Cambridge Consultants

THE REAL POWER OF 5G:
HOW TELECOM OPERATORS CAN HARNESS 5G TO LEAD THE DIGITAL TRANSFORMATION OF THE ENTERPRISE

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CONTENTS

1   HARNESSING 5G TO TRANSFORM THE ENTERPRISE

The evolution in wireless standards over the past 20 years has resulted in dramatically enhanced communications for consumers. The improvements in data speed, capacity, coverage and handset technology have changed the way people not only communicate, but also take photos, watch movies and even date each other. Telecommunications networks have evolved to become platforms that connect consumers with a huge number of services; from social networking to education and retail. Society has been profoundly changed as a result.

For telecom operators, the wireless revolution has led to dramatic changes in their traditional revenue streams. Wireline service revenues have declined precipitously as wireless alternatives have emerged. To sustain wireless revenue growth, the telecom business model has centered on selling the latest, often very expensive, handsets to consumers along with ever-increasing amounts of data. The approach to business customers has been very similar.

For all intents and purposes, the word "*wireless*" is synonymous with *"smartphone"*. But that will have to change.

Smartphone penetration is reaching saturation and smartphone shipments are dropping year over year[1]. Telecom operators are under pressure to provide high capacity data networks, but are finding it increasingly difficult to monetize the vast amount of data that flows across them. Of course, there is much excitement about the latest standard, 5G. Like its predecessors, 5G is a huge leap forward in terms of latency, speed and capacity. Unlike its predecessors, these gains do not immediately translate into desirable benefits to the consumer. Although there is much talk of virtual and augmented reality, and even HD TV, no killer app has been identified which could drive consumer demand for 5G.

So where does that leave wireless telecom operators?

The real power of 5G lies in how it can enable the digital transformation of the business world. Digital transformation is the change to an organization's tools, processes, structure and culture brought about by the increased use of digital technology. Some organizations will gain significant value simply from digitizing documentation, for example, and

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providing remote access to the data. More advanced cloud native organizations, on the other hand, base their operations on the use of virtualized cloud infrastructure. In the future, *"network native"* organizations will base their operations around 5G based connectivity with their customers, extending their relationship for the entire lifetime of their product.

Telecom operators are in a unique position to unlock 5G's huge potential for their enterprise customers. Operators, and indeed the whole mobile communications value chain, are understandably very keen to develop the technology to create new revenue streams and business lines.
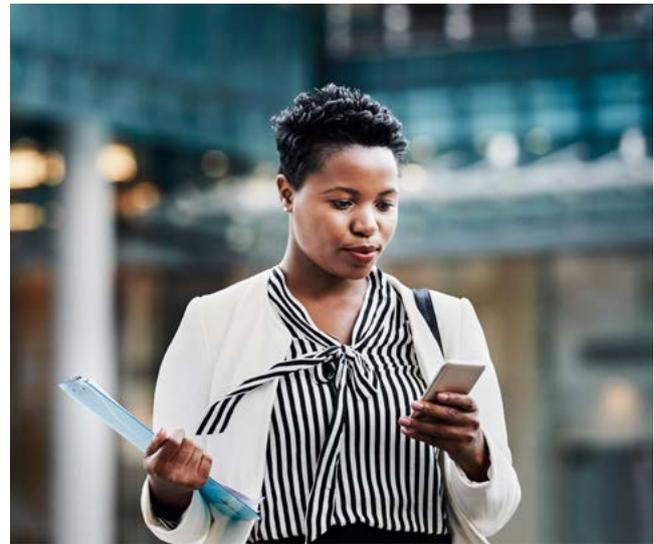
Cambridge Consultants has developed high performance connectivity technologies and cloud-based services for many years. We have been connecting enterprises in industries as diverse as automotive, consumer, healthcare, and manufacturing. We have developed products and devices for these industries based on the latest advances in robotics, sensing, machine learning and virtualized services. In this white paper we describe some of the insights we have made into how enterprises can exploit 5G technologies to their advantage and also how operators can capitalize on this new opportunity.

However, to accomplish this will require more than just a technology shift. Telecom operators will need to embrace a cultural shift.

Telecom operators will need to respond to the unique needs of diverse enterprise customers.

2   CONNECTIVITY PERFORMS VITAL ROLES FOR MODERN ENTERPRISES

As enterprises undertake their digital transformations, it is important to note that different industries will bring their own unique needs to the table and therefore will benefit from different aspects of connectivity. A one-size-fits-all philosophy will not work, because the industry sectors differ so dramatically in terms of their technological needs, as well as their market environments.

Retail, for example, is experiencing a revolution. As shoppers switch to purchasing online and become ever more discerning in terms of price, delivery and service, retailers must become more adept in streamlining their business. One company to transform its operations is Ocado, the world's largest online-only grocery retailer. Ocado has introduced a proprietary wireless control system to underpin a fully automated warehouse solution (see case study).

In parallel, manufacturing is undergoing a revolution driven by robotics, augmented reality and analytics. Healthcare on the other hand is under pressure caused by spiraling costs, an aging population and more complex and expensive treatments.

CASE STUDY: OCADO SMART PLATFORM

Ocado is the world's largest online-only grocery retailer – shipping more than two million items every day to customers around the UK. Its proprietary technology – the Ocado Smart Platform (OSP) – is at the heart of its automated customer order fulfillment system.

The platform controls thousands of fast-moving robots simultaneously, each to within a fraction of a second, controlled by the world's most densely packed mobile network. In operation, the system is fully scalable; from just a few robots handling hundreds of stock items, to many thousands of robots, handling millions of items per day.

Ocado asked Cambridge Consultants to help develop their wireless network, which has not only transformed Ocado's business, but is revolutionizing the entire retail industry. Ocado has recently licensed its automation technology to US giant Kroger, ICA in Sweden, Sobeys in Canada, Casino in France and Coles in Australia.

2.1 ENTERPRISE CONNECTIVITY REQUIREMENTS ARE VITAL AND A WORLD AWAY FROM CELLULAR SLAs

All enterprises are under enormous pressure to grow their revenue while managing their costs. Enhanced connectivity services can help them achieve that. However, to embrace a new platform, enterprises will need to be sure that it will deliver high-level benefits including:

- Increased agility/competitiveness

- Ease of doing business

- Enhanced capabilities

- Reduced costs in the longer term, capital as well as operational

- Scalability and future-proofing

Further, as an enterprise considers a new platform, various logistical issues will be top-of-mind, including how quickly it can be provisioned and operational, and how easy it is to integrate into existing systems. Enterprises may also not be aware of the extent to which connectivity can benefit them, so will need guidance to understand the full impacts. For example, IoT offers the possibility to track a product throughout its entire lifecycle, from manufacture to disposal, but enterprises may not understand the advantages and responsibilities that result.

2.2 PURCHASING MODELS ARE AS VITAL TO AN ENTERPRISE AS THE CONNECTIVITY ITSELF

Enterprises will be extremely sensitive to the overall total cost of ownership of the solution, but each enterprise will have different needs in this regard. A small, self-contained facility, such as a campus or single manufacturing plant, might consider the upfront purchase of a private network, whereas an entity with a broader geographic footprint, such as a state with broad connected-vehicle coverage, might require a different model for wide area connectivity. For the greatest accessibility, enterprises would use a subscription-based system to minimize capital cost, ideally being able to provision their connectivity services in real-time as their needs change. Enterprises are becoming increasingly accustomed to this type of purchasing model with the emergence of the "*as a service*" (aaS) model for infrastructure, platform and software (IaaS, PaaS and SaaS).

The management of the solution will also need to be considered – some enterprises might prefer to operate and manage their own networks, while others will prefer a more comprehensive solution on the part of the telecom operator.

Enterprises will also be keen to minimize the risk of the deployment, especially if it involves a significant investment. It would be highly beneficial to the enterprise if the solution could be deployed in phases, for example, not only to spread the cost, but also to allow time for risks and issues to be identified and resolved prior to a large-scale deployment. Again, a flexible subscription service would be very attractive to minimize risk.

There are significant legal issues to consider as well once the service is operational: as connectivity becomes more critical to the operations of a facility, any failure in that connectivity could lead to enormous downtime costs for the enterprise. Service agreements between an enterprise and a telecom operator will require careful assessment of the liabilities involved and how they can be mitigated.

"Some enterprises might prefer to operate and manage their own networks, while others will prefer a more comprehensive solution."

3 5G OFFERS INNOVATIVE WAYS FOR TELECOM PROVIDERS TO ACCELERATE THE DIGITAL TRANSFORMATION OF THEIR ENTERPRISE CLIENTS

Clearly enterprises face a number of challenges when selecting their next generation communications services. It is equally clear that telecom operators face critical challenges of their own when delivering those services.

Consider, for example, that global internet traffic grew from 100 GB per day in 1992 to 2,000 GB per second in 2017, and is forecast to reach 150,000 GB per second by 2022[2]. Telecom operators are expected to keep up with these massive increases in network loads while also trying to maintain the service level agreements (SLA) their enterprise customers frequently require. These contractually oblige the operator to guarantee a particular quality of service (QoS).

Meanwhile, application and content providers, such as Google and Netflix who are focused on delighting their end- users with a high quality of experience, have gone a step further. As an example, applications are deploying the IEEE QUIC protocol to secure bandwidth and throughput in resource limited environments. (See Google QUIC[3] example).

To date, the only method available to operators to meet enterprise SLAs, as well as consumer demand, has been to continue to add network capacity. This, of course, is very capital intensive, so has led to an ecosystem in which operators focus on reducing data production cost while equipment vendors focus on providing equipment which enables low cost data production. The resulting networks are over-provisioned and woefully under-utilized. The bottom line is that telecom networks are becoming the commodity data pipelines over which revenue-generating applications and content are delivered.

We believe that 5G provides an opportunity for telecom operators to change their value proposition to enterprise clients from simple network-capacity providers to innovative digital-service partners, to the great benefit of both.

3.1 5G TECHNOLOGIES HAVE THE POTENTIAL TO PROVIDE BESPOKE CARRIER-GRADE CONNECTIVITY IN LINE WITH ENTERPRISE NEEDS

5G offers much more than an improvement in network performance. It is a new *connected platform,* which not only enables best-effort connectivity to consumers, but also provides defined QoS and SLAs for high-performance connectivity to enterprises. 5G will allow operators to take a different approach to the provision of high-performance connectivity, allowing them to differentiate their services and better utilize the networks they have invested in.

CASE STUDY: GOOGLE QUIC

In 2013 Google released an experimental transport layer network protocol called QUIC, designed to improve the performance of web applications by overcoming some of the limitations of the existing protocol, Transmission Control Protocol (TCP). QUIC gained popularity rapidly; it has been used as the protocol for YouTube Android traffic since 2016 and more recently for YouTube iOS traffic. QUIC poses two challenges to mobile operators. First it is encrypted, which renders it almost invisible to traditional traffic management tools. Second it tends to consume high volumes of data without regard for the performance of the whole system. Over the years global video traffic has grown to represent more than 75% of all IP traffic on fixed and mobile networks[2], forcing operators to provide more capacity to support that traffic with no additional revenue coming from it.

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Furthermore, 5G will allow enterprises to use wireless connectivity in new ways by introducing the concepts of network slicing for traffic differentiation: high QoS Ultra-Reliable Low-Latency Communication (URLLC) will be available for latency-sensitive applications, such as autonomous delivery vehicles or robotic surgery, while Massive Machine Type Communication (mMTC) will enable Internet of Things (IoT) applications on a large scale, such as smart electrical grids and wearable devices, for which QoS requirements are much lower. 5G also extends the concept of cloud computing into the network and, in the process, exposes network functionality in the form of Application Programming Interfaces (APIs) and Software Development Kits (SDKs), which could allow enterprise clients to control and manage their own virtual private networks, for example[4].

Telecom operators are well-placed to develop and offer easy-to-use platforms of enterprise services based on 5G capabilities, but a deep understanding of the enterprise is key.

3.2   HOW DO YOU EXPOSE 5G TO ENTERPRISES AND INDUSTRY?

5G utilizes an architecture that supports development and outcomes of services (that is, it is a service-based architecture or SBA). By using RESTful APIs, enterprises will be able to access 5G core network functionalities via the Network Exposure Function (NEF)[5], one of many network functions within the new 5G core. APIs are a well-established method used today so are likely to be familiar to enterprise development teams. Examples of functionality provided by NEF APIs include monitoring, device triggering, communication patterns provisioning, packet flow description management, resource management of background data transfer and procedures for traffic influence[6]. Another example would be a Service Management Platform which exposes not only actual QoS in real time, but also allows pre-emptive optimization to be taken to improve future QoS.

"5G will allow enterprises to use wireless connectivity in new ways."

3.3   5G OFFERS A GENUINE OPPORTUNITY TO ACCELERATE THE BENEFITS OF DIGITAL TRANSFORMATION

Businesses are turning to public cloud infrastructure for their storage and applications needs. Cloud services offer numerous benefits[7], including a reduction in up-front capital expenditure, reduced IT operational costs, improved accessibility to data from any location, improved collaboration across dispersed teams, fast implementation and the ability to purchase computing power as and when it is needed. The benefits of an expensive IT infrastructure are now available even to the smallest business.

Cloud services have been wholeheartedly embraced: according to a 2018 IDG study, 73% of organizations now utilize the cloud to some degree[8]. Although businesses are still using slightly more non-cloud than cloud models (53% non-cloud, 23% SaaS, 16% IaaS and 9% PaaS), the balance is expected to shift to 31% non-cloud within the next year or two.

Cloud native computing goes a step further with applications developed specifically to take advantage of the cloud ecosystem rather than traditional on-premise servers[9]; cloud native services are developed as microservices, which minimize the risk of large-scale failure of an application and enable considerable flexibility and elasticity. The applications are also divided into smaller modules (containerized), which can be added or updated independently of the rest of the application. A cloud native architecture promises decreased development- and hence release-time, even lower costs than cloud computing, and greater flexibility and resilience[10], but it means that an enterprise must adapt its development methodology to take advantage of these benefits by embracing rapid iteration and a DevOps model in which development and operations teams are merged to allow faster innovation, shorter release times, and increased scalability[11].

The network native operations model will be the next step in this evolution for businesses, combining the enhanced network functionalities provided by 5G, such as network slicing and edge computing, with cloud computing and data storage to form a complete ecosystem for business.

Network native enterprises will base their mode of operation on the flexible capabilities of this ecosystem and will be able to tailor the ecosystem to their specific needs. Analogous to cloud native applications, network native applications will be designed specifically to take advantage of the 5G environment. Similar to the enterprises that embraced the cloud, network native businesses will gain advantages in agility, productivity and innovation.

"The benefits of an expensive IT infrastructure are now available even to the smallest business."

4 CARRIERS HAVE AN OPPORTUNITY TO UNLOCK FURTHER VALUE IN ENTERPRISE 5G CONNECTIVITY

Enterprise customers have wholeheartedly embraced cloud computing platforms and are open to other connectivity-based solutions. Telecom operators, have the opportunity to leverage 5G capabilities to revolutionize the way their enterprise customers do business. Undoubtedly, operators have the experience and skilled resources to develop, deploy and maintain these enhanced networks.

But technology alone will not guarantee success for operators in a 5G world.

To become a platform for business and operations for enterprises, the telecommunications industry must adapt its culture to partnering with these other industries to meet their diverse needs.

Achieving this will require a deep understanding of the challenges and ambitions of different industry sectors, as well as recognition that these needs could be very different and even contradictory.

For example, the automobile and manufacturing industries want to maintain jurisdiction of their networks for safety and liability reasons, whereas the broadcasting industry is happy to rely on others to provide high performance connectivity.

Here we provide our insights into how the telecommunications industry can help their enterprise clients realize value from high performance connectivity as well as how telecom operators can generate market pull for these capabilities.

Based on experience from multiple projects our insights into how operators can successfully address the enterprise include:

- Adapting to the target industry

- Providing dedicated 5G services – industrial IoT and private networking solutions

- Enabling easy access to wide area IoT connectivity

- Creating a developer friendly platform – exposing network capabilities through APIs that appeal to the DevOps community

4.1 ADAPT TO THE TARGET INDUSTRY – SHIFTING FROM A 'PRODUCT-DRIVEN' TO A 'MARKET-DRIVEN' STRATEGY

Product-driven companies focus on the attributes of their products rather than on their customers – investing in their product's capabilities to appeal to as large a market as possible. Appealing to as large a market as possible enables leveraging economies of scale to optimize manufacturing costs, whilst at the same time reducing product differentiation and hence accelerating the product commoditization.

Telecom operators have successfully used this model for many years, providing SIMs and unlimited data capacity to consumers and enterprises. But that business model is increasingly threatened by competition and as service differentiation is increasingly dominated by public cloud providers capable of providing customized software-based applications on commoditized networks and hardware.

The convergence that began in the telecom industry when cable companies entered the wireless business will only accelerate as large e-commerce and cloud-computing companies begin to encroach. Microsoft, Amazon and Google have all demonstrated an incredible capacity to evolve from their original domains into adjacent markets, massively disrupting the incumbent industries. These players have a heritage in enterprise business, so have a significantly better understanding of those sectors, as well as much closer relationships, and hence have a head start when it comes to satisfying enterprise needs.

Microsoft, IBM, PTC, SAP and C3.ai are already leading the way in Industrial IoT (IIoT) software platforms[12]. Meanwhile Amazon aims to utilize Citizens Broadband Radio Service (CBRS) shared spectrum to deliver *"high performance, scalable and secure"* IIoT services. It has partnered with Athonet and Federated Wireless to deploy LTE networks that are controlled by AWS cloud, allowing on-premise segregation of traffic and data for security, analysis, low-latency and computing while using the cloud for network management and control[13].

Embedded SIM cards will erode the relationship between users and operators. eSIMs allow users to change service providers at any time. Further, they will allow users to hold multiple services from different providers on one device and will even permit people to use their handsets in a foreign country without roaming charges.

5G has the potential to transform numerous industries, but unlike the consumer market, which is essentially homogeneous, each industry will have very different requirements and will speak its own language. Enterprise considerations for connectivity services may include, for example:

- Managed security

- Specific latency requirements (from very low to completely unimportant)

- Potentially large numbers of devices

- Highly varied data rates

- Geographic spread (local connectivity all the way to wide area coverage, potentially global)

- System management and control, including a need for real-time KPI data and easy-to-use online tools

- 24/7 technical support and rapid issue resolution

A market-driven approach, in which the needs and wishes of the customer, is central to the design and delivery of 5G. This approach requires excellent products and services based on a deep understanding of client needs, combined with top-level customer-service. For this model to be successful, telecom operators will need to reach out to their enterprise customers to understand their needs; build tailored, convenient services and respond to their business and technical concerns quickly and efficiently.

4.2 DEDICATED 5G SERVICES – INDUSTRIAL IoT AND PRIVATE NETWORKING SOLUTIONS

Enterprises, clearly convinced that telecom operators cannot meet their needs, are building out their own private networks. Equipment providers such as Nokia, Ericsson, Huawei and Samsung are already offering private LTE solutions for industrial applications. Huawei, for example, deployed enterprise LTE (eLTE) based on MulteFire at Shanghai Yangshan Port[14], which provided < 30 ms latency communications for 60 Automated Guided Vehicles. More recently, in November 2018, car manufacturers VW, Daimler and BMW approached the German spectrum authority BNA to express their interest in private 5G networks[15].

To encourage enterprises to embark on a new technology journey in partnership with a service provider, operators must make end-to-end processes simple, flexible and customizable by:

- Offering knowledgeable professional services to support the enterprise, especially at the beginning of the project

- Providing simple service bundles

- Zero touch automation – making the platform easy to provision, scale and access

- Creating a service-enablement platform that includes edge computing, data storage, connectivity and IoT services

- Designing online tools to allow self-service provisioning and monitoring

Until now, operators have been unable to offer highly differentiated services to their enterprise clients. 5G has the

potential to unlock that capability via network slicing. Operators will have the capability to provide numerous tailored virtual networks on one physical infrastructure, each fulfilling a different set of functionality and performance criteria. Each slice will be isolated from the others and will be configured with its own architecture and networking provisioning. This means that operators can offer a much greater variety of cellular services than ever before both localized and in the wide area.

4.3 ENABLE EASY ACCESS TO WIDE AREA IoT CONNECTIVITY

The telecommunications industry has the capability to play an important role in the digital transformation that is occurring across industry. However, as described above, there is strong competition for enterprise business. Public cloud providers such as AWS, Microsoft Azure, Google cloud and others have already created easy to use platforms and are marching ahead in making these platforms available to industry.

To compete in this arena, the telecom industry must take a flexible, proactive approach to create market pull.

Wide area IoT connectivity provides enterprises with the ability to remain in contact with their products and their customers over the entire product lifecycle: This will give enterprises the following advantages

- Insights into how customers are using products

- The ability to feed customer usage back into the product design cycle

- A mechanism to provide functional upgrades and fault fixes remotely

- Remote assistance, help and advice

- Remotely embedded functionality to simplify products and enable them with cloud or edge-based functionality

"Telecom operators will need to reach out to their enterprise customers to understand their needs; build tailored, convenient services and respond to their business and technical concerns quickly and efficiently."

5G NB-IoT and LTE_M connectivity will allow a minimum level of connectivity useful primarily for telemetry and data collection. URLLC will enable tightly synchronized functionality in the edge to appear as *"remotely embedded"* software in the device itself enabling new applications such as ultra-low form factor devices such as spectacles to become intelligent.

The telecom industry will need to adapt its ways of working and its culture to each client industry to be able to make the value proposition of 5G network-based services more evident.

Over time, enterprises have developed tried and trusted methods of working which minimize risk and cost and provide a clear return on investment. 5G capabilities offer tantalizing possibilities for revolutionizing how they do business, but to transfer to a new platform enterprises must be confident in the investment that they are making. They must be confident that the risk of transferring to a wireless platform will be worth it in the form of the promised flexibility and reduced costs. Further, will this new platform really deliver on the promise to revolutionize the way enterprises do business and delight their customers?

Carriers will need to be able to demonstrate that they understand the risk that enterprises are taking and help mitigate those risks.

4.4   CREATE A DEVELOPER-FRIENDLY PLATFORM

Since a platform based around 5G will have to prove its value in competition with public cloud providers as well as in competition to private enterprise clouds, operators will need to work closely with specific industry sectors to understand their needs and thereby create a user-friendly platform.

The definition of a platform in this sense is a service-enablement platform in which underlying functions and services are exposed in an easy to use manner. Operators are in the process of creating open platforms based around virtualization, network slicing and APIs. An established open API, such as the TMForum Open API, is a good place to start[16]. The initial focus should be on providing DevOps type functionality and evolving the APIs in accordance with user requirements to make it more attractive to other enterprises and industries.

There are several strategies for creating such a platform, including partnering with a public cloud provider such as AWS or Microsoft Azure, partnering with one of the many smaller platform vendors, such as PTC, or building and operating one from scratch independently.

"The initial focus should be on providing DevOps type functionality and evolving the APIs in accordance with user requirements."

5   CONCLUSIONS

The telecom industry has all the technical capabilities to succeed in a 5G world, but it will need to adapt to the changing environment very quickly. Given the diverse enterprise client base, operators must shift from a product-based strategy to a customer-based strategy focused on the unique needs of each client. To accomplish this, operators must partner with a small number of key customers to develop platforms and services that add value. Inevitably this will mean upfront investment, but as the operators become more knowledgeable, they will be able to better demonstrate their value to new clients and the business will scale. The network native enterprises that will come about due to 5G will have a competitive advantage over other enterprises in the form of new business models, new insights into the use of the product by the customer and superior service levels and hence will be able to upsell functionality to their customer bases. By developing a convenient service-enablement platform for businesses, telecom operators will be able to move away from the traditional capital-intensive overprovisioning model towards a more flexible and agile application subscription service model.

The telecom industry has all the technical capabilities to thrive in the emerging 5G driven enterprise world. To succeed, it will have to drive 5G as a critical emerging technology for the enterprise.

Given the rapidly evolving and diverse enterprise client base it is important operators embrace the four key elements highlighted in this report.

To accomplish this operators' enterprise organizations must create portfolios of enabling technologies that they can adapt and offer to targeted verticals.

Inevitably this will require upfront investments in technology and processes and also in lead customers with whom the operator will be able to explore the new way of working and subsequently scale efficiently.

Network native enterprises will leverage these new capabilities in their own internal operations or to improve the value of the products and services they provide to their customers. They will benefit from the competitive advantage in the form of new business models, new insights into the use of the product by the customer and superior service levels; and hence will be able to upsell functionality to their customer bases.

By developing a convenient service-enablement platform for businesses, telecom operators will be able to move away from the traditional capital-intensive overprovisioning model towards a more flexible and agile application subscription service model.

To discuss strategies to leverage the technology and market opportunity of 5G and IoT contact:

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About Cambridge Consultants

Cambridge Consultants is a world leader in innovation and technology-based consulting, helping ambitious companies achieve the seemingly impossible. From large multinationals to innovative start-ups, our clients trust us to develop breakthrough technologies and solve their most critical, high-risk challenges.

With a team of more than 900 staff in Cambridge (UK), Boston, San Francisco and Seattle (USA), Singapore and Tokyo, we have one of the world's largest independent wireless development teams.

Over the years, we have led the creation of major wireless technologies and developed service platforms that have transformed our client's businesses. This includes the world's first single-chip Bluetooth radio, radios that manage more than half of the globe's airspace and the most densely packed cellular network in the world, which has revolutionized warehouse automation.

We have created breakthroughs that defy convention across diverse markets. These range from telecoms, IoT and satellite, to healthcare, consumer, audio and automotive. This technical expertise and deep market knowledge also provides the commercial insight that helps our clients navigate the emerging technology landscape and offers the intelligence to underpin their most critical strategic decisions.

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