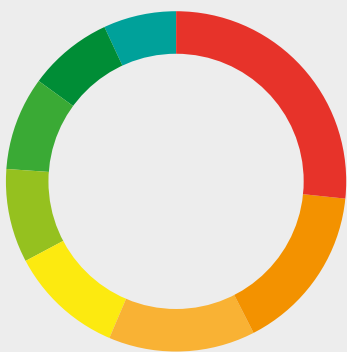
Quite a few factors are affecting the optimal security solution deployment. When the survey respondents were asked to select the obstacles and concerns their companies were facing while deploying new security solutions, the results are well distributed. Understandably, on top of the list is the concern over the inadequacy of budget, chosen by 27% of the respondents, followed by the lack of expertise, at 16%.

New attacking techniques or old techniques coming back in new shapes have been used to attack the businesses' security systems. Recently we have seen hardware tampering hitting headlines, but instead of hiding a listening device in a vase, microchips

have allegedly been planted in SOCs. We have also seen increase in focused attacks on cloud service providers, the so-called Operation Cloud Hopper. Instead of a sweeping attack on a large number of companies, hoping some of them would be vulnerable, this new type of attack would target a few managed IT service providers (e.g. Amazon Web Services, Microsoft Azure), which, if successful, would spread malware to all the clients on these outsourcing companies. New technologies would be needed to defend against new attacks like these.

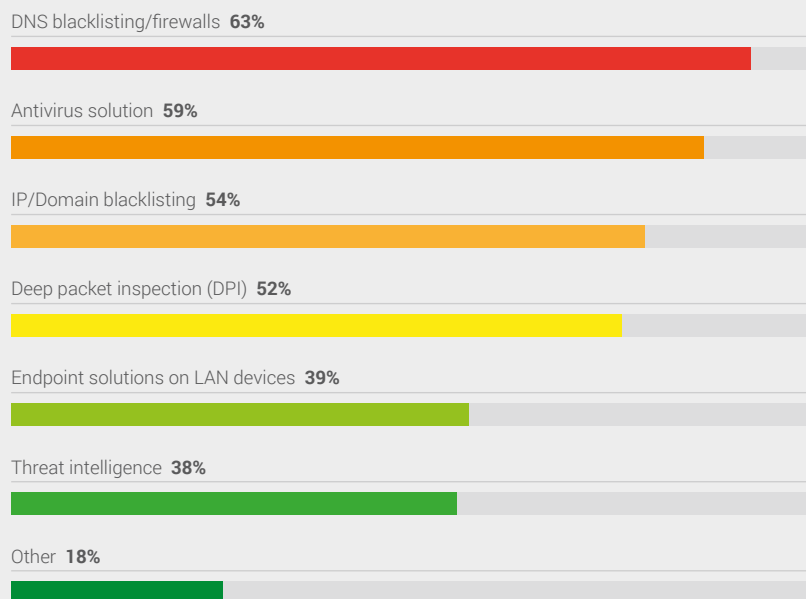
One of the new technologies that has been employed is Artificial Intelligence. When asked which areas of AI applications in the respondents' companies are the least developed, 41% of the respondents selected AI's weak capability to predict customer demands. In comparison, only 26% of the respondents felt their AI application for network security

What obstacles and concerns is your company facing while deploying new security solutions?



- Budget27%
- Lack of expertise16%
- Unclear customer demand.....14%
- Other11%
- Latency9%
- Easy to Adopt Solutions.....9%
- No clear understanding of applicability or need.....8%
- Privacy concerns.....7%

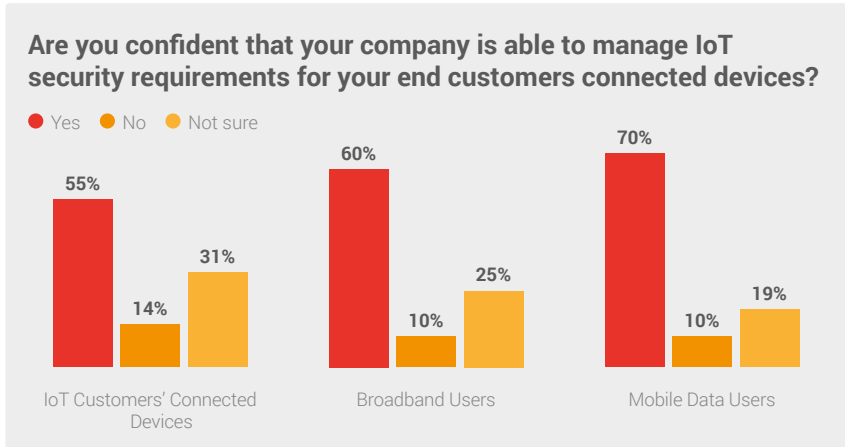
Which of the following technology solutions does your company currently use to ensure security for your customers? (choose all that apply)



is the least developed. The low level of anxiety could either be a reflection of high confidence in their company's AI capability to defend security, or be a sign of low priority that security is given when AI is being deployed.

In general, the businesses surveyed have seen various attempts being made to continue to attack their networks and their customers. Different kinds of solutions have been deployed to defend against the attacks. However, businesses should recognise that as the attacking techniques constantly evolve, so should the defending technologies and business processes. From the breach of data security of Yahoo's 500 million users in September 2016 to the shutdown of Google+ after the data of half a million users being leaked in October 2018, we have all come to recognise that even the world's best webscale companies with the most advanced defence tools at their disposal are not attack proof.

The General Data Protection Regulation (GDPR), which came into effect in May in the European Union,



demands that businesses should also assess their suppliers' security risks. Although the focus of GDPR is mainly on safeguarding user's private data, companies will find it beneficial to expand the assessment to all security aspects. By doing so they will not only improve their regulation compliance measure by also reduce, if not pre-empt, the risk of attacks through the suppliers which may not always have the most stringent defending solutions in place, pressed by cost or other reasons. ●

Sponsor's Comment

With the growing number of devices at customer's homes, there are more attack vectors that criminals can exploit. Cyber-attacks became both more frequent and severe, threatening user's personal and financial information. Network operators currently deploy traditional cybersecurity methods, but they see the value in exploring new solutions. The shift towards cybersecurity powered by artificial intelligence is happening now, and network operators can deliver security and privacy to their customers.

Key Takeaways

- The most popular solution against cyber-attacks currently deployed are DNS blacklisting/firewalls (63%), antivirus (59%), and IP/domain blacklisting (54%).
- Key benefits that operators seek to provide their users after deploying new cybersecurity solutions for their customers are greater network security (52%), ensuring user privacy (50%), and ensuring legal compliance (40%).
- The main obstacles associated with deploying new security solutions include budgetary concerns (27%), lack of expertise (16%), and unclear customer demand (13%).



TEST & MONITORING

Test & Monitoring is critical to assure and improve network reliability and quality of experience, but it is expected to play a more important role in the 5G era, with 5G's new technology property, new architecture, and new air interface.

KEY TAKEAWAYS

- Two thirds of the survey respondents expected to see T&M material impact on their company's success in the coming years;
- More than half of the respondents saw improving the performance and reliability of networks or services as the biggest benefit of successful T&M implementation;
- Customers are looking to T&M vendors to support their innovation needs, especially capabilities to deliver customer and service insights, real-time alerting, and embedded AI and predictive capabilities.

EXFO

THE NEXT GENERATION

Test & Monitoring (T&M) covers the technologies, equipment and services used for validating, assuring, and optimising networks, services, and user experience. These involve both technological quality control and business assurance (revenue and margin assurance, fraud detection and prediction, etc.). They are essential tools and processes for telecom companies, some may question their prominence in the management agenda. This is misguided since T&M, comprised of multiple, interrelated elements, may not generate immediately visible return on investment, but failing to invest properly is likely to result in long term perils.

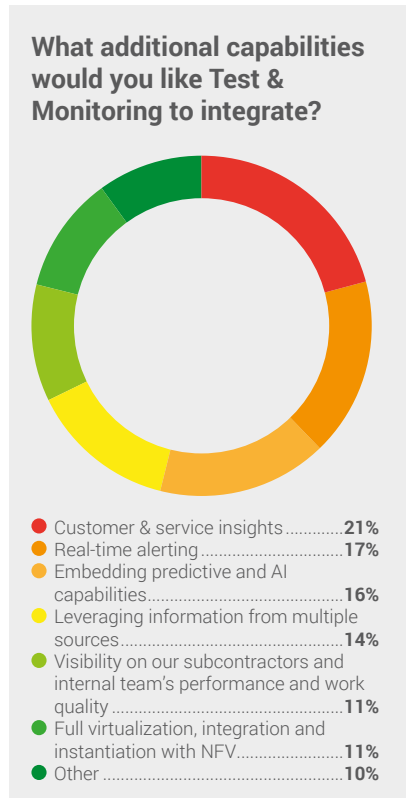
Although T&M is sometimes regarded as an afterthought in the case of mature technologies, used only to find and fix faults following the report of service impacting issues, it has become a true priority for investment when new network technologies, features or services are introduced. Service providers need to ensure that these should work as expected and can be commercially successful. Failing to invest in T&M at the early stage increases the risk of network, service and customer experience issues that will impact market reputation and success of any service provider.

Nearly two-thirds (64%) of the respondents to this survey expected T&M to have a major or moderate impact on their company's success over the next 5 years. On the other hand, 36% expect only a minor impact or no impact at all. Although the exact T&M role depends on regional, service provider and network specific characteristics, this high percentage shows that many companies and individuals worldwide may still underestimate the significance of T&M.

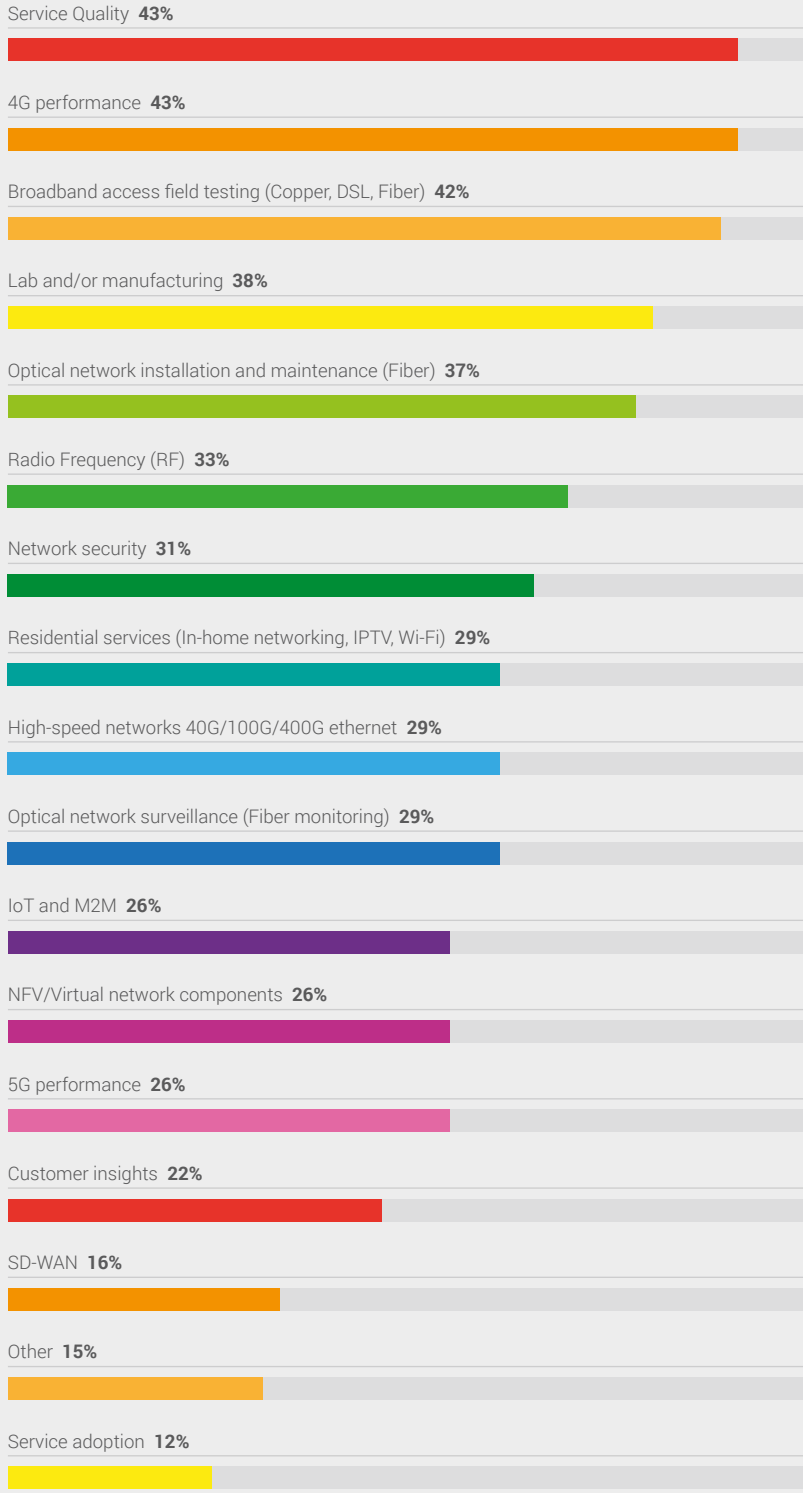
It is important that the industry should understand that lack of sufficient T&M investment can affect business success through increased risk of network and service failure.

This concept is also supported by the top spot occupied by Service Quality when respondents chose the areas where T&M is being used. Also high on the list are 4G performance, and Broadband access field testing (Copper, DSL, Fiber) selected by almost equal numbers of the survey respondents. Meanwhile, the positions of IoT and M2M, NFV/Virtual network components, and 5G, should not be read as a lack of interest but rather these are new technology areas, therefore fewer companies have engaged in the business, hence a small scale of T&M dedicated to them. If anything, we will see T&M in these domains be strengthened in the years to come, not the other way round.

When it comes to the benefits of implementing T&M, the majority of respondents agreed that it would help improve the performance and reliability of networks or services (54%). >



In which of the following areas does your company now use Test & Monitoring? (choose all that apply)



This was followed by three perceived benefits chosen by almost equal number of respondents: managing customer experience (including QoS and QoE) (43%), allowing for greater network and service agility (42%), and gaining end-to-end visibility into faults and events in network and services (therefore reducing mean time to repair) (41%).

Another way of looking at the implementation status and prospective of T&M is to understand the challenges in the industry professionals' mind when they consider T&M. The biggest concern the respondents voiced is that networks are evolving at a very fast pace, therefore their investment in T&M might not last long enough. The security and data-integrity are high on the list especially when the industry professionals looked at cloud-based solutions, followed by the concern over the complexity of continuing to support legacy infrastructure while introducing new technologies.

Virtualised T&M will provide a strong supplementary option in particular when the industry moves into 5G era, when large portions of the networks are software-defined. Virtualised T&M technologies can considerably reduce the time and resources needed and increase the process efficiency. Additionally, the flexibility of on-demand virtualised T&M also gives the testing and monitoring experts the possibility to create and simulate unlimited number of scenarios, often not achievable on real machines, to conduct more proactive error detection and error fixing. This would translate initial investment into long-term cost savings as complex, time-consuming troubleshooting and delays can be avoided.

It is encouraging to see that the awareness and acceptance of virtualised T&M solutions has increased. Nearly a quarter (23%) of respondents have either already

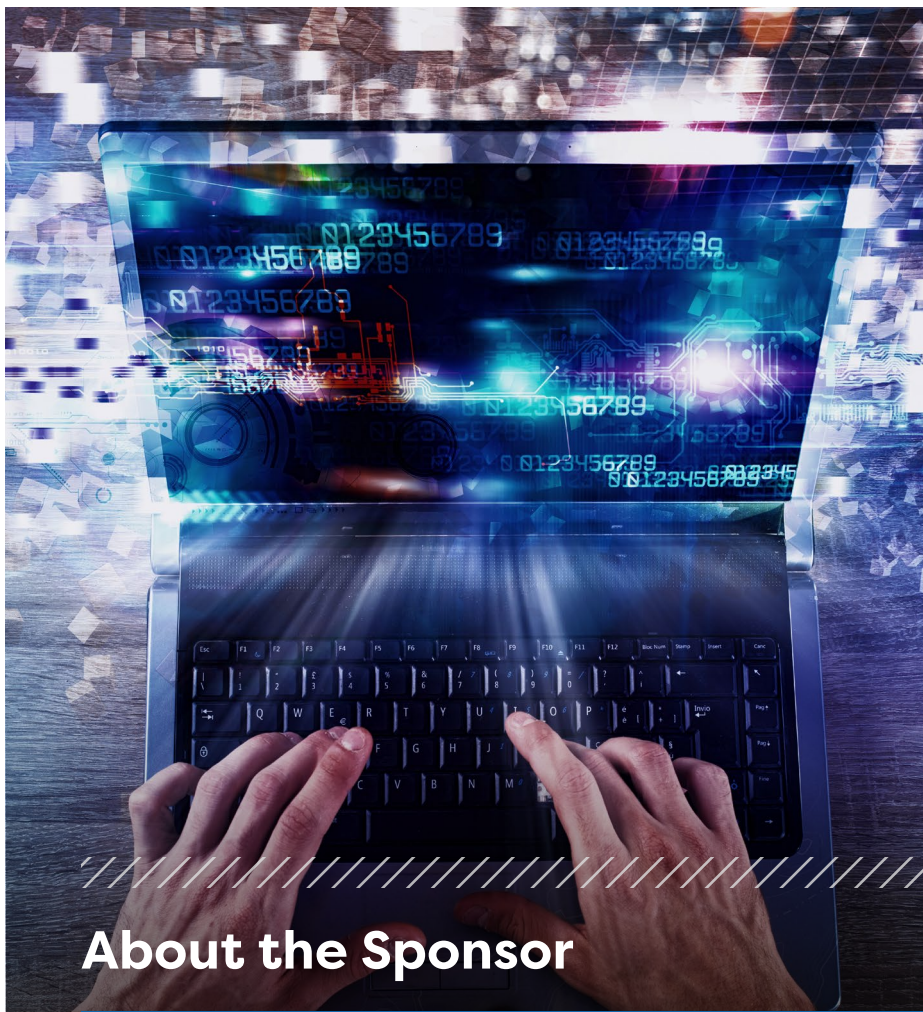
started using them or are planning to use them very soon, while a further 45% of respondents are either likely to adopt these solutions in a few years or are looking into them now.

When it comes to the drivers for choosing T&M partners, nearly half of the survey respondents have selected price (CAPEX) (46%) and return on investment (ROI) (43%) as their most important drivers. These are two sides of the same

consideration, reinforcing the importance for T&M solutions to be planned as an integrated part of any network transformation project and budgeted accordingly. On the other hand, if replies are weighted by respondent company types and functions, it would be the T&M vendors' innovation capability and differentiation that top the list for service providers, followed by vendor credibility and market position, while price (CAPEX) would come last.

In response to customer need for innovation and added value, leading T&M suppliers are integrating relevant additional capabilities in their offers. When asked to select the most desired features, the requests from the respondents were well distributed. Customer and service insights led with 21%, followed by real-time alerting at 17% and embedded AI and predictive capabilities third at 16%, a clear message to call for new generation of intelligent and automated Test & Monitoring solutions to support network and service lifecycles.

Undoubtedly, T&M is a critical component in any major network transformations, for example, the successful introduction of 5G technology. Although 5G represents the next evolution in wireless technology, it will co-exist with legacy network infrastructure for a long time. More than ever they should already be extensively implemented at the pre-commercial stage, not the least due to the new lead use cases, the complexity of its air interface, as well as the central roles played by software and virtualisation. Even if 5G is not on the agenda of some companies, it is vital for them to recognise the risk of ignoring or underinvesting in T&M. As seen many times in real life, the price to pay when things go wrong – and experience has repeatedly shown that they will go wrong – can be very high. ●



About the Sponsor

EXFO develops smarter test, monitoring and analytics solutions for fixed and mobile network operators, webscale companies and equipment manufacturers in the global communications industry. Our customers count on us to deliver superior network performance, service reliability and subscriber insights. They count on our unique blend of equipment, software and services to accelerate digital transformations related to fiber, 4G/LTE and 5G deployments. They count on our expertise with automation, real-time troubleshooting and big data analytics, which are critical to their business performance. We've spent over 30 years earning this trust, and today more than 2,000 EXFO employees in over 25 countries work side by side with our customers in the lab, field, data center and beyond.



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