STATE OF 5G – THE ROAD AHEAD

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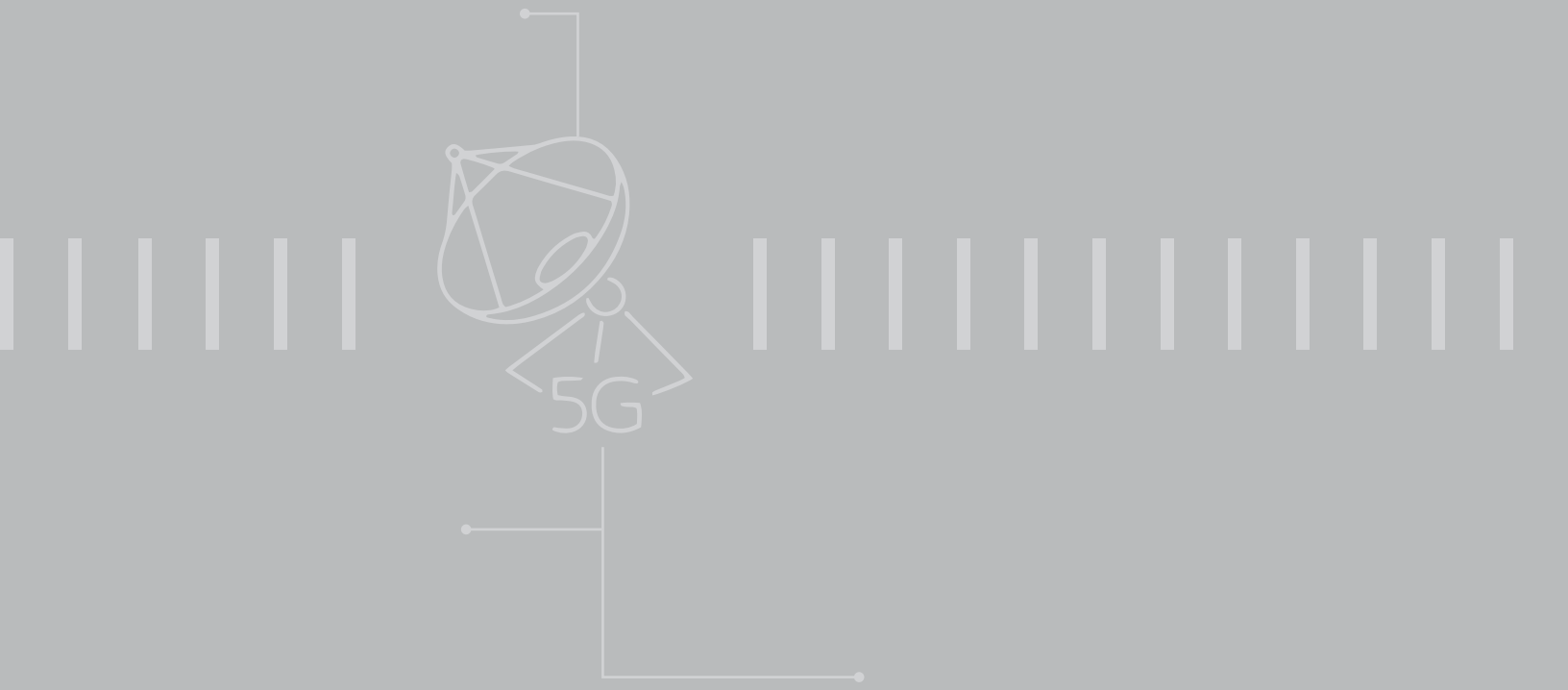
5G

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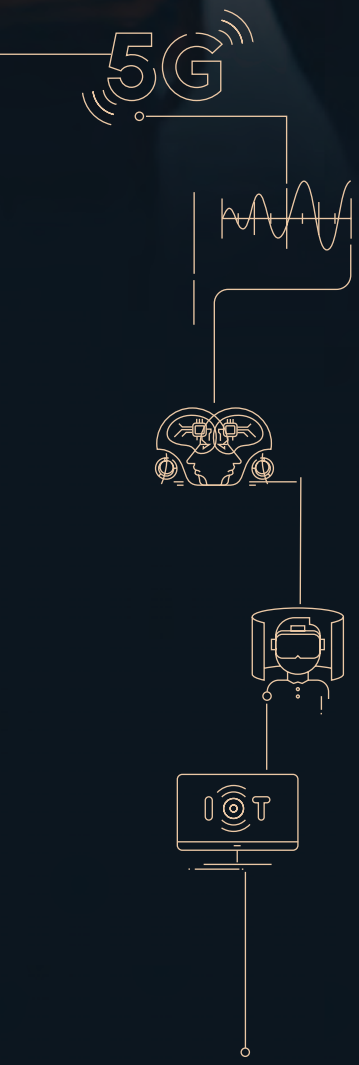


In an era of hyper-connectivity and rapid technological advancements, 5G technology is poised to become a connectivity fabric that brings together people, devices, machines and physical ecosystems. Amid all the hype, 5G is being heralded as a major driver of innovation due to its three improved characteristics — low latency (ultra-reliable connectivity enabling real-time experiences), massive machine type communication ("smart connected devices") and increased bandwidth (ability to stream large volumes of digital content). 5G has huge transformational potential across industries with its service-based, cloud-native architecture and higher-frequency bands that enable a greater amount of data to be transmitted in real-time. Indeed, most industries are investigating 5G and how it can add value to their business. But, there are numerous challenges in their way.

In an effort to provide perspectives around the current state of adoption of 5G and to identify current and future initiatives, Infosys commissioned a research survey covering 850 industry practitioners and leaders. "State of 5G – The Road Ahead" serves as a guide for business and technology leaders across enterprises who are looking to demystify the hype around 5G, understand the levels of maturity across industries, identify the future outlook on adoption and address challenges in their 5G digital transformation journey.

The research shows that almost all the industries are looking at 5G. But, it also shows that they face a lot of challenges — such as security concerns, lack of regulation, dearth of skilled workforce and lack of standards — in translating these opportunities into reality. Lack of underlying infrastructure and necessary equipment are other hurdles in their way today. 5G will truly be a step ahead only if enterprises are able to use 5G's unique characteristics for advanced applications such as ultra-fast analytics and massive machine to machine interaction. Therefore, parallel development of such technologies will be necessary to utilize the full potential of 5G.

> We are seeing service providers actively forge partnerships with banks, automobile manufacturers, utilities, healthcare and other industries to create joint value propositions. Such collaboration, unheard of during the 2G, 3G or even 4G rollouts, is an indicator of the significant impact that 5G is making in the B2B space. We believe this trend is only going to accelerate as we move forward.
>
> **– Nitesh Bansal,**
> Senior Vice President and Global Head of Engineering Services, Infosys

The era of 5G will uplift existing technologies such as IoT and provide avenues to monetize emerging technologies such as augmented reality, virtual reality and mixed reality, for both business-to-business and business-to-consumer interactions. The research also shows that there is a strong opportunity for telecom providers and system integrators to guide these firms in their 5G journey. Network service providers will become highly influential. System integrators will play a key role with their industry knowledge and familiarity with existing enterprise landscapes. This when coupled with their technical and domain expertise, will make them crucial partners for successful adoption of 5G.

The survey found that the majority of businesses are already identifying the use cases and establishing partnerships that can help them move forward. However, industries are at different stages of adoption.

> Machine to machine communication use cases are the most awaited 5G-enabled use cases across industries. Going beyond communication that is largely user-to-user and user-to-network, 5G will enable a massive amount of device-to-device communication such as vehicle-to-vehicle communication in autonomous vehicles and smart connected devices on manufacturing shop floors.
>
> **– Sreekanth S.S.,**
> Associate Vice President, Infosys

Many factors influence the selection of use cases. Some firms are looking for the most effective use cases that will bring in new revenue streams and customers, while others are looking for use cases that promise quick returns. The survey also highlights stark differences in factors that influence industries in selecting the use cases.

> The early uptake of 5G services is with business customers. Here, we believe there is a premium for the innovative new applications that will be created with low latency and increased speed. One example of this innovation is network slicing where an enterprise will take a slice of an operator's network to operate a virtual private network.
>
> **– Senior Director IT,**
> Leading IT and Network Provider

5G blurs the boundary between network service provider and the wider digital ecosystem, opening avenues for data monetization. It is critical to understand where enterprises and network service providers stand in terms of service readiness and deployments.

This reports pieces together the constantly evolving story of how, across industries, both groups are preparing to ride the 5G wave.

The most awaited 5G use cases

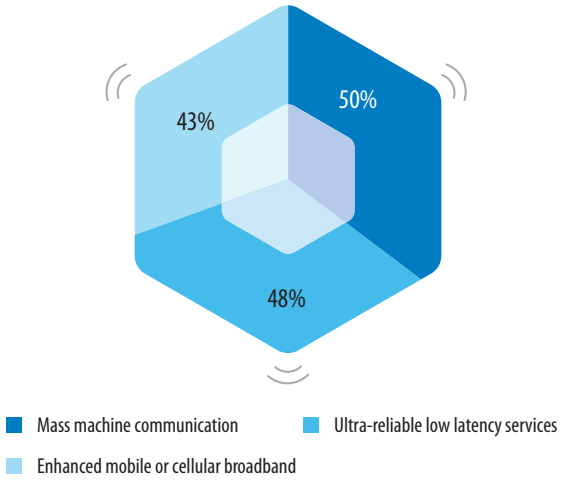
Every generation (G) of wireless technology has had a transformative impact on the user experience, and 5G will be the biggest jump yet. Increased network speeds along with high bandwidth will open doors for smart device technology.

> For the energy industry, 5G would be a kick-starter for greater levels of automated and robotic manufacturing processes coming in. Faster turnaround from the rig to the factories, utilization of augmented reality in terms of digital twins or component wear and tear would also bring in significant benefits.
>
> **– Senior Director IT,**
> Multinational Oil and Gas Corporation

With the availability of more bandwidth, users will be able to do more with their devices, making them more versatile and responsive. A fusion of edge computing, advanced sensor technologies, artificial intelligence and machine learning will uplift the connected world ecosystem.

According to the survey, the most anticipated applications are mass machine communication (50%) and ultra-reliable low latency services (48%), as shown in Figure 1.

Figure 1. Focus areas for 5G use cases



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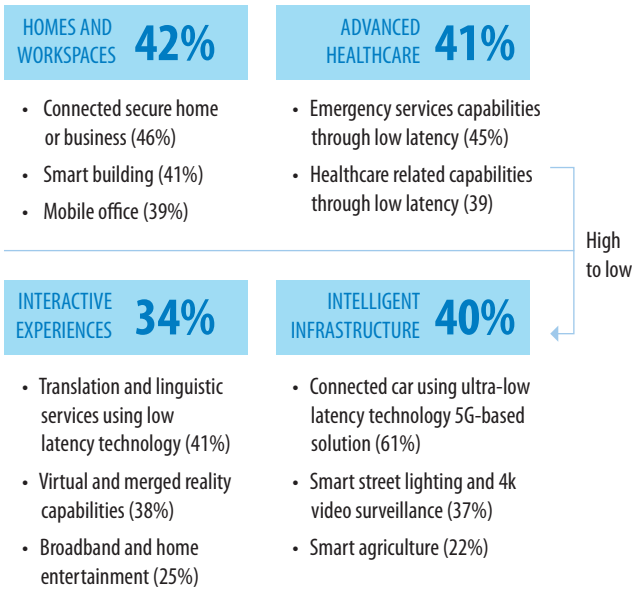
These two trends leverage the core offering of 5G networks — very high data speeds on reliable, low latency networks. Average data speeds on 5G are expected to be around 10 Gbps , and the network is designed for less than 1-millisecond latency. Networks will be highly reliable, with data loss levels at less than one in every 100 million packets. The technology is also expected to use higher frequency bands (30-300 GHz), which ensure less interference. The result is a seamless, always available network that can be deployed for critical applications.

Key use cases that will drive 5G penetration center around "smart spaces" across the home, office and shop floor, according to 43% of respondents (Figure 2). The end-user applications specifically are connected or secure homes, smart buildings, and mobile offices. In fact, early stage experiments involving smart spaces that can gather real-time information on power consumption patterns are already underway.

Figure 2. Most anticipated use cases



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> Today, we are witnessing manufacturing enterprises experiment with 5G technologies as part of their Industry 4.0 transformation. Drawing cables across factory floors to connect and monitor equipment is a tedious task. Manufacturers are therefore taking advantage of private 5G networks to connect hundreds of sensors and devices to enable real-time monitoring and decisions. 5G connectivity is also being used in video surveillance, where low latency is enabling real-time analytics while higher bandwidth enables live streaming and real-time decision making.
>
> **– Manjunath D. K.,**
> Associate Vice President, Infosys

Healthcare seems equally important, with 41% of respondents visualizing 5G growth led by applications such as telemedicine and emergency healthcare delivered through low latency networks. There is heightened interest in the area of robotic surgeries, where extreme low latency can enable remote operations synchronized to a very high level of precision.

Interactive experiences around media delivery (34%) and intelligent infrastructure (40%) for connected cars and smart grids were also focus areas for respondents. In 2019, Infosys partnered with Australian Open Tennis to develop 360-degree Virtual Reality Media streaming of live sports to remote locations, augmented with digital content. This was delivered with close to zero latency, thus providing a live experience to the user. 5G will make such experiences the norm.

The state of 5G in enterprises

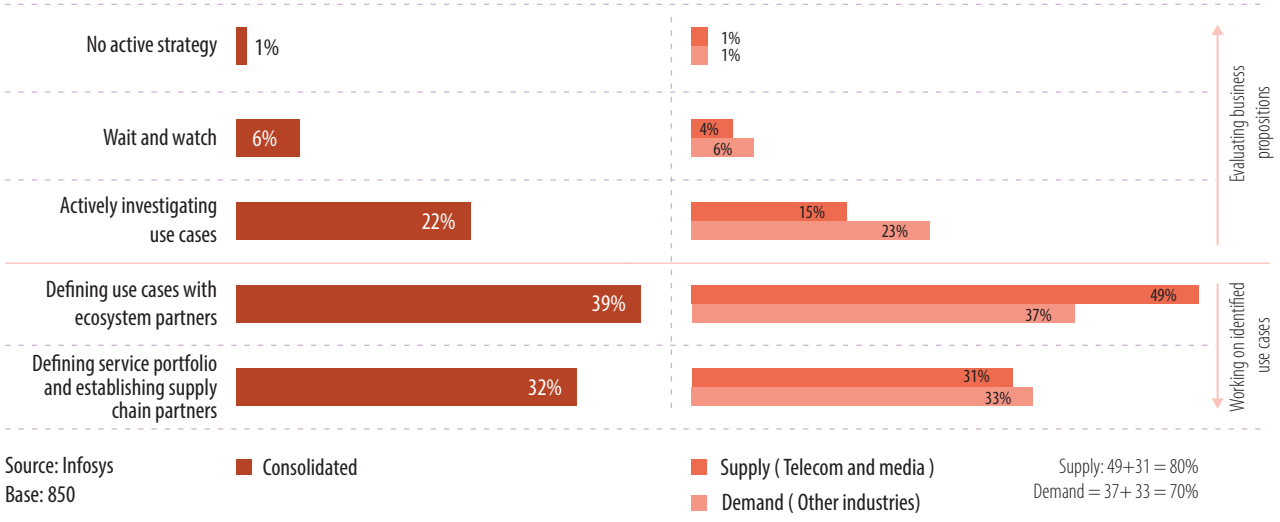
This research shows that enterprise adoption of 5G is at various stages on a continuum — at one end, some enterprises are experimenting with prototypes and proofs of concepts, while at the other end, others are trying to actively define 5G monetization strategies. Even within an enterprise, various functional groups such as R&D, technology, design and operations are at different stages of technology adoption.

Research responses indicate that network service providers are setting the pace for 5G adoption (Figure 3). Of the telecom and media companies surveyed (the "supply" side), 80% of respondents said they were working on either defining use cases (49%) or defining service portfolio and establishing supply chain partners (31%), as compared to 70% of enterprises in other industries (the "demand" side) that said they were doing the same.

We have witnessed, in the case of smartphones and wearable gear, that digital technology adoption reaches an inflection point when consumers of the technology start influencing the evolution of the technology. At present, the network service providers are defining use cases and road maps for 5G rollout and adoption. But, given the nature of 5G and the enterprise use case possibilities, this could well change as enterprises take greater ownership of the technology. Features such as network slicing that enable the creation of enterprise-wide virtual networks that function as the primary IT backbone will drive this change. This is likely to give a boost to enterprises in manufacturing and healthcare as well as smart spaces in any setting that can deploy a private 5G network and connect the devices over a dedicated, reliable high-speed network. With 5G, service providers will be able to provide secure and robust operations through end-to-end compartmentalization of the network, catering to end-user demand.

> We are engaging with leading service providers, networks and technology vendors. Also, we are connecting with the standardization bodies that will be involved. We are doing this to ensure that the interests and benefits of 5G are clearly understood and all the entities involved will start from a common ground and focus on driving this technology on a faster success route.
>
> **– Director,**
> Leading Technology Firm

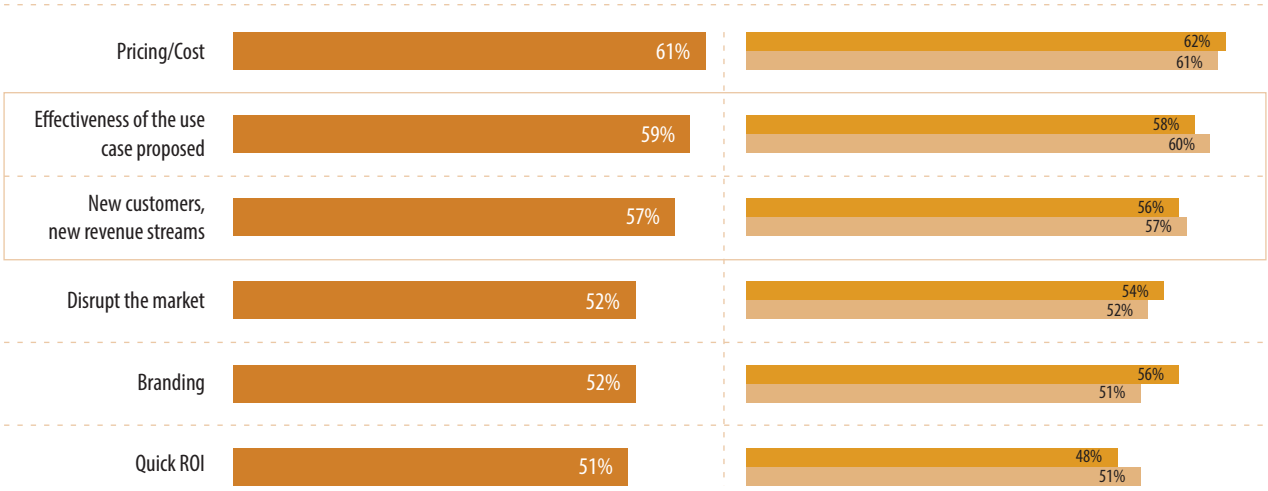
Figure 3. The state of 5G in organizations



Criteria for use case selection

The survey results highlight cost (61%), effectiveness of the use cases (59%) and the possibility of new revenue streams (57%) as the most important criteria for selecting use cases across industries (Figure 4).

Figure 4. Criteria for use case selection



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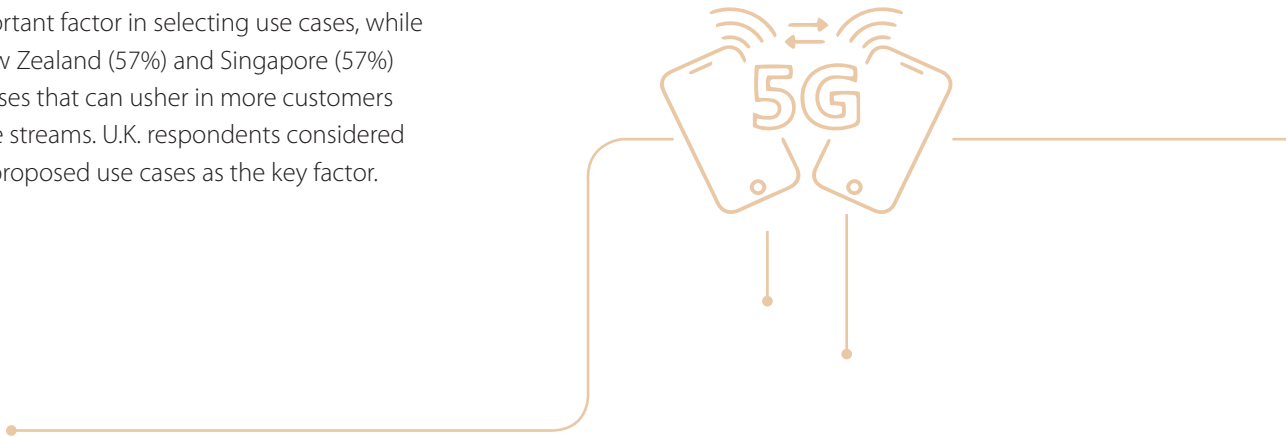
> In addition to expertise in 5G, we expect the capability to marry that with our organization in the best way. Also, while we make this shift, we expect them to enable continued operations with incremental updates.
>
> **– Vice President,**
> Large U.S. Logistics Firm

On the one hand, the respondents from telecom companies (57%) are exploring use cases that could help them disrupt the market (57%) and that can help them in branding. On the other hand, 51% of the respondents from non-telecom sector firms are looking for use cases that would bring in quick return on their investments.

> From the factory shop floor to the game center, 5G has the tools to unlock a more interactive, immersive experience. The same technology that will make factory machines smarter and production lines more efficient can also create more personalized, interactive experiences at the movie hall and sports stadium.
>
> **– Vikram Meghal,**
> Associate Vice President, Infosys

> Enterprises are exploring new services that are built on top of 5G, IoT, edge computing and emerging technologies. These include retail store of the future, factory of the future, remote maintenance guidance, smart health, digital oil fields, smart spaces, drones for varied services like surveillance and cloud gaming. All these services are driving new digital bundles and new business models supporting B2B and B2B2X.
>
> **– Gnanapriya C.,**
> Associate Vice President, Infosys

The survey results showed some differences in the responses from different regions. Respondents from Europe (56%) and the U.S. (67%) considered cost involved as the most important factor in selecting use cases, while Australia and New Zealand (57%) and Singapore (57%) looked for use cases that can usher in more customers and new revenue streams. U.K. respondents considered effectiveness of proposed use cases as the key factor.



Enterprise 5G adoption trends

Our research indicates that enterprises are at different stages of 5G adoption. Each have different priorities based on the business landscape, current investments, identification of use cases, availability of talent, influence of partner ecosystem, availability of technology components and strategic road map. It was evident from survey responses that enterprises could not be segmented based on their 5G adoption patterns as the technology itself is in a nascent stage and the ecosystem is evolving.

Given this, it is more insightful to view the enterprise adoption as a continuum in which enterprises can move from being passive spectators to active adopters based on their involvement with 5G technologies. The use of a continuum underscores the fact that 5G adoption is a journey in progress, where players are on the move and could accelerate rapidly through the stages (Figure 5).

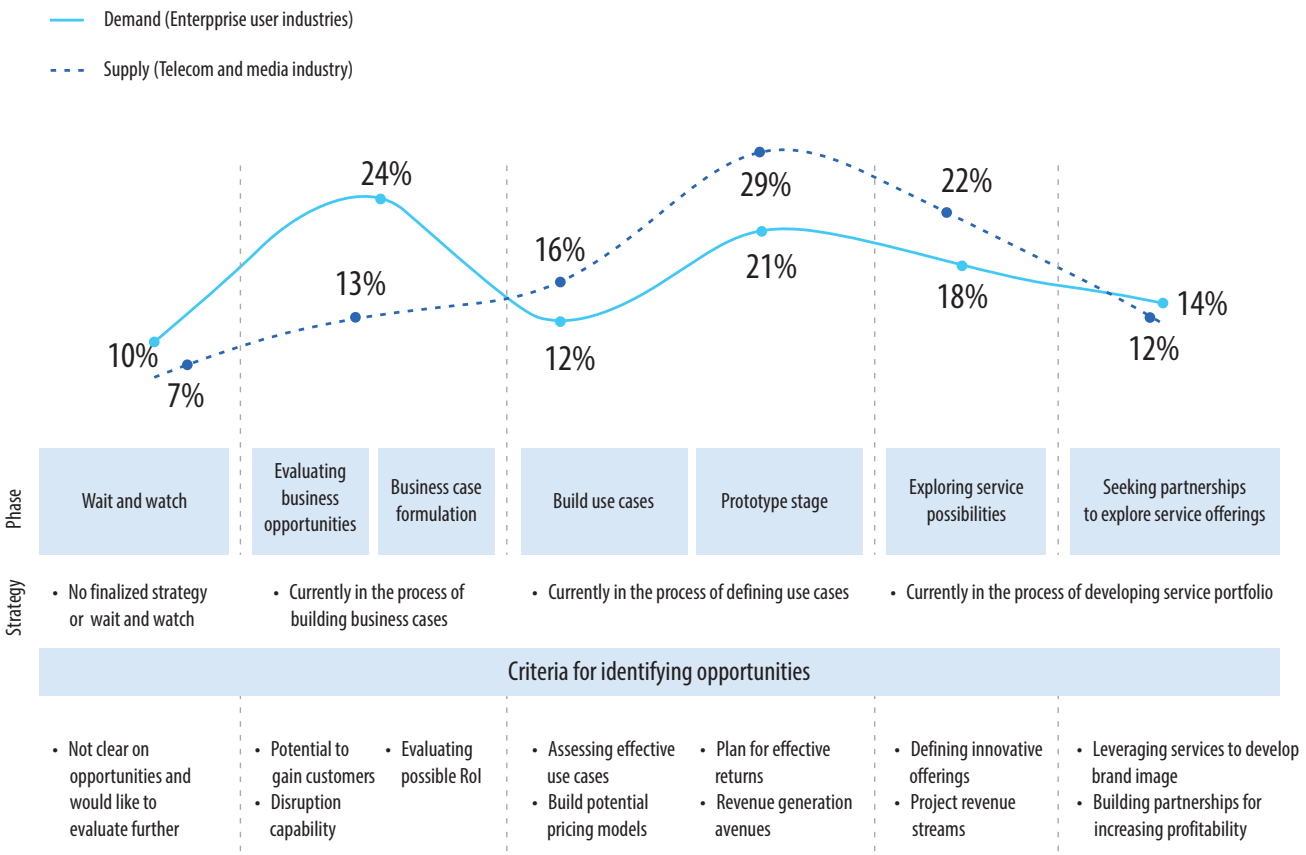
This methodology led to four broad stages of adoption:

- **Skeptics** (these include Passive Watchers who do not have an active 5G adoption strategy)
- **Prospectors** (these include groups that are identifying opportunities and are in the process of building business cases)
- **Innovators** (these include active adopters who are aligning use cases and evaluating prototypes)
- **Visionaries** (these include groups that are actively exploring service possibilities and seeking partnerships to implement service offerings)

Skeptics are at the early stage of the 5G journey, whereas Prospectors, Innovators and Visionaries have made much more progress comparatively. What is driving 5G adoption within these stages? The research indicates that Prospectors rely on criteria such as customer acquisition, disruption capability and ROI; Innovators consider pricing models, effectiveness of use cases and revenue streams; and Visionaries look at new revenue streams, branding and disruption.

The 5G enterprise adoption curve demonstrates that enterprises are chiefly at the stage of evaluating business opportunities (24%) and to a lesser extent at the prototype stage (21%). The 5G network service provider adoption curve shows that these players are ahead and mostly focusing on prototyping (29%) and exploring service possibilities (22%).

Figure 5. Adoption patterns in the 5G continuum



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Barriers and challenges

As the firms navigate the different stages of 5G adoption, they are confronted with many challenges and barriers that can slow down their journey or add to the already high costs. Based on the survey responses, we have classified them into three groups — adoption barriers, deployment challenges and operational challenges.

Adoption barriers

When the enterprises set out to identify and develop 5G use cases, data security, regulations, investments involved and lack of skilled workforce are the biggest challenges they face (Figure 6).

> With the "internet of things," enterprises have more network end points to guard. Research from Gartner (2018) estimates that worldwide spending on IoT security will reach USD 3.1 billion by 2021, a 158% increase from 2017 spending of USD 1.2 billion. The firm expects to see demand for tools and services aimed at improving discovery and asset management, software and hardware security assessment, and penetration testing .

Trillions of gigabytes of data will continuously flow through the 5G network. A lot of the data will be highly confidential and critical. Therefore, data security is a key concern for 5G use cases. This is reflected in this Infosys survey, where 59% of the respondents said that addressing data security concerns is the biggest barrier for 5G adoption. The network service providers see security as a bigger concern (62%) as they develop and implement 5G networks today. The criticality of data security remained the highest across all adoption stages.

Government regulation is an especially big concern for the service providers who have invested millions of dollars in creating 5G networks and infrastructure. Unfavorable rulings or regulations, delays in approvals, and spectrum allocations can derail the 5G projects. Also, telecom companies will have to spend more if they decide to source the equipment from another seller. Reflecting this, 55% of the respondents from telecom companies consider large investment involved, as an adoption barrier.

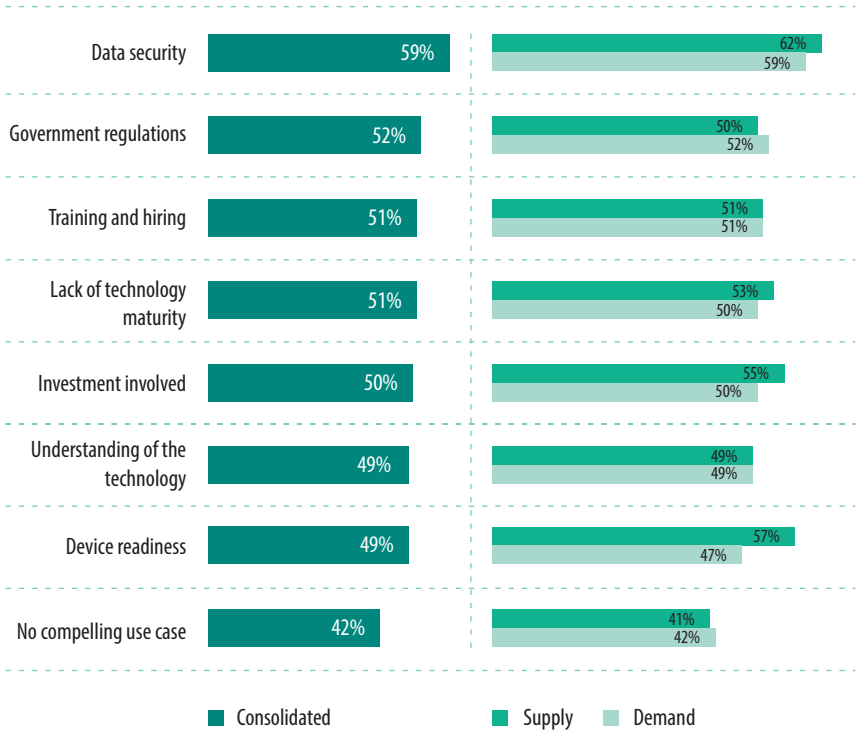
Another challenge that firms face is finding the right talent with knowledge of 5G related technologies (57%). As with any emerging technology, there is a lack of workers with a clear understanding of 5G standards and knowledge of 5G related technologies such as software defined networks and virtualization. This requires further investment in reskilling or hiring the relevant workers. See the training requirements section for further details.

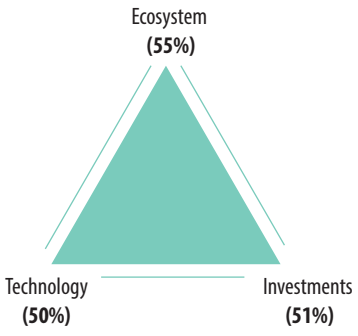
Fifty-seven percent of the network service providers surveyed consider device readiness as another barrier. 5G will need a wave of new devices, such as software defined network equipment, 5G compatible mobile devices, and "internet of things" devices and routers. All these are in different phases of development today, and commercial use cases have to wait for all such necessary devices.

The survey responses across regions show that all regions consider data security and government regulations as the biggest concerns. While Singapore, Australia and New Zealand respondents see investments as a major challenge, Europe identified device readiness. U.K. and U.S. respondents consider lack of technology maturity and lack of talent as roadblocks for 5G adoption.

> The ability of systems and devices to exchange and interpret data on a global scale while maintaining the security and consistency in user experience is a key challenge. A global interoperable platform could be a solution. We are a member of ONAP [Open Network Automation Platform], which aims to automate physical and virtual networking functions.
>
> **– Senior Vice President,**
> IT, Leading Technology Firm

Figure 6. Adoption barriers to 5G





Ecosystem
- Data security
- Government regulations

Technology
- Lack of technology maturity
- Understanding of the technology
- Device readiness

Investments
- Training and hiring
- Investments involved

Source: Infosys
Base: 850

We further categorized the adoption barriers into three areas: ecosystem, technology and investments. Ecosystem barriers are the issues such as government regulations and data security, which concern the organizations implementing 5G as well as other organizations in the ecosystem. Investment issues are related to reskilling or hiring relevant workers and investment needed for 5G. Technology issues pertain to the availability of the right software, tools and devices. Surprisingly, we found that ecosystem and investment issues are bigger barriers in comparison to technology barriers for firms looking at 5G.

Deployment challenges

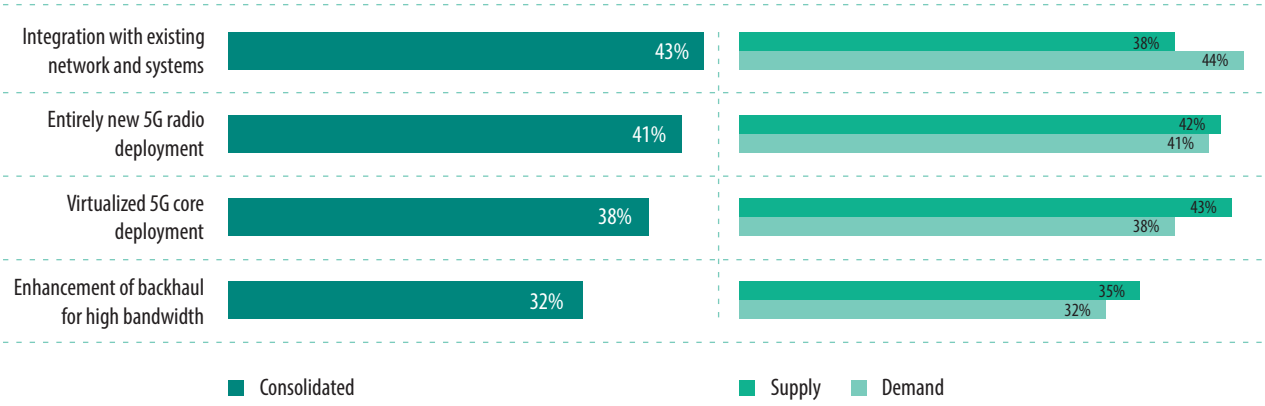
As the companies move from ideation to the execution phase, they face a different set of challenges, such as deploying the complex infrastructure and integrating the new use cases with their existing system (Figure 7).

One of the biggest concerns is integrating the new with the old, say 44% of those surveyed. To reap the full benefits of 5G investments, the 5G-based use cases should function in tandem with the existing use cases. However, it might not be easy since the underlying technology is different. Since 5G standards are evolving and there are no standard deployment references, the service providers need to be diligent in supporting their clients with integration.

5G comprises a software based virtualized core that provides flexibility to offer multiple services on 5G. However, developing and deploying this core can be complex and expensive. This is reflected in the survey results; 43% of the telecom companies surveyed said that deployment of the virtualized core is their biggest challenge.

Issues around radio deployment, both technical and regulatory, are a concern for those engaged in business case formulation. Enterprises are also concerned about the investment required for establishing the infrastructure for 5G use cases. These sentiments are echoed by most of the industries.

Figure 7. Deployment challenges



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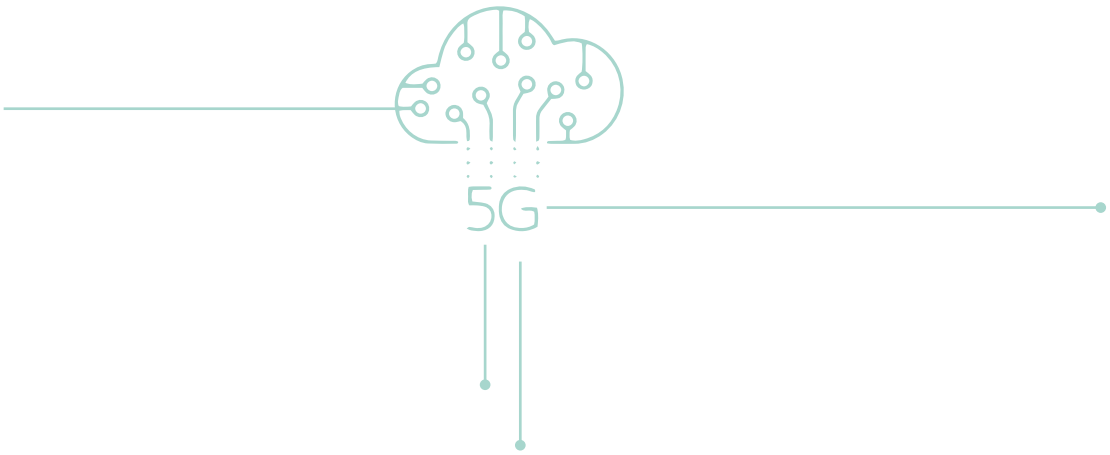


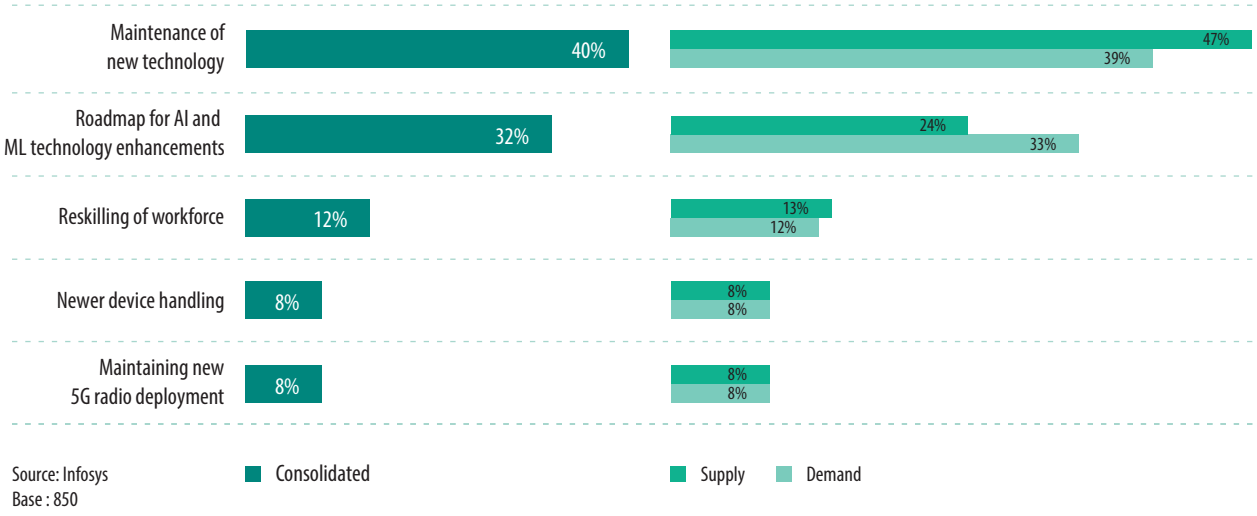
Operational challenges

Although most enterprises have not yet reached the deployment phase of 5G use cases, they anticipated many challenges once the new processes are deployed. For network service providers, maintenance of new technology (47%) is the biggest challenge expected post-deployment (Figure 8).

5G would be truly a step forward, but only if enterprises are able to use 5G's unique characteristics for advanced applications like ultra-fast analytics and massive machine to machine interaction. For enterprises, concerns stem from how they would deploy artificial intelligence and machine learning going forward, with 33% of respondents highlighting this as a challenge.

Both these concerns stem from questions about the availability of trained people to manage 5G transformation. Organizations that are able to balance tech deployment with resource readiness will make the 5G jump faster. To become such an agile player, training investments are crucial.

Figure 8. Operational challenges



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> Most organizations are keen on 5G to help enable AI and IoT capabilities, but there is a challenge in ensuring the existing plans and roadmaps can accommodate the benefits of 5G. There can be many changes that are to be built in for the AI and ML strategy.
>
> **– Director,**
> Large Logistics Firm in Europe

Training requirements

The question to firms on talent readiness for 5G yielded interesting responses. It is concerning to see that more than half of the firms, including telecom companies, are struggling in core areas such as basic understanding of 5G, virtualization, software defined networks and core mobile network (Figure 9). Though telecom companies are slightly ahead of others in terms of training, the survey shows that they still have significant ground to cover.

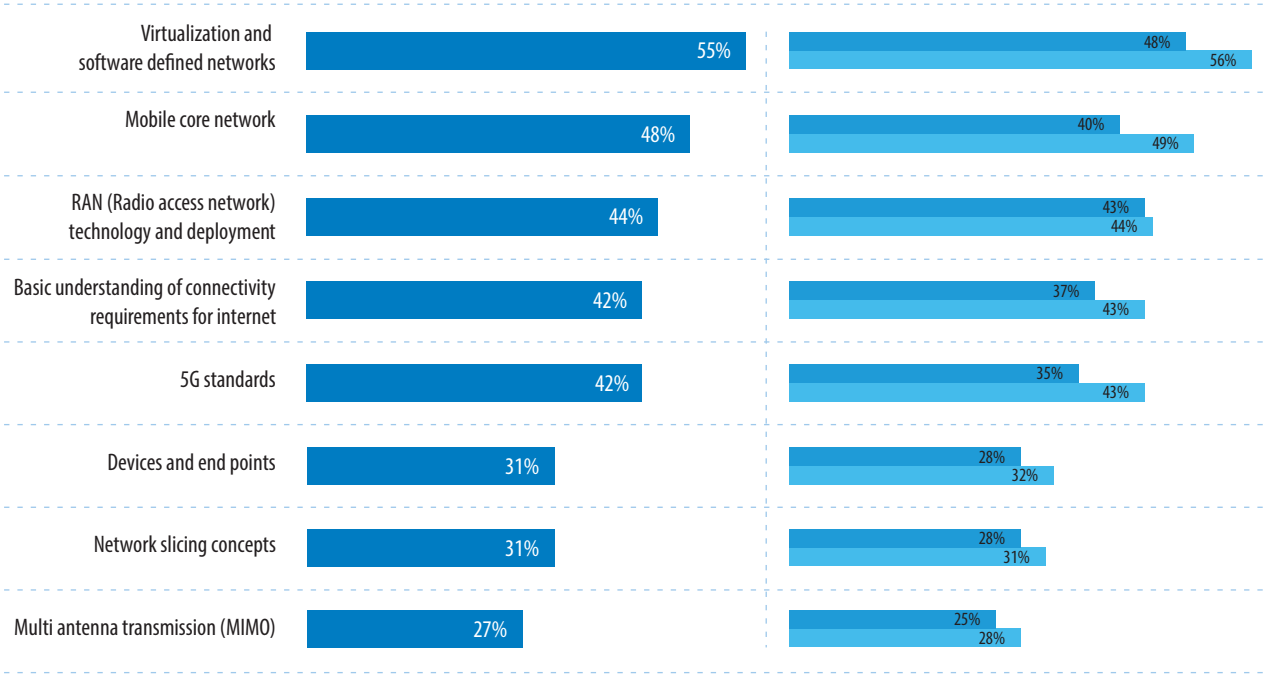
A staggering 55% of the respondents said that they need support in understanding virtualization and software defined networks. More than half of the non-telecom sector respondents view this as a critical area of focus for training. It is surprising to see that almost half of the respondents from telecom companies also echo this thought.

Almost half of the respondents find that their workforce needs to be trained on the core mobile networks. While 40% of the respondents from the telecom sector see this need, 50% of the non-telecom sector respondents see themselves lagging in this area.

Forty-two percent of the enterprises feel that they still do not have a clear understanding of 5G standards and a basic idea of connectivity requirements. While one-third of the service providers see the need for training their workforce on 5G standards, almost half of the respondents in other industries do.

This is an area where technology service providers can play a significant role. For instance, Infosys is working with telecom companies in developing 5G and other industries in using 5G for business cases. Therefore, Infosys can be a strong partner in training the enterprises in 5G relevant skills. The firms can also outsource work related to new technology to the technology service providers while they reskill their teams.

Figure 9. Training requirements



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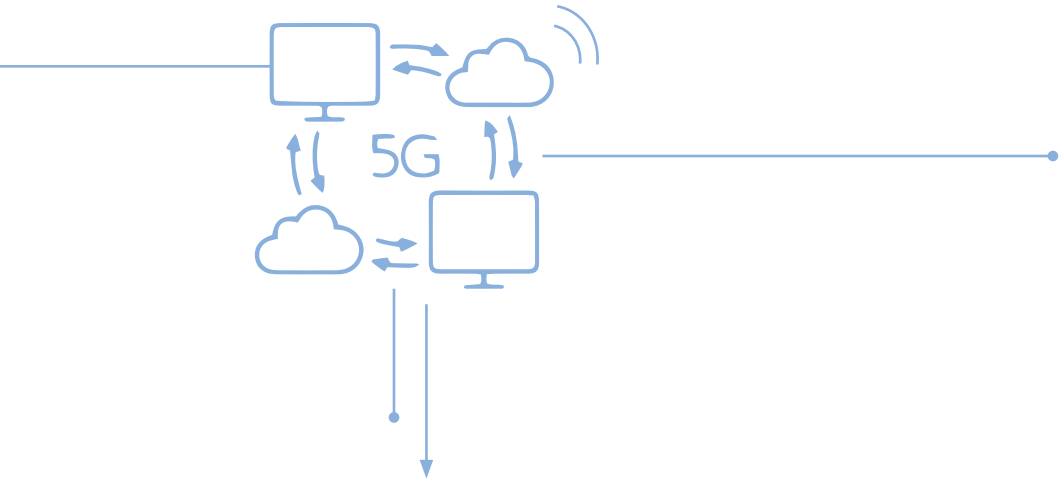


Understanding the partnership ecosystem

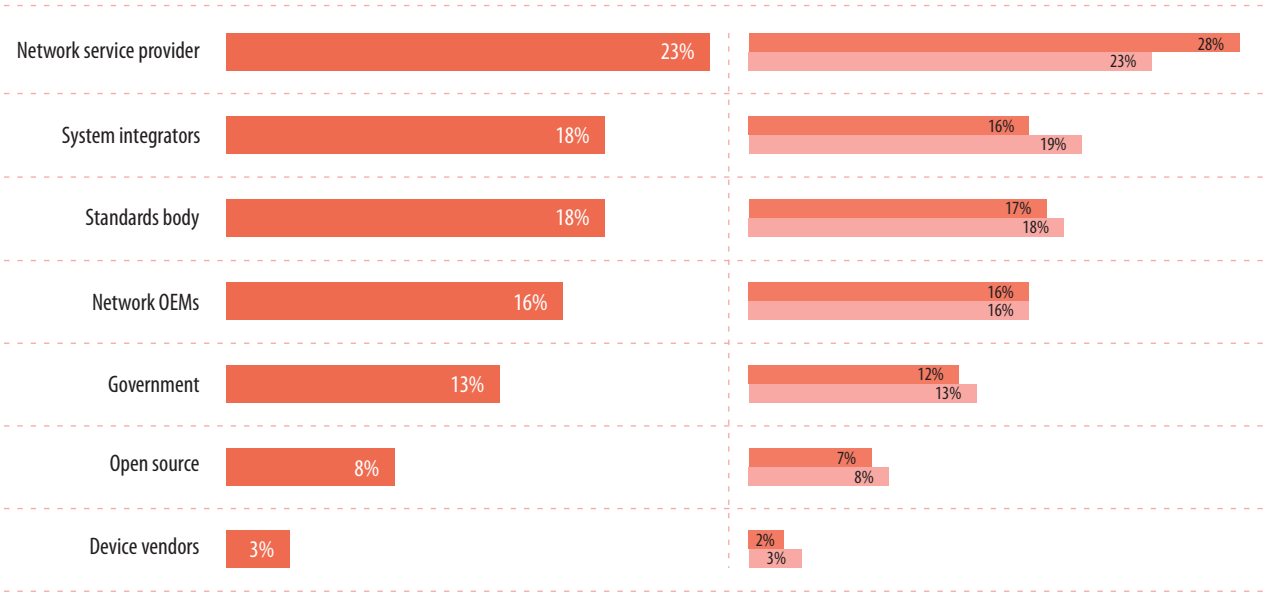
5G services require setting up network, spectrum, equipment and 5G-enabled devices. One company cannot supply all these requirements. To realize 5G's full potential, all the players need to come together. Different participants bring different capabilities to the ecosystem. Survey participants indicated that they viewed network service providers (23%), system integrators (18%) and standards bodies (18%) as most influential in the 5G evolution (Figure 10).

Network service providers and software providers are expected to take center stage with 5G, with the former rated as the most influential of all players by respondents. Indeed, 23% of demand side businesses consider network service providers as the most influential players in the 5G evolution. This selection is consistent across all the regions covered by the survey.

There are no firm standards around 5G services yet, but network service providers, infrastructure providers, equipment suppliers and other stakeholders are actively part of organizations developing standards for 5G services. There are many standards bodies, including 3GPP (3rd Generation Partnership Project), which is defining 5G technical standards; IETF (Internet Engineering Task Force), which is developing standards for virtual network functions; and ITU (International Telecommunication Union), which is defining 5G radio interface technologies. The survey results (18%) reaffirm that standards organizations will be influential in how 5G evolves.

Survey respondents (18%) perceive that system integrators will also play an important role in helping both telecom companies and other industries build 5G-based solutions and applications. With technical expertise and domain knowledge, system integrators will play a crucial role in accelerating the 5G adoption journey. With their presence across the value chain, they can help in integrating the 5G ecosystem.

Figure 10. Most influential players in the evolution



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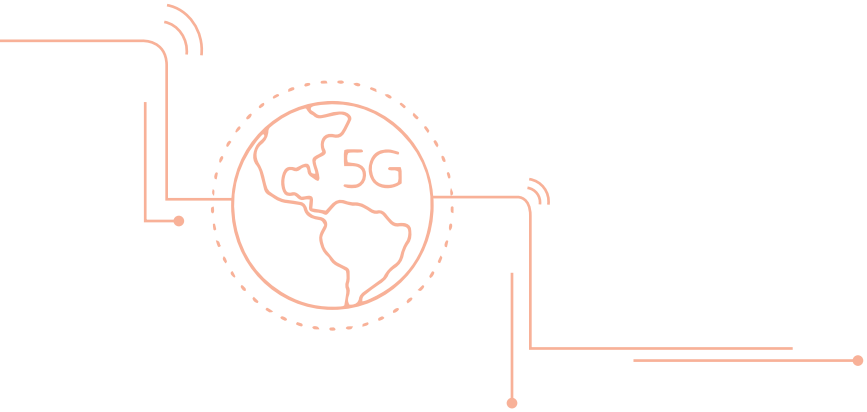


Most preferred partners in 5G adoption

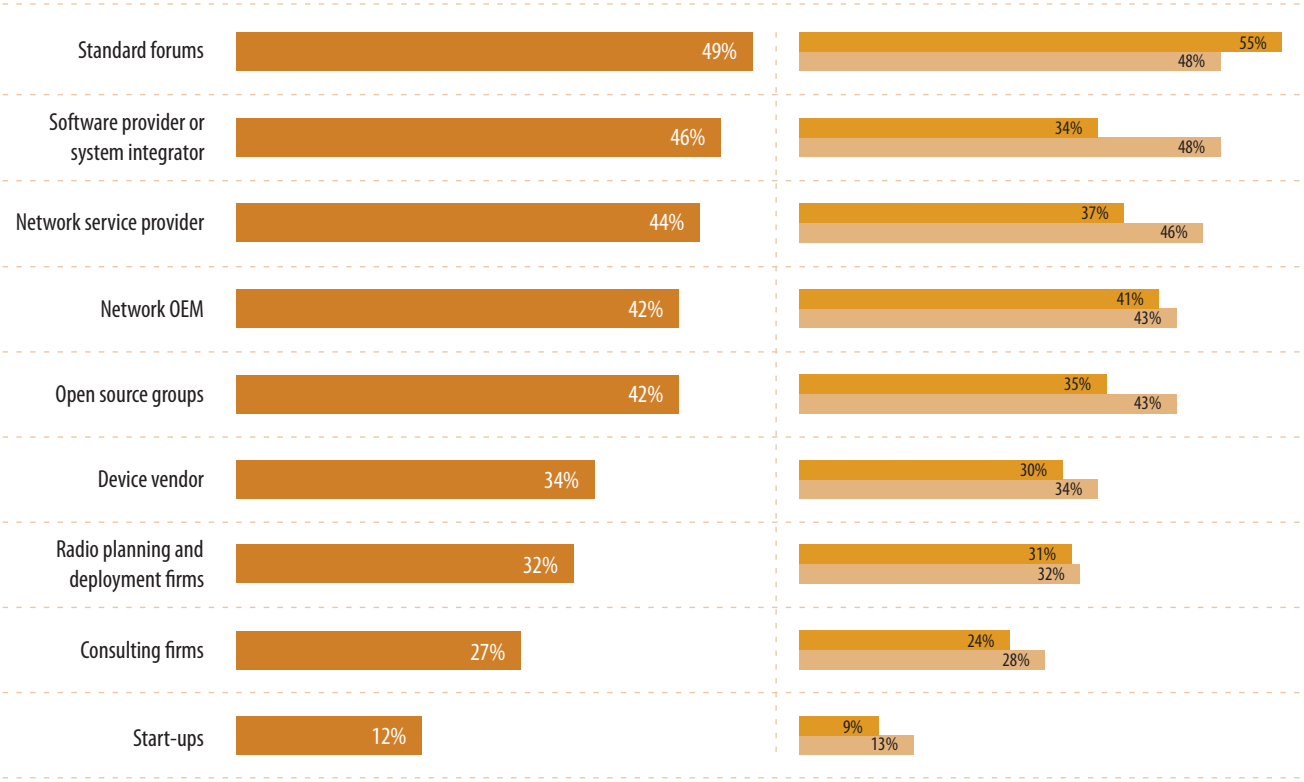
There is a divergence in the responses from the supply side and demand side about who is the most important partner in the ecosystem (Figure 11).

Today, standards bodies play an important role in standardizing 5G frameworks, and many telecom service providers are actively participating. Therefore, it does not come as a surprise that 55% of the service providers consider standards bodies the most important partner in their 5G journey. And according to 41% of the respondents from telecom companies, network OEMs are important for them since they supply 5G-enabled equipment.

While one-third of carriers consider system integrators as important partners in 5G adoption, it is interesting to see that almost half (48%) of the enterprises see system integrators as their most trusted partners. This provides evidence that technology providers will be more influential and important as partners than telecom providers in the 5G era. Industries looking to create 5G-enabled use cases need partners who have both technical and domain knowledge and that understand the underlying 5G technology. Among the non-telecom sector respondents, 48% consider standards bodies as the key partners, while 46% consider telecom companies to be very important.

Considering the interest of the users on the demand side, telecom companies need to work with the system integrators to provide a holistic solution to consumers.

Figure 11. Most preferred partners in 5G evolution



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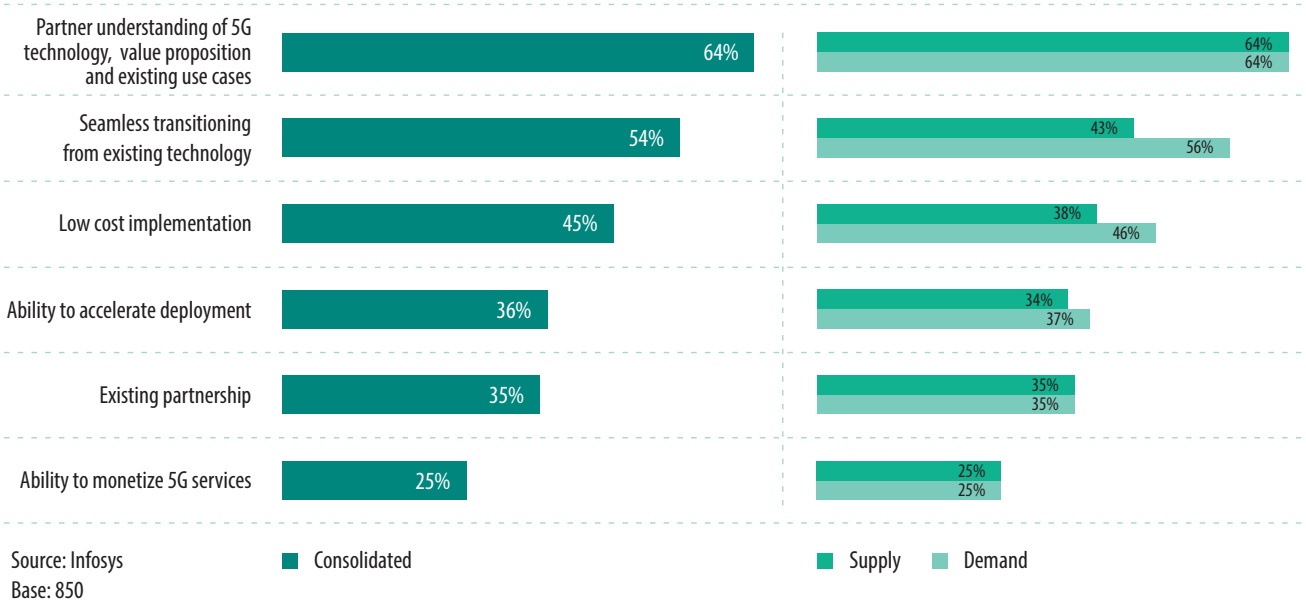
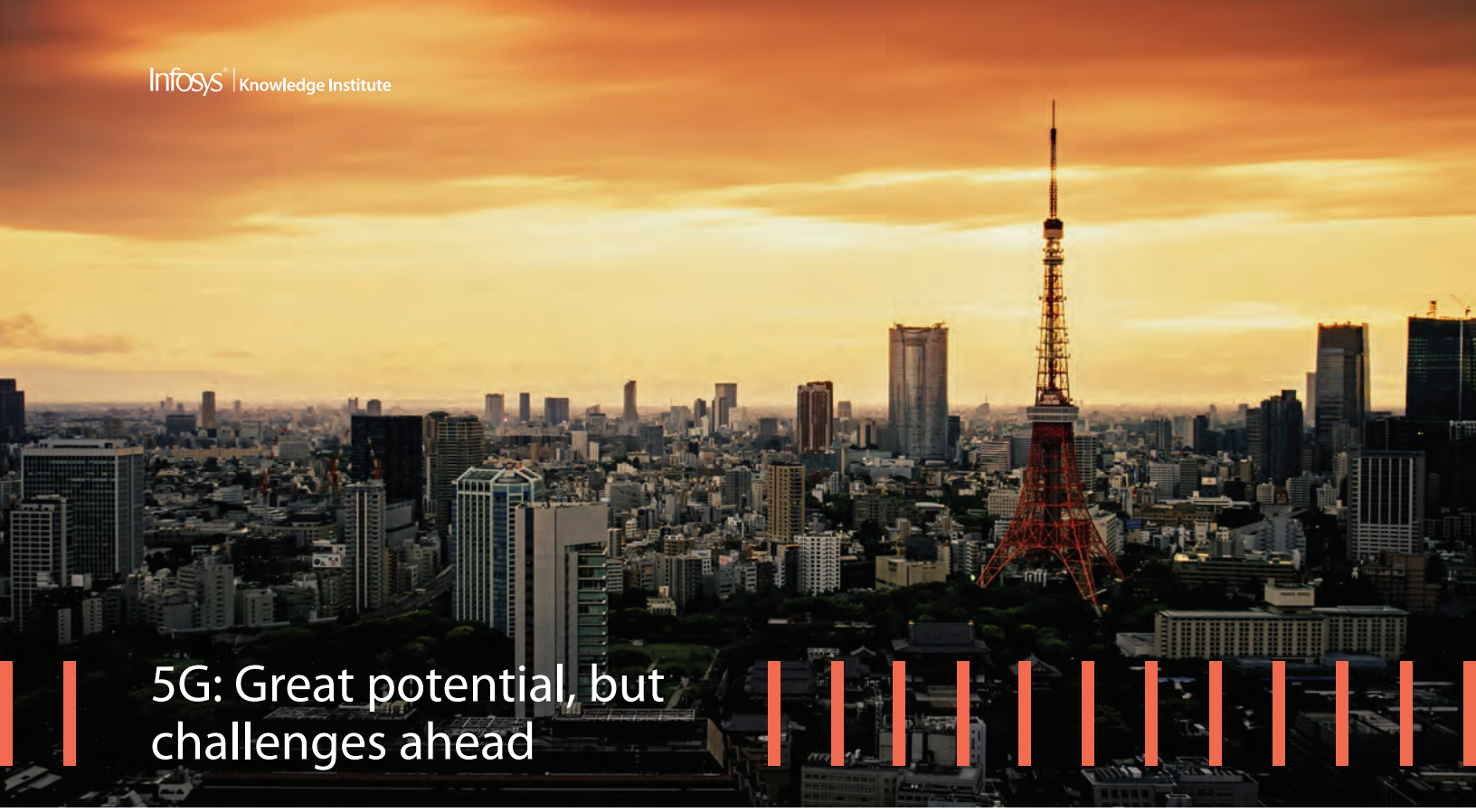
Base: 850

Criteria for selecting partners

For survey respondents, the key criteria for selecting partners (64%) is the partner's knowledge of technology, value proposition and existing use cases (64%) (Figure 12). The survey shows that they also expect the partner firms to help them transition from the existing technology to the new one seamlessly (54%). Low cost is another important factor, according to 45% of respondents. Both demand and supply side show the same sentiments. System integrators meet all the requirements discussed above. This underlines the fact that system integrators will be the most important partners in accelerating 5G adoption.

Figure 12. Key criteria for selecting partners





5G: Great potential, but challenges ahead

It is clear that there is significant potential in 5G. But there will be several challenges in translating the vision to reality. Significant efforts and investments will be required to develop regulations, standards, a 5G-ready workforce, and 5G infrastructure and devices.

This will provide an opportunity for network service providers and system integrators to step up and play an important role in 5G's evolution. For instance, better adoption could be driven by collaborating with clients in different industries – and bringing different organizations together across industries – to develop domain-specific use cases and prototypes.

It is through initiatives such as these that 5G equipment suppliers, standards bodies, infrastructure providers, cloud service providers and end users can work together to harness 5G's potential. Such collaborative platforms – bringing together open source communities, technology forums and industry experts – will accelerate innovation, understanding and implementation of this critical future technology.

Survey methodology

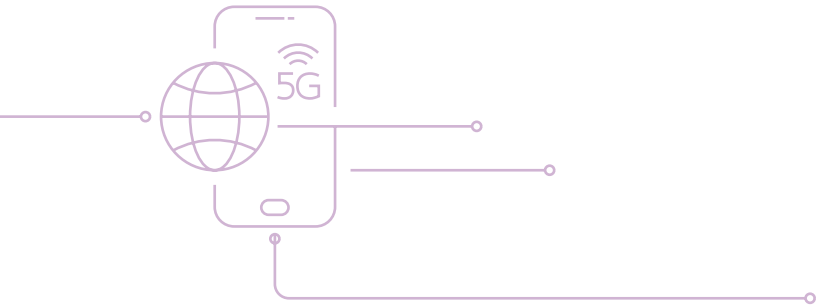
The research was based on data gathered in early 2019 when a wide spectrum of industry leaders across industries as well as supplier segments were interviewed. The industries covered were:

- Consumer Goods, Retail and Logistics (CRL)
- Communication, Media and Technology (CMT)
- Energy and Utilities (E&U)
- Financial Services and Insurance (FSI)
- Healthcare, Life Sciences, Government and Agriculture (HLS)
- Industrial Manufacturing, Automotive and High Tech (MFG)

In all, 850 senior leaders from firms with more than USD 1 billion in revenue were surveyed. While the majority (49%) were from the U.S., continental Europe was also fairly represented (28%), with the U.K. alone accounting for 13%. To get a comprehensive picture, we had responses from Australia and New Zealand (6%) and Singapore (4%) too.

C-Suite

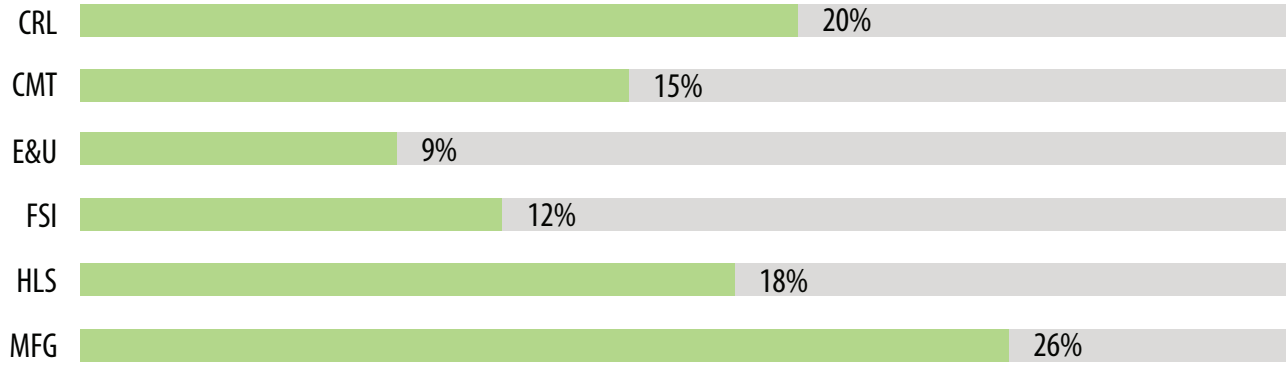
C-Suite respondents	Number of respondents
Information technology and communications	129
Manufacturing, production or operations	32
Administration and facilities	20
Accounting and finance	15
Human resources	15
Business development	13
Sales	10
Facilities management	5
Marketing	5
Supply chain, logistics and distribution	5
Legal	2
Research and product development	2
Customer service/support	1
Design	1
Purchasing	1
Total	**256**



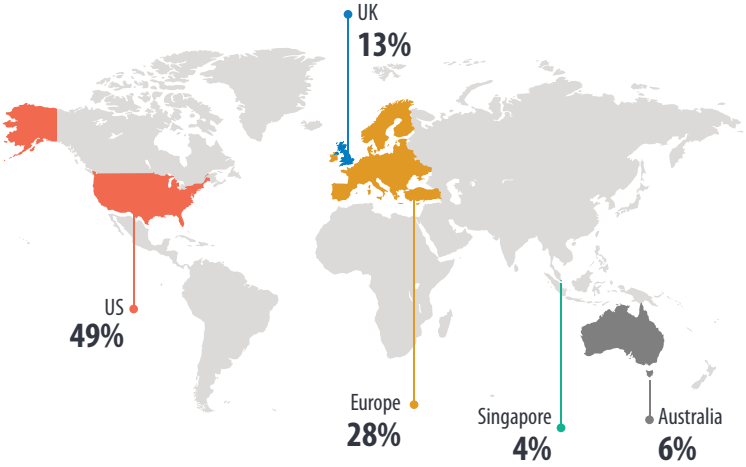
Coverage Achieved

Figure 13. 850 senior leaders from firms with more than USD 1 Billion revenues

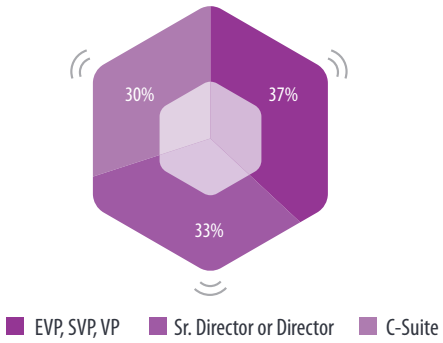
Industrial Spread



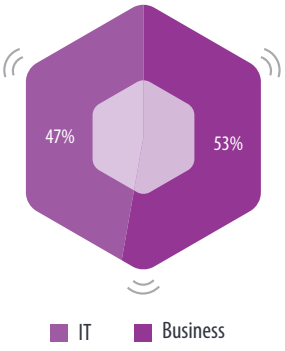
Geographical Spread



Respondent Level



Functional Spread



References

1 *"Next-generation 5G speeds will be 10 to 20 Gbps", Network Week, June 2019, https://www.networkworld.com/article/2941362/next-generation-5g-speeds-will-be-10-to-20-gbps.html*

2 *"5G is real and lightning fast", CNET, June 2019, https://www.cnet.com/news/5g-is-real-and-lightning-fast-sometimes-heres-everything-you-need-to-know/*

3 *"Gartner Says Worldwide IoT Security Spending Will Reach $1.5 Billion in 2018", Gartner, March 2018, https://www.gartner.com/en/newsroom/press-releases/2018-03-21-gartner-says-worldwide-iot-security-spending-will-reach-1-point-5-billion-in-2018*

4 *"5G standards," SDX Central, https://www.sdxcentral.com/5g/definitions/5g-standards/*

Notes:

Notes:


5G

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