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WHITE PAPER

UNLOCKING DIGITAL OPPORTUNITIES WITH 5G: A GCC OUTLOOK

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Foreword

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New advances in cloud computing make it possible for businesses and governments to undertake a digital transformation, enabling them to support vast numbers of new users with greater personal control than ever. Furthermore, digital transformation will enable a new generation of advances in medicine, transportation, industry, and education which societies around the world will benefit from. 5G will underpin this digital transformation.

Unlike previous generations of networking, 5G requires a closer interaction of partners who cooperate but also act independently of one another. New applications enabled by 5G will need not only connectivity but also other capabilities (e.g. security, device management) that can be controlled in the network. Delivery of these new 5G services will require large investments by telcos and other technology firms, but will not be made unless companies have the assurance of stable and supporting regulatory regimes. In some cases, governments will need to provide the necessary support so that all elements of society benefit from these advances.

With sponsorship from Huawei, Analysys Mason has developed the following white paper to explain the potential for societal advances from digital transformation and 5G networks. The white paper includes recommendations for network operators, governments and enterprises to fulfil this potential. The analysis and the recommendations presented in the paper were developed independently by Analysys Mason's key 5G and regional experts.

The emergence of 5G technology brings with it huge expectations for potential benefits, yet also carries uncertainty in terms of how and when to move forward. In which areas should governments, regulators, operators and vendors put their focus is a question on the minds of many of us. How do our nations, societies, economies and companies benefit from such potentially revolutionary technology transitions whilst taking steps to mitigate the risk of not acting in time or even doing too much too soon?

As we see the 5G era as being one of greater collaboration across industry, it necessitates curating a broader ecosystem, with us all contributing to the adoption of 5G in order to realize the benefits for our markets. To this end, Huawei is pleased to sponsor such research into the 5G domain across industries and society in the GCC. The thought leadership of key industry research and consulting experts should provide us all with food for thought and guidance we can leverage for our own situations.

With the collective efforts of the industry, it is our ambition that we can all make better informed decisions, solidify our plans and ask for the necessary support so that we can reach our goals with a better-connected world. We invite you to explore with us the "Unlocking digital opportunities with 5G: A GCC outlook", a paper developed by Analysys Mason, which assesses the trends and benefits of 5G for the GCC region.

Executive summary

The fifth generation of wireless technologies, known as 5G, is expected to have a profound impact on peoples' lifestyles, societies and economies globally, stretching far beyond the telecoms industry and its users. In this white paper[i] we analyze 5G and its value in the context of the Gulf Cooperation Council (GCC) region and provide recommendations to the region's telcos, governments and regulatory bodies on how to maximize the value the technology is expected to generate for them.

5G is not just another wireless technology generation – 5G will be a key enabler of digital transformation in the GCC and worldwide

Digitalization is transforming economies and societies, and 5G will be one of its key enablers. For consumers, digitalization provides the promise of a more ubiquitous, convenient and personalized access to these services, while fostering innovation and the development of new products (for example, entertainment based on augmented reality (AR) and virtual reality (VR), consumer drones and robots). For enterprises, new digital services based on artificial intelligence, analytics, virtual reality, industrial Internet of Things (IoT), and drones are expected to produce long-term gains in efficiency and productivity. For the wider society, digitalization, enabled by 5G is expected to generate environmental benefits, enhance safety and create additional jobs.

The internationally agreed vision for 5G technology is that it will lie at the heart of the future digital economy and society. 5G's technical capabilities – i.e. very high (>1Gbit/s) data speeds, high and reliable network availability and low latency communications in the densest environments – will not only enhance the delivery of existing mobile broadband services, but are also expected to support a wide and diverse mix of completely new solutions and services.

Most GCC governments have not yet formally included analysis of the value of 5G in their policy documents. However, with one of the highest rates of mobile and fiber adoption in the world, the GCC region is well positioned to benefit significantly from 5G. In the GCC region, 5G could generate an estimated cumulative new revenue opportunity over ten years totaling USD273 billion (see Figure on next page), a large share of which will be addressable by telcos.
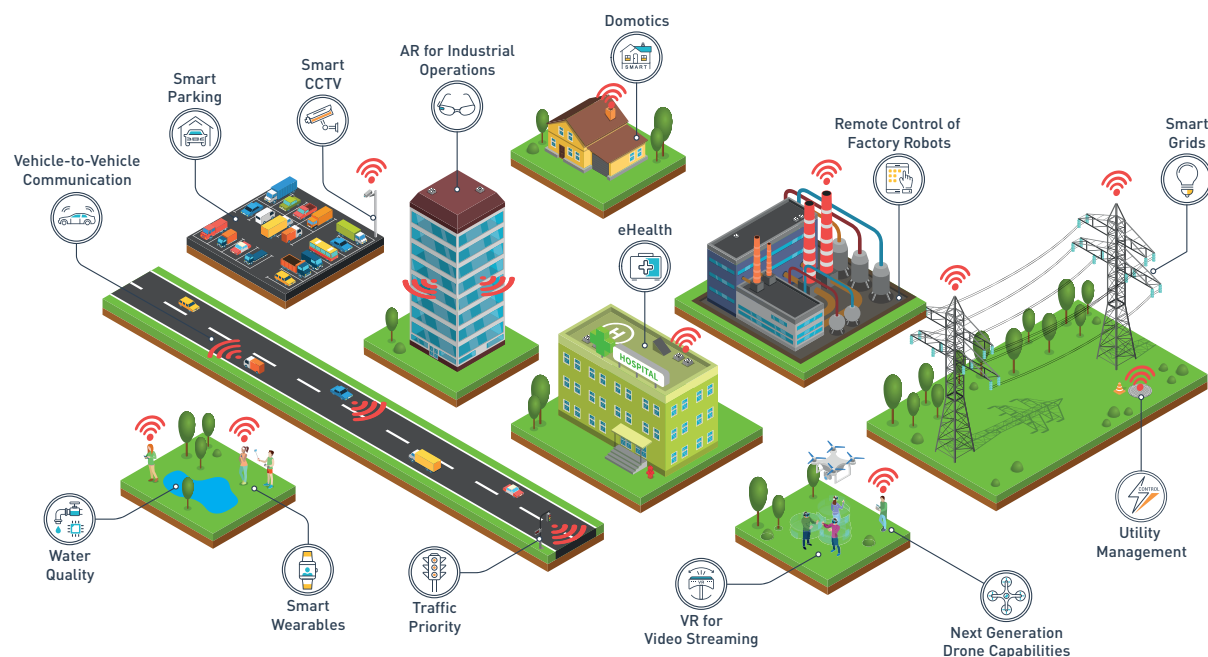
Overview of 5G-enabled digitalization
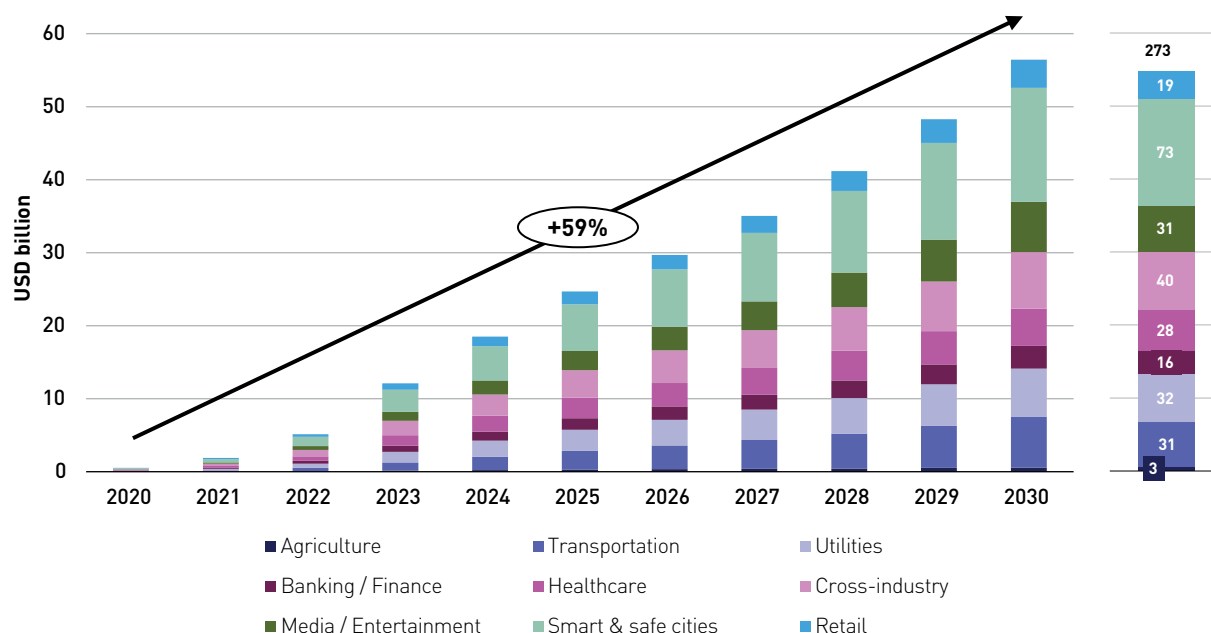
Potential 5G revenue opportunity from new digital services in GCC by vertical, 2020–2030

However, to address this opportunity, and truly reap the benefits of 5G's potential in the next decade, the GCC region needs to become more '5G ready' now. The results of Analysys Mason's 5G country readiness benchmark analysis suggest that, on average, the GCC region is behind the leading benchmark countries (USA, Japan, South Korea and China) in terms of both regulatory readiness and operator readiness criteria. However, the range of scores for regulatory and operator readiness achieved by individual GCC countries is very wide, with the UAE being the most 5G-ready country in the region. On the regulatory front, the region needs more focus on industry vertical policies for 5G. On the operator front, more focus on network virtualization, automation, and digital experience will be needed in the near term.

The GCC region should become more '5G ready.' More focus on industry vertical policies for 5G is needed.

Network slicing, the key enabler of 5G use cases, will revolutionise business models and service pricing

To really benefit from 5G capabilities, operators need to tie their 5G vision and roadmap closely to their digital transformation strategies. Traditional business models and 'ways of doing things' will not be sufficient to enable operators to make the most of 5G opportunities. Operators will need to introduce network slicing to expect revolutionizing business models and service pricing. Network slices will be created on demand and will be independently controlled and managed with the degree of customization that could previously only be achieved with dedicated physical networks. The use of network slicing means partners can be integrated into a network platform in similar ways as on a dedicated private network, but with far less integration effort. It will also enable operators to expand their role from connectivity to other areas of the value chain – such as cloud and edge services, orchestration, and applications. In these areas, operators will meet new competitors too and they will have to fight hard for their new value-chain roles.

[i] This forecast has been developed based on a top-down and bottom-up approach. More detail on methodology are provided in Annex D

COMMUNICATIONS SERVICE PROVIDERS	DIGITAL SERVICE ENABLERS	DIGITAL SERVICE PROVIDERS
MOST	SOME	NONE

Provides voice, SMS and data services

Provides enhanced connectivity through network slicing

A risky strategy that will not allow operators to recover investment in network transformations

Platform play
Owns and operates a platform that enables services of third parties

Diverse investment strategy
e.g. has venture funds, start-up incubators etc

Ecosystem play
Has a large number of partners and can support flexible business models

Offers digital services
Offers services that proved successful on the operator's platform

Engages with customers in a digital way
Offers advanced self-service apps

Owns a digital network
Near zero-touch network automation, fully virtualised network with micro-service based architecture

Weak business case for 5G based mostly on cost savings

Improved business case for 5G with new revenue opportunities and limited additional costs

Attractive business case for 5G with new revenue opportunities from high-value services

Operators' digital transformation path and the link to 5G opportunities

Operators, and the telecoms industry as a whole, should not be looking for a single 'killer' 5G use case. Instead, operators will need the agility that digital transformation will bring about to enable and benefit from many possible 5G digital services, through new partnerships and new business models. GCC operators should focus on 5G use cases that will deliver the greatest benefits in the short run and consider smaller-scale deployments at first to generate essential knowledge. The Figure on the following page summarises key 5G use cases that we believe will be attractive for the GCC region over the next ten years, and an expanded list of over 50 use cases is provided in

Annex E. The rest of the paper provides a more-detailed analysis of the most immediate 5G opportunities. In particular, we believe that VR for on-demand video streaming and VR for 4K/8K live video streaming use cases should be considered by most operators in the region.

Platform thinking will enable large numbers of new services – don't wait for the 'killer' 5G app

2019 - 2022	eMBB	FWA	Location analytics services	Remote patient care	Facial recognition smart CCTV
	5G in-vehicle entertainment	VR for live video streaming	VR for on-demand video streaming		Wireless smart grid
	Wearables for crowd management		5G-based V2X services		Drones for inspection
2023 - 2025	VR for telemedicine		Immersive VR for gaming		Ultra-high frequency mobile trading
	Blockchain-based banking		AR for operations support		Precision farming
2026 - 2030	AR for financial data visualisation		Remote surgery		VR for enterprise live training
	V2X services for self-driving cars			Remote control of factory robots	

Connectivity • Smart and safe cities • Cross-industry • Utilities • Media/entertainment

Healthcare • Transportation • Retail • Banking/finance • Agriculture

Variety of 5G use cases that will become available to GCC operators in the next ten years

The rest of the paper is structured as follows:

• Section 1 discusses the value that 5G is expected to generate for societies, economies and telcos in the GCC region

• Section 2 provides an overview of the GCC context to 5G

• Section 3 analyses the GCC region's readiness to embrace 5G from a regulatory and operator perspective

• Section 4 explains why operators need to closely tie their 5G plans with their digital transformation efforts, as well as am overview of the most attractive 5G use cases

• Section 5 discusses the critical success factors for GCC telcos, considering this potentially game-changing technology

• Section 6 provides an analysis of the expected business impact of 5G for operators

We anticipate that this white paper will provide a starting point for further discussion specific to each market.

Chapter 1. 5G will have a significant impact on digital transformation worldwide and in the GCC region

1. 5G will have a significant impact on digital transformation worldwide and in the GCC region

To a far greater extent than previous generations of telecom network technology, 5G promises to have a profound impact not just on peoples' lifestyles, but across whole societies and economies, stretching way beyond the telecoms industry and its users. 5G will have a global impact, and eventually it is expected to help narrow the "digital gap" between developing and developed countries. However, some regions, such as the GCC, are expected to lead the way and provide early evidence of the power of 5G.

1.1 Digitalization is transforming economies and societies

Technological breakthroughs in areas such as artificial intelligence, virtual reality, IoT, 3D printing, drones, connected (and, in the future, autonomous) vehicles have the potential to connect billions of people and devices and bring significant socio-economic benefits to society.

Figure 1.1 summarizes the key benefits that digitalization offers for consumers and enterprises. In addition, a study conducted by the World Economic Forum estimated that the potential value at stake associated with the digitalization of society and industry could exceed USD100 trillion worldwide in 2025 (of which USD28 trillion accrued by ten key industries – see Figure 1.2), with the majority of this value benefiting societies and individuals.

For consumers, digitalization of the economy has already significantly transformed the way people access and consume products and entertainment services (e.g. online gaming, music and video streaming), while providing increased access to choice and information (e.g. for e-commerce, tourism, transportation) and significant time savings (e.g. the use of e-government platforms, applications for smart parking). In future, further digitalization offers the
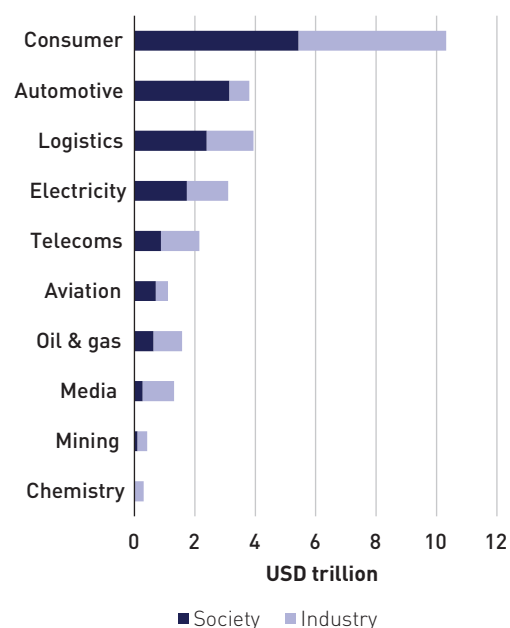

Figure 1.1: Societal benefits from digitalization

Figure 1.2: Cumulative benefits of digitalization for society and industry, 2016–2025 [1]

Sources corresponding to references made in the text are listed in Annex A

promise of a more ubiquitous, convenient and personalized access to these services, while fostering innovation and the development of new products (e.g. AR-/VR-based entertainment, consumer drones and robots).

For enterprises, technological innovations such as cloud and IoT are already creating new revenue opportunities by enabling the creation of new products (e.g. smart home) and by improving businesses' access to new markets. Digital services such as artificial intelligence, analytics, virtual reality, industrial IoT ('Industry 4.0'), and drones are expected to produce long-term gains in efficiency and productivity.

For the wider society, digitalization is expected to generate environmental benefits (e.g. reduced CO_2 emissions and energy consumption through smart-grid initiatives, connected cars) and safety impacts (e.g. reduction in deaths on the road from the fitment of vehicle-to-everything (V2X) systems on new vehicles), as well as creating additional jobs.

1.2 5G is not just another wireless technology generation – 5G will be a key enabler of digitalization

The internationally agreed vision for 5G technology is that it will lie at the heart of the future digital economy and society. 5G technical capabilities – enabling very high (>1Gbps) data speeds, offering very high network availability and low-latency communications in the densest environments – will not only enhance access to and delivery of existing mobile broadband services, but are also expected to underpin a wide and diverse mix of completely new solutions and services supporting the ongoing digitalization of society.

The role of 5G as a key enabler of the digitalization of society is emphasized in the following statement from Ronan Dunne, Vice President and Group President of Verizon Wireless: [2]

"5G has the potential to join a very exclusive club-the handful of technologies throughout history that transform industries across every sector of the economy ... redefining work, elevating living standards, and having a profound and sustained impact on our global economic growth"
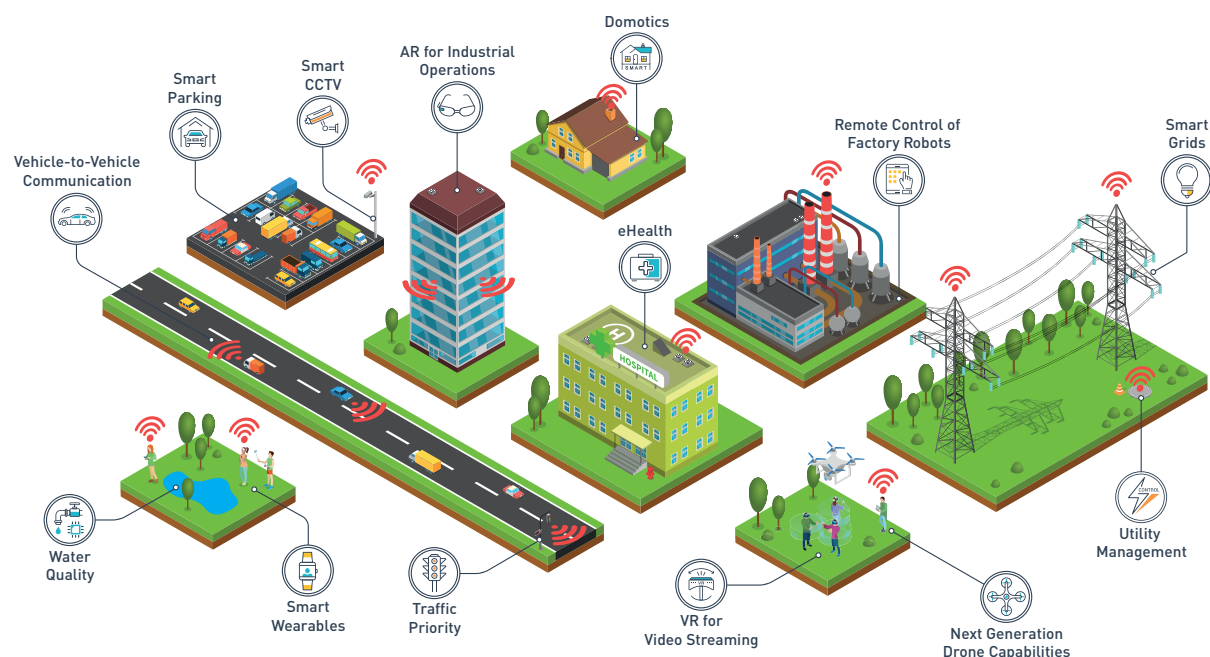

Figure 1.3: Overview of 5G-enabled digitalization

5G will enable new digital solutions and services

5G is expected to enable a diverse mix of nascent digital solutions across a wide range of vertical sectors, from cloud-based robotics for healthcare and manufacturing, through AI-enabled video surveillance for the public sector, to V2X-enabled autonomous vehicles in the transportation vertical, and a smart supply chain in the retail industry, etc. Vertical sectors will be able to harness 5G as a key enabler of their digitalization efforts. Broadly, the vertical sectors in which the greatest impact will be felt are those which:

- face significant commercial challenges, driving the need for investment in further digitalization

- have high requirement for 5G capabilities (high-speed connectivity, low latency, high mobility, very high numbers of IoT connections envisaged)

- are already advanced in their digital transformation efforts, or involve processes that are ripe for digitalization.

Figure 1.4 below illustrates some of the key challenges faced by selected vertical sectors and possible 5G-enabled digital solutions to address these.

	Challenges	Potential 5G-Enabled Solutions
Manufacturing	High level of competition; very susceptible to business cycles	Smart supply chain and smart factory greatly increase quality and efficiency
Healthcare	Ageing population; rising consumer interest in wellbeing	Combining low-latency connectivity with AI for remote diagnosis, consultation and treatment
Media and entertainment	User-generated content; complex value chain with declining ARPU growth	Differentiate and add value to content with immersive experiences such as VR; provide interactive platforms for user-generated content
Energy and utilities	Shift of industry from oil to alternatives; more pressure on margins and efficiency	Smart grid to improve distribution and usage efficiency, critical infrastructure monitoring
Public safety	Rising cyber and physical threats from crime and terrorism	Enhanced surveillance with real-time AI-based analytics to detect and predict incidents
Transportation	Rising need for transport causes congestion, pollution and accidents; reduced productivity	Intelligent transport management, including autonomous private and public vehicles and high-quality V2X

Figure 1.4: Key challenges and possible new 5G-enabled solutions, in selected vertical sectors

The role of 5G across a variety of vertical sectors has been well captured by Günther H. Oettinger, European Commissioner for Budget & Human Resources: [3]

5G will also enhance existing services

As well as enabling new digital solutions, 5G will also improve the performance of existing applications that currently work on 3G and 4G networks, including:

- **Fixed wireless access (FWA).** Fixed wireless, including LTE, is already used as a fiber alternative in some underserved areas, but it represents a significant performance compromise compared to fiber to the premises (FTTP). With 5G, people in areas which are uneconomical to reach with fiber, or even copper, will be able to access the same quality services as customers with wireline links, with the added advantage of using the same subscription for mobile services when they move beyond the home or office

- **Mobile video streaming services.** These include in-car video entertainment, remote teleconsultations between doctors and patients, online schooling and interactive lectures, videoconferencing between business sites, or simply access to mobile video entertainment

- **IoT applications.** Existing IoT solutions provided via 2G/3G/4G networks will benefit from improvements when delivered over 5G. In the healthcare sector, for example, the ultra reliability and low latency of 5G will improve the accuracy and reliability of products and services (e.g. real-time patient diagnosis and monitoring). In the logistics industry, track-and-trace applications will benefit from the expected lower power consumption of 5G networks. In the public sector, 5G connectivity will support more-reliable and lower-latency emergency services communications, as well as enabling larger amounts of data to be transmitted in real time

- **Enterprise connectivity requirements.** With 5G and network slicing, industries will be able to access connectivity which supports all their requirements, not just voice and high-speed data. For example, very low latency or very high security might be critical for one vertical industry, while another may be more interested in very high data rates. Industries that can obtain exactly the connectivity characteristics they require will be able to transform their business processes far more radically than before.

"My vision for 5G […] is not only about more speed and more bandwidth for mobile but about building the communication platform that will power the digital revolution. This means that public services, utilities, manufacturing, healthcare, and farming will all be using 5G networks to deliver new, smart products and services based on next generation connectivity"

1.3 5G will have a central role in the digital transformation of the GCC region

GCC countries have enjoyed a spectacular economic boom since 2003, driven by high oil prices. However, in the light of recent oil price shocks, governments across the GCC have recognized the importance of diversifying their economies, to reduce their reliance on oil & gas.

This has encouraged GCC governments to reshape their multi-annual economic development programs and set ambitious goals to accelerate economic diversification, encourage growth, promote sustainability, improve public services (e.g. health, education, smart cities, e-government) and the overall wellbeing of citizens. Some GCC countries have expressed the objective of encouraging a more entrepreneurial culture in order to diversify their economies. Others have committed to increasing access to healthcare and providing a first-class education system. Finally, some will endeavor to create an environment that attracts and retain the necessary skills and capabilities from abroad.

Digital transformation, in which 5G plays an important part, underpins most of these ambitions. For example, it can help to improve the manufacturing capability of small and medium businesses through industrial IoT solutions, simplify administrative processes via e-government initiatives, improve energy efficiency by creating a smart grid, reduce the number of road accidents by encouraging the adoption of connected vehicles, or improve the access to healthcare through remote patient monitoring or telemedicine solutions.

GCC region, driven by the availability and penetration of high-speed broadband, the adoption of connected devices (e.g. smartphones, tablets, IoT) and the already prevalent use of digital economy services (e.g. e commerce, media, mobile payments), it has significant

potential for further growth. To this end, GCC countries have developed digital ICT strategies which aim to define the role played by technologies to achieve these goals. While most GCC governments have not yet formally included the role played by 5G in their policy documents, it is expected that 5G will be a key enabler of digital solutions. For example, 5G capabilities will support advances in robotics services, which could form an essential part of the future industrial processes, as well as key public services such as healthcare. These services will require ultra-low latency and reliable wireless connectivity to deliver real-time responsiveness. In addition, 5G will play a major part in the smart infrastructure that is expected to have a significant role in many aspects of day-to-day life, from autonomous vehicles to smart buildings, energy networks and cities. As recently stated by Mats Granryd, Director General at the GSMA: [4]

1.4 5G could generate over USD273 billion for the GCC ICT industry over a decade

The likely contribution of 5G to an economy has been the subject of many studies. Most agree that, to derive the maximum benefits, a country or a region will need to have a high existing level of mobile penetration, and a clear roadmap for deploying digital platforms. With one

of the highest rates of mobile adoption in the world (see Section 3), the GCC region appears well positioned to benefit significantly from 5G. According to the GSMA, in the Middle East and North Africa (MENA) region, mobile technologies and services generated around 4.2% of GDP in 2016, equating to USD165 billion of economic value. In the period to 2020 the GSMA expects this to increase to almost USD200 billion (4.3% of GDP). [5]

The diverse and increasingly urgent vertical sectors' requirements for digitalization will translate into new potential revenue opportunities for the ICT industry, with operators responsible for the bulk of the build-out of 5G networks and platforms, while other ICT players will provide enterprise services that leverage the operators' 5G networks (e.g. cloud services, applications, integration or computing). ICT players may, in some sectors, share some of the investment in 5G networks themselves – for instance, by building a localized network of small cells to support a particular venue or enterprise location. In the GCC region, Analysys Mason estimates that 5G will provide a cumulative new revenue opportunity over ten years totaling USD273 billion[i] (see Figure 2.5), with about 50% of this addressable by mobile operators (MNOs) and the rest by other ICT players.
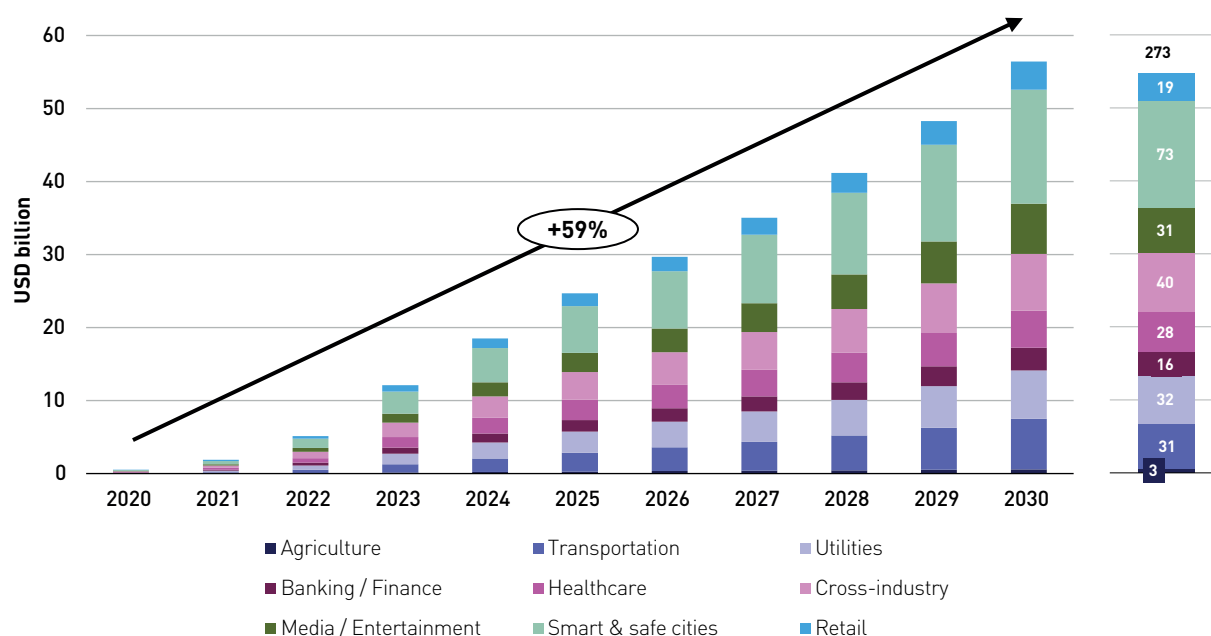
Figure 1.5: Potential 5G revenue opportunity from new digital services in the GCC region by vertical, 2020–2030[ii]

"5G is more than just a generational step; it represents a fundamental transformation of the role that mobile technology plays in society. [...] It is an opportunity for industry, society and individuals to advance their digital ambitions, with 5G a catalyst for innovation"

1.5 Operators in GCC countries are well positioned to address a significant share of the 5G revenue opportunity

Although GCC operators have enjoyed healthy revenue growth over the past few years, driven by strong demand for data connectivity and digital services, overall mobile service revenue is expected to increase by a modest 0.6% annually between 2018 and 2025 as a result of market saturation and increasing competition. Operators are therefore keen to explore ways to generate new revenue streams, slow down ARPU erosion and protect revenue margins, while delivering increasingly complex and traffic-hungry services. At a high level, 5G offers several opportunities for operators to improve their business model, including:

- **Using 5G to enhance existing mobile broadband services,** for instance by offering enhanced connectivity tailored to the specific needs of vertical sectors through network slicing, or by providing enhanced 5G-based FWA services. As in other regions, these are likely to be the first priority of GCC operators when initially leveraging 5G

- **Using 5G to provide new services to consumers,** such as upselling an interactive smart-home service to mobile broadband users, offering an AR/VR gaming or shopping service, or launching an immersive VR-based video-on-demand or video live streaming service to over-the-top (OTT) subscribers

- **Using 5G to provide new services to vertical sectors,** especially for the vertical sectors identified in Section 1.3, such as industrial IoT or AI-enabled analytics, in addition to premium connectivity. However, this means that operators will need to enhance their role in the value chain, which will require investment to develop a digital platform of capabilities (see Sections 5 and 6 for more detail on this). This platform will allow operators to move into new areas of the value chain such as security or analytics, and provide flexible support for a wide range of services in future – even those which are not currently envisaged.

By embracing these opportunities operators can expect to drive further revenue growth:

- For example, the GSMA expects that, globally, 5G can help operators increase mobile revenue growth over 2016–2025 from a CAGR of 2.5% to 5%. [6]
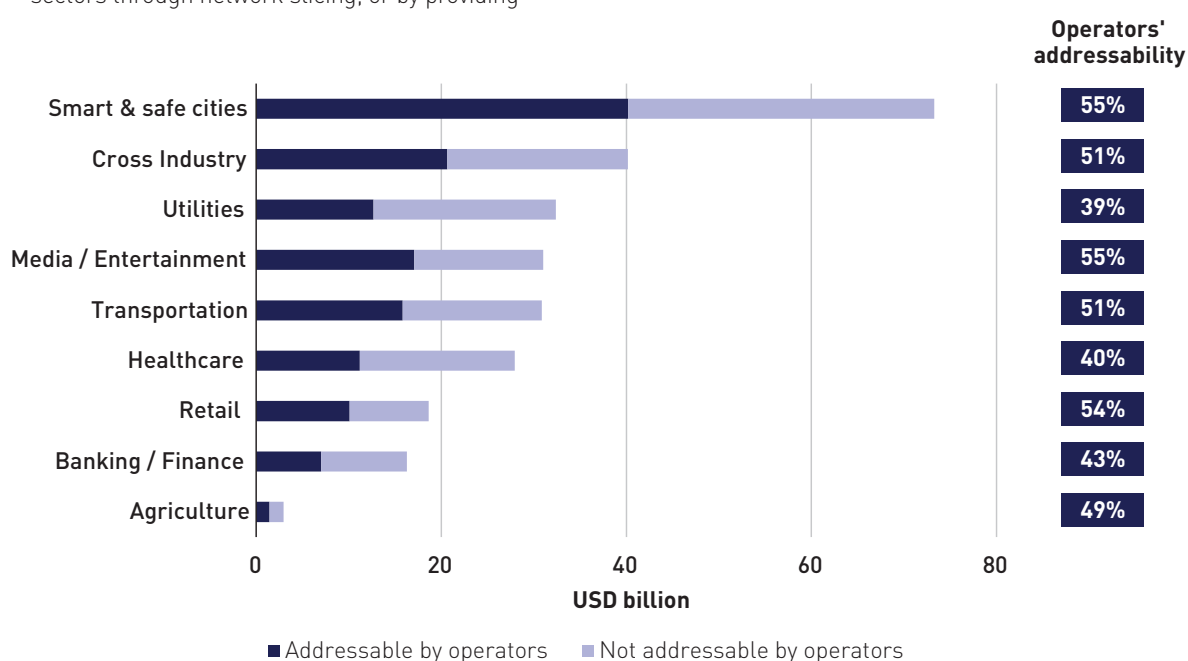
Figure 1.6: Cumulative revenue from 5G-enabled solutions, by vertical and operators' addressability, 2020–2030, GCC[i]

[i] This forecast has been developed based on a top-down and bottom-up approach. More detail on methodology are provided in Annex D.

- In the GCC region, Analysys Mason expects the provision of new services to vertical sectors to support their 5G-enabled digitalization efforts to offer a cumulative revenue opportunity to operators of USD137 billion over a ten-year period, i.e. over half of the revenue potential of USD273 billion for the ICT industry discussed in Section 1.4. Figure 1.6 illustrates the cumulative addressable 5G revenue opportunity for operators and other ICT players in the GCC region over a ten-year period, by key vertical sector.[i]

In a survey of mobile operators in the GCC region, Analysys Mason found a significant shift in the pattern of vertical sectors which MNOs expected to target in the first three years of a 5G deployment, as opposed to those in years 4 to 6. MNOs were asked to name all their 5G commercial use cases. Among those use cases which were cited most frequently, MNOs were asked to select their top four in terms of network investment and marketing effort. As Figure 1.7 shows, for years 1 to 3, the biggest priorities are mainly extensions of existing services – enhanced mobile broadband (eMBB) speeds and quality of service for consumers and business people; and added-value applications which run over those eMBB connections and largely target the same users – connected personal health, connected cars and citizen services within a smart city.

In years 4 to 6 of a commercial deployment, operators expect to prioritize a somewhat different mixture of services in terms of network and marketing investment. Although continued enhancement of eMBB services remains a top-four priority for over 40%, the largest percentage of MNOs expect to be targeting services which rely on future releases of 5G standards, such as robotics and drones, or VR services (for business or consumers) and AI-enhanced services.

To summarize this discussion of the impact of 5G on digital transformation, we expect 5G to be one of the key enablers of digital transformation and digital solutions worldwide and in GCC countries. Both digital transformation and 5G will have a profound impact on individuals, societies, industry segments and telcos in the region, generating a new revenue opportunity of over USD273 billion for the GCC ICT industry over a decade. Telcos will be well positioned to address a large share of this opportunity.

In the next two sections we discuss the current GCC communications market context (Section 2) and then compare the region's 5G readiness with that observed in leading countries globally (Section 3).
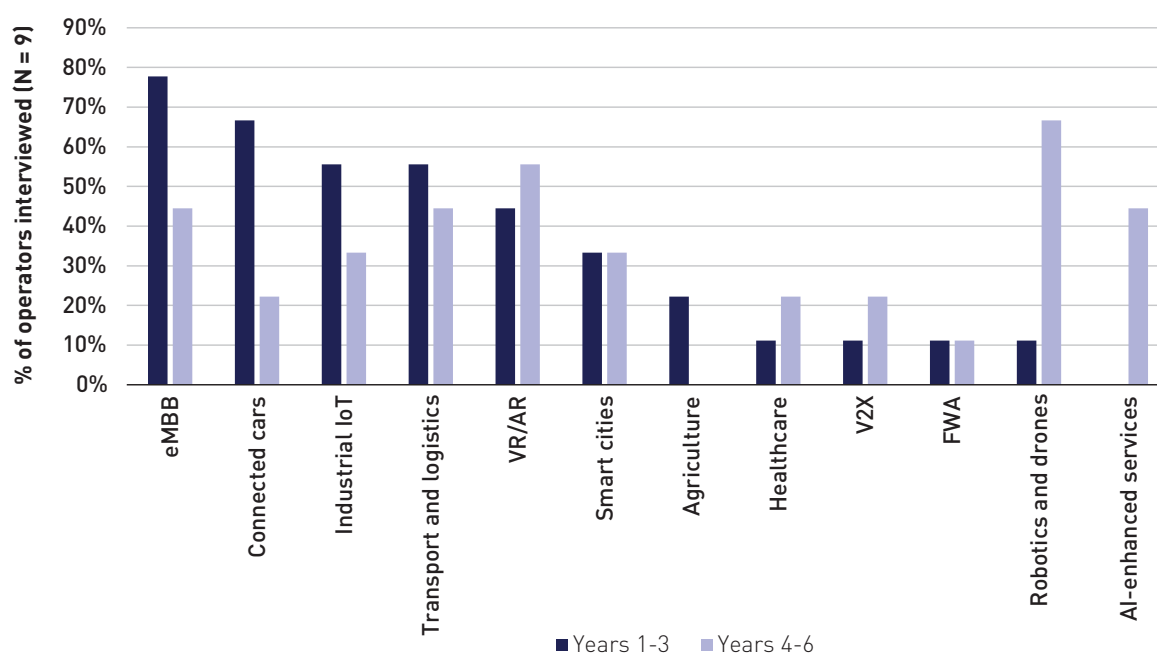
Figure 1.7: Percentage of GCC mobile operators placing each use-case category among their top four commercial priorities for 5G, in years 1–3 and 4–6 of deployment

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[i] Please note that the estimate presents an optimistic scenario and depends significantly on whether the operators will realise the capabilities explained in detail in Sections 6 and 7.

Chapter 2. The GCC region's drive to sustain technology leadership globally creates fertile land for 5G

2. The GCC region's drive to sustain technology leadership globally creates fertile land for 5G

The GCC region hosts some of the most advanced telecoms markets in the world, in terms of access to high-speed data services, the sophistication of network infrastructure, and the consumer appetite for social media and media streaming services. Regional telcos are keen to maintain their technology leadership, slow down ARPU erosion and protect revenue margins while delivering increasingly complex and traffic-hungry services. To do that, operators have been investing in digital transformation and future network technologies, such as 5G and network virtualization.

2.1 Operators hope to gain a first-mover advantage and maintain their technology leadership by preparing for 5G

Market maturity, enforced SIM registration policies, a reduction in the number of expatriates and economic slowdown due to low oil prices, led to a contraction of the subscriber base in some GCC countries in 2017. However, the adoption of data services across the region remains very strong, driven by growing smartphone penetration and the roll-out of LTE networks. The large young, technology-savvy, consumer base in the region has also helped to drive the demand for new digital services. Figure 2.1 sets out mobile retail revenue by service type, and mobile ARPU for the region.

The GCC region was one of the first regions to launch 4G (LTE) services, in 2011. Adoption of LTE has accelerated in the last three years thanks to extended coverage, the availability of more-affordable smartphones, and the introduction of new technology iterations (such as LTE-A and LTE-A Pro) which support higher data speeds.

For 5G, most operators in the region will start by deploying the first set of specifications, 5G New Radio Non-standalone (NR NSA) which do not require a 5G core. The next stage will be to deploy 5G NR Standalone, and introduce a 5G core. From 2020, Release 16 (and then subsequent releases) will introduce more-advanced 5G capabilities such as lower levels of latency, very high availability, and support for unlicensed spectrum bands. With each iteration, there will be new demands on the transmission network and the quality of fiber required. These will mainly consist of increased capacity to backhaul 5G base stations and support higher speeds; very low latency fiber connections for fronthaul links in a cloud radio access network; and more-extensive fiber to the curb to support dense city networks.
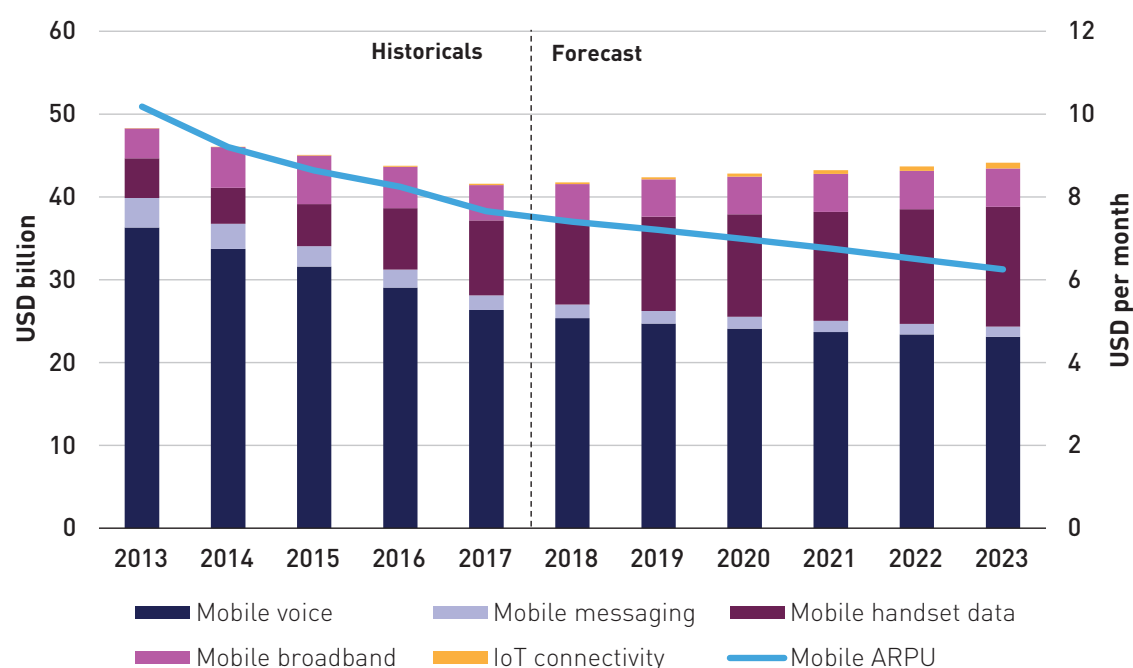
Figure 2.1: Mobile retail revenue by service type[i], and mobile ARPU, Middle East and North Africa, 2013–2023 [7]

[i] Mobile voice: service revenue from operator-billed voice services from mobile handset SIMs ; mobile messaging: service revenue from operator-billed mobile P2P (SMS and MMS) services from mobile handset SIMs ; mobile handset data: operator service revenue from data services accessed through mobile handset SIMs (does not include data revenue from mobile broadband or IoT services) ; mobile broadband: operator service revenue from mobile broadband connections, including all mobile broadband PC, laptop, netbook, or tablet connections via a USB modem, datacard or connected tablet device ; IoT connectivity: operator service revenue from mobile IoT (cellular, LPWA) connections.

Operators in GCC countries hope to gain a first-mover advantage and maintain their technology leadership by preparing for 5G. It is anticipated that 5G technology will support the data connectivity and digitalization aspirations of consumers and enterprises and expand on the current 4G capabilities in terms of latency, speed and network capacity to support a wide range of services and use cases.

2.2 Both the fixed and mobile segments are well suited to take advantage of 5G high capacity and bandwidth characteristics

In some GCC markets there has been steady and strong demand for mobile-connected tablets, dongles and personal MiFi devices as alternatives to fixed broadband services (or a complement to it). The market for mobile broadband services is expected to expand by 2.7 million between 2018 and 2023 across the whole GCC region (see Figure 2.2).

The growing adoption of data-hungry, high-quality, video and audio streaming services, accessible from a variety of smart devices (including tablets, laptops and TVs) will contribute to the rapid growth of data traffic. While network capacity enhancements introduced in 4G and 4.5G will be sufficient for most users in the short term, migration to 5G will help operators keep up with growing demand for data in the medium to long term.

Operators are investing in expanding their capabilities to better support the business segment

FWA (i.e. the use of wireless technologies to offer fixed broadband services) has also proved popular across the wider MENA region, mainly based on LTE and in underserved areas. But 5G will make FWA more commercially attractive in developed GCC markets too (for example, 5G-based FWA could help governments achieve national broadband targets more economically). The number of FWA connections across the GCC region is set to increase from 119 000 in 2017, to 386 000 in 2023.

The modest rate of growth in revenue from the consumer segment in the GCC region has prompted many operators to strengthen their ICT service propositions towards enterprises, in search of new revenue opportunities. Operators in the region have traditionally been well positioned in providing co-location and hosting services to medium and large enterprises (by leveraging their existing data-center infrastructure), as well as security services (as an extension of their connectivity business). More recently, however, they have increased their focus on pursuing emerging ICT opportunities, such as providing dedicated connections to large enterprises, cloud services (e.g. private cloud, hybrid cloud for medium and large enterprises), advanced security services (e.g. security consulting) and IoT.
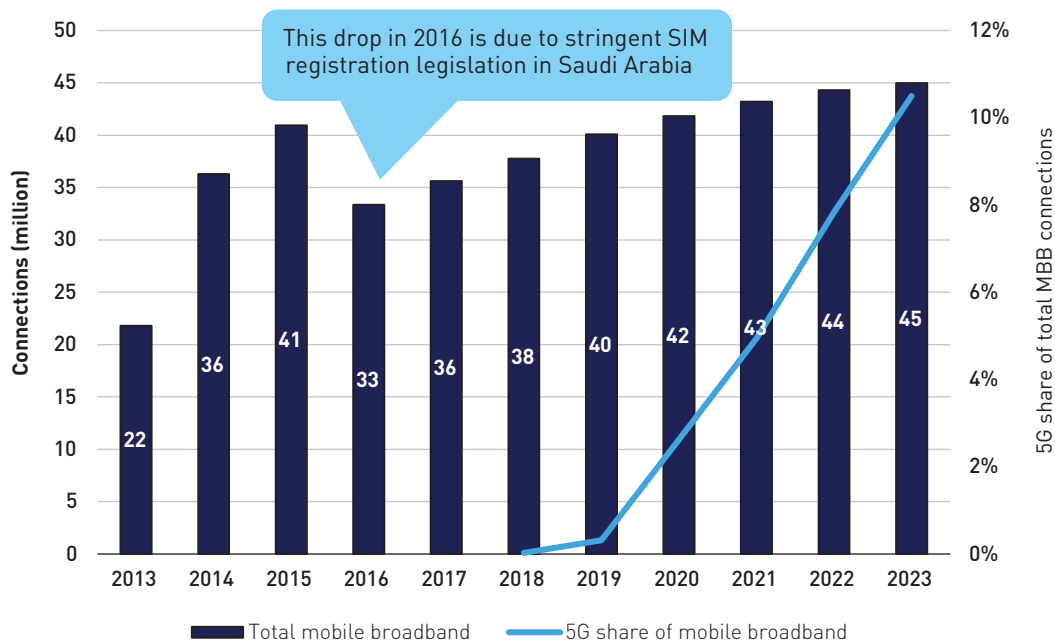
Figure 2.2: Mobile broadband connections forecast and 5G share of mobile broadband [7]

On the IoT front in particular, demand is expected to continue to emerge from the automotive industry (e.g. connected vehicles) and from government-led initiatives (such as smart-city projects) which can act as a catalyst for the adoption of IoT. IoT connectivity services will continue to be dominated by telcos given the high barriers to entry to the wide-area connectivity market and data rates will benefit from the enhancements introduced in 4G and 5G. Participation in parts of the value chain beyond connectivity carries more risk, but also generates higher revenue and, typically, higher margins.

2.3 **To address the opportunities, GCC operators have been investing in digital transformation**

The increased pressure from OTT players, the need to increase their agility and level of automation to quickly design and launch new digital services, and the necessity to reduce operating costs and improve efficiency have been pushing GCC operators to evolve into digital service providers.

Customer support functions are often one of the first areas to be 'digitalized' by operators. Digitalization of customer journeys helps with customer retention and costs (e.g. by reducing calls to call centers). There is also the perceived need to conduct business on a more

'digital' basis – many operators see digitalizing their customer services as the first step in increasing their involvement in, and developing, new consumer services akin to those provided by OTT players. A number of GCC operators have made good progress in digitalizing customer experience, such as by launching mobile self-help applications and websites. This entails using digital channels to deliver services and support, and offering a seamless experience across the different interfaces.

As part of this digital transformation, telcos are also adopting software-defined network (SDN) and network function virtualization (NFV), also known as telco cloud. It is expected that preparations for 5G launch will continue to accelerate the demand for telco cloud solutions in 2019. Major operators are leading the way in the GCC region and driving spending on these solutions. The telco cloud market is expected to be worth more than USD555 million in 2021, up from USD214 million in 2018 (see Figure 2.3).

The GCC operators have embraced digitalization to remain relevant and competitive
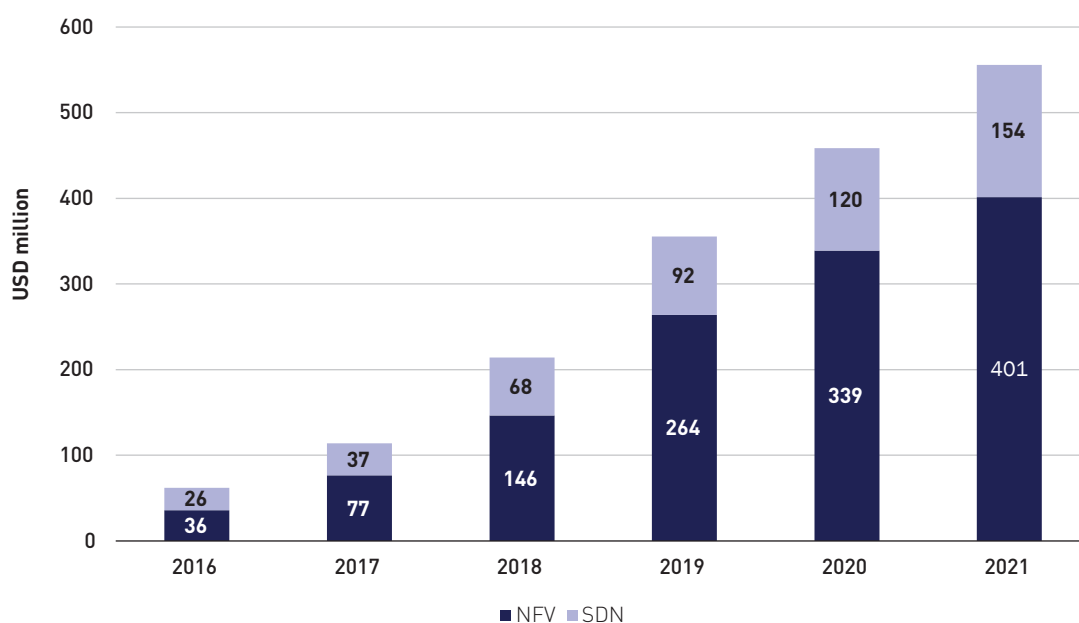
Figure 2.3: Mobile broadband connections forecast and 5G share of mobile broadband [7]

Chapter 3. 5G readiness index: the GCC region needs more 5G-focused vertical policies

3. 5G readiness index: the GCC region needs more 5G-focused vertical policies

To provide a view on the relative positioning of GCC countries in terms of promoting 5G development and commercial deployment, and identify potential gaps and best practice for regulators and operators, we have assessed their '5G readiness'. Our assessment is based on a set of criteria that our research indicates are relevant to the overall success of 5G in a given country.

We have grouped these criteria into two broad categories: regulatory readiness and operator readiness, as outlined in Figure 3.1 and Figure 3.2 below.

To identify additional best practices for GCC countries, we have also compared their 5G readiness against those of leading 5G-ready markets, including China, Japan, South Korea and the US.

Amount of 5G spectrum and timeline for release	• Total amount of spectrum being released for 5G • Amount of spectrum being made available in different bands (low, mid, high) • Timetable for spectrum being made available to operators for commercial use
Publication of 5G roadmap	• Publication of a detailed 5G roadmap with indication of bands to bemade available for 5G use and/or under study • Plans for equipment testing, schemes to facilitate early commercial trials, detailed schedule for spectrum release, etc.
Government backing and infrastructure policy	• Extent of proactiveness of national governments for 5G deployment • Government policies aimed at streamlining planning and easing early 5G infrastructure deployment
Vertical policies	• Publication of multi-annual national plans for the development of key sectors in the country (e.g. utilities, healthcare, smart cities, transport) • Importance of the role played by ICT in achieving roadmap objectives, and the extent to which technology-ena bled initiatives are being implemented today or ongoing

Figure 3.1: Regulatory readiness criteria.[i]

Operator trials and roadmap to launch	• Extent of 5G network and equipment trials conducted by operators and industry stakeholders to demonstrate 5G technology • Progress made by operators towards commercial 5G launch
Pre-existence of required infrastructure	• Extent to which operators already have an extensive 4G mobile network footprint • Extent of high-speed fixed broadband networks
Focus on customer happiness	• Progress being made by operators to offer a modern digital experience for customers • Includes the provision of self-service applications, social media/omni-channel support and delivery of personalised offers
Network operation automation	• Extent to which operators have implemented zero-touch automation in their network, including progress on network virtualisation, implementing orchestration, deploying a mature Self-Organizing Network (SON) and automated Network Operation Center (NOC), implementing closed-loop automation
Vertical readiness	• Operator engagements across other verticals to trial and deploy new technologies or services • Includes partnering on or leading projects in other verticals (e.g. smart cities, retail)

Figure 3.2: Operator readiness criteria.[i]

[i] Regulatory and operator readiness criteria developed by Analysys Mason. More detail on 5G readiness index methodology are provided in Annex C.

3.1 The GCC region hosts some of the most 5G-ready countries globally

The result of our 5G readiness index suggests that, on average, the GCC region is less advanced than the benchmark countries on both regulatory readiness and operator readiness criteria. However, the ranges of scores achieved by each of the GCC countries against these criteria is very wide; on average, the UAE is the most 5G-ready country in the region. Figure 3.3 shows the overall results from the index.

The most advanced GCC countries in terms of 5G regulatory readiness have spectrum available in the low, mid and high bands for the operators to trial and launch 5G services. In terms of operator readiness, the best positioned countries have already launched a 5G network (irrespective of its scale) and have a clear 5G deployment roadmap.
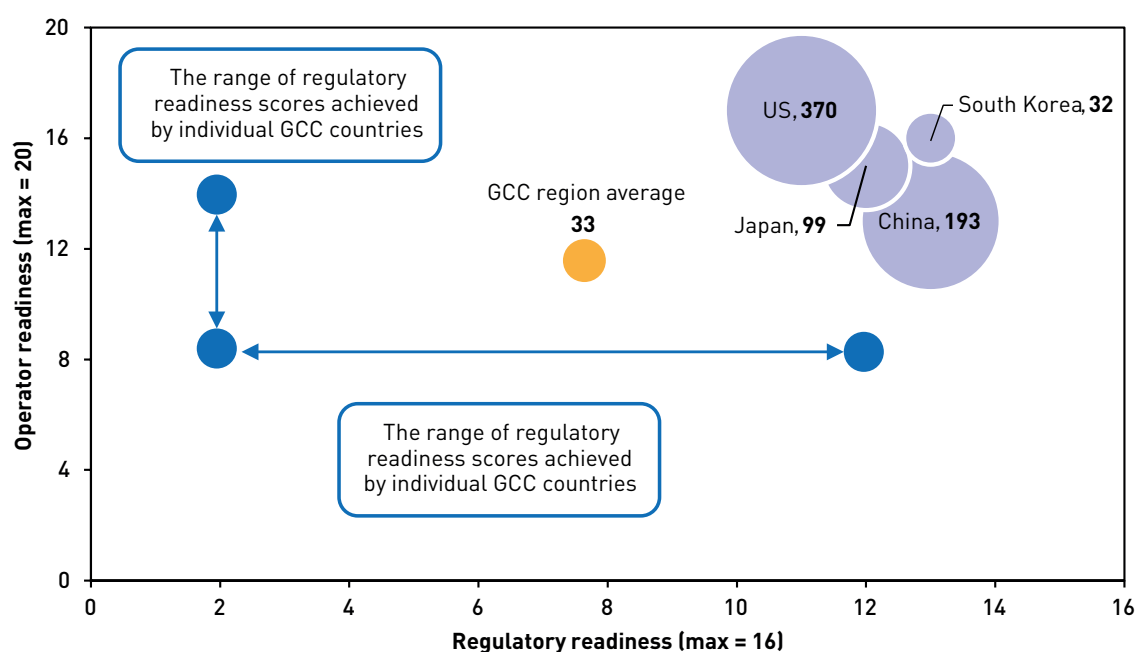
Figure 3.3: Summary of results from 5G readiness index[i]

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[i] Size of the bubble indicates the country total fixed and mobile service revenue as of 2018. More detail on 5G readiness index methodology are provided in Annex C..

3.2 Regulatory readiness: the GCC region needs more focus on industry vertical policies for 5G

As set out in Figure 3.1 earlier, we have identified four key criteria that describe a 5G-ready country and extrapolated a set of best regulatory practices, as shown in Figure 3.4.

The amount of spectrum and the timeline for its release are critical for 5G trials

The regulator must release the right amount of spectrum in the low, mid and high bands before 2020 so that 5G trials and a successful commercial launch can occur, in line with practice in the benchmark countries. Operators need clarity about this roadmap in order to plan effectively. Some GCC countries have already allocated 5G spectrum to the operators this year, while others are either at an early stage of planning or have not yet announced any plans to release 5G spectrum.

Operators need clarity from the regulators on 5G roadmaps

A successful 5G network trial and roll-out will only happen if operators are able to plan their activities, but this requires regulators to have roadmaps in place for regulations, digital policy and other factors, as well as spectrum release. This will enable operators to develop a strong commercial roadmap. In line with the benchmark countries, some GCC countries have a clear roadmap to assign significant mid- and high-band spectrum in the next few years, while others have not released any formal 5G roadmap documents. China and the US are two countries furthest ahead on this criterion, since they have published several broadly based digital strategy plans which are relevant to 5G technological development and commercialization.

Governments should have favorable technology and infrastructure development and sharing policies to streamline 5G investment by operators

Regulators should put policies in place aimed at encouraging new infrastructure developments and public infrastructure sharing, set regulatory policies to facilitate cross-industry collaborative testing and development, as well as direct funding for the development of 5G technology. In some GCC countries, governments have developed roadmaps to accelerate 5G deployment and have a dedicated team to bring regulatory authorities and operators together to discuss and plan the role that the government and regulator should play to facilitate commercial service launch. In other countries, government investment in 5G has been more limited, although there are significant investments in 5G technology enablers such as fiber.

AMOUNT OF 5G SPECTRUM AND TIMELINE FOR RELEASE
Sufficient spectrum suitable for 5G scheduled to be released in 2018, including mid- and high-band spectrum

5G ROADMAP PUBLISHED
Publication of a detailed timetable for low-, mid- and high-band spectrum allocation, as well as 5G roadmap strategy providing clear 5G ambition and indication of action plan / next steps

5G-READY REGULATOR

GOVERNMENT BACKING AND INFRASTRUCTURE
Large amount of 5G-specific investment, policies aimed at encouraging infrastructure development and public infrastructure sharing, as well as broader government backing of trials, research and cross-industry collaborative tests spectrum

VERTICAL POLICIES
Publication of multi-annual roadmaps for key verticals, with a clear description of the role played by ICT communications, 5G contribution to a substantial number of vertical sectors action plan / next steps

Figure 3.4: Best practices on regulatory 5G readiness

GCC governments have made efforts to develop vertical policies, but emphasis on 5G is missing

Through analysis of the different GCC countries, we have determined that the governments and regulators have developed long-term visions and roadmaps and that in most cases they are engaged with the operators; however, there are no specifics on how 5G networks will support the vertical policies.

High scores in this category are awarded to countries where regulators have published multi-year national plans for the development of key vertical sectors. It is also important that the published roadmaps specifically indicate how 5G will contribute to the partnerships with vertical sectors. The advanced countries with the highest scores are mainly Japan and South Korea, which have published several trade and industry initiative documents across the key vertical sectors, with detailed roadmaps and strategies to develop future economic and social systems. China and the US are not far behind these two countries.

3.3 Operator readiness: GCC operators should consider further investment in intelligent operating models and customer experience

In countries that are 5G ready from an operator perspective, all operators typically plan to deploy 5G commercially in 2018/2019, having invested significantly in fiber, virtualization, and automation and digitalization of customer-facing interfaces. Perhaps most importantly, all operators in a 5G-ready country must have already deployed some digital services in key vertical sectors. Figure 3.5 outlines best practices on operator 5G readiness in a country.

Most GCC operators have trialed and developed roadmaps for 5G launch in line with the benchmark countries

We have looked at public announcements by MNOs to evaluate how far operators have planned and carried out 5G trials and what their roadmaps are for 5G launch. A high score in this category indicates that a

TRIALS AND ROADMAP
All operators in the country are conducting extensive trials, across a range of bands and vendor solutions, and aim to launch commercial 5G in 2018/19

INFRASTRUCTURE
All operators have high nationwide FTTH penetration to ensure fibre backhaul infrastructure to achieve >Gbps speeds, nationwide 4G coverage for site re-use for rapid initial 5G roll-out

5G-READY OPERATORS

AUTOMATION
All operators have a virtualised network with orchestration in place, a matured SON deployment, a fully automated NOC and have achieved closed-loop automation

VERTICAL READINESS
All operators have deployed or trialled innovative services across key country vertical sectors, and have already engaged with 'non-traditional' sectors likely to benefit from 5G

DIGITAL EXPERIENCE
All operators offer advanced self-service apps, unified omni-channel support, personalised offers and automated service provisioning
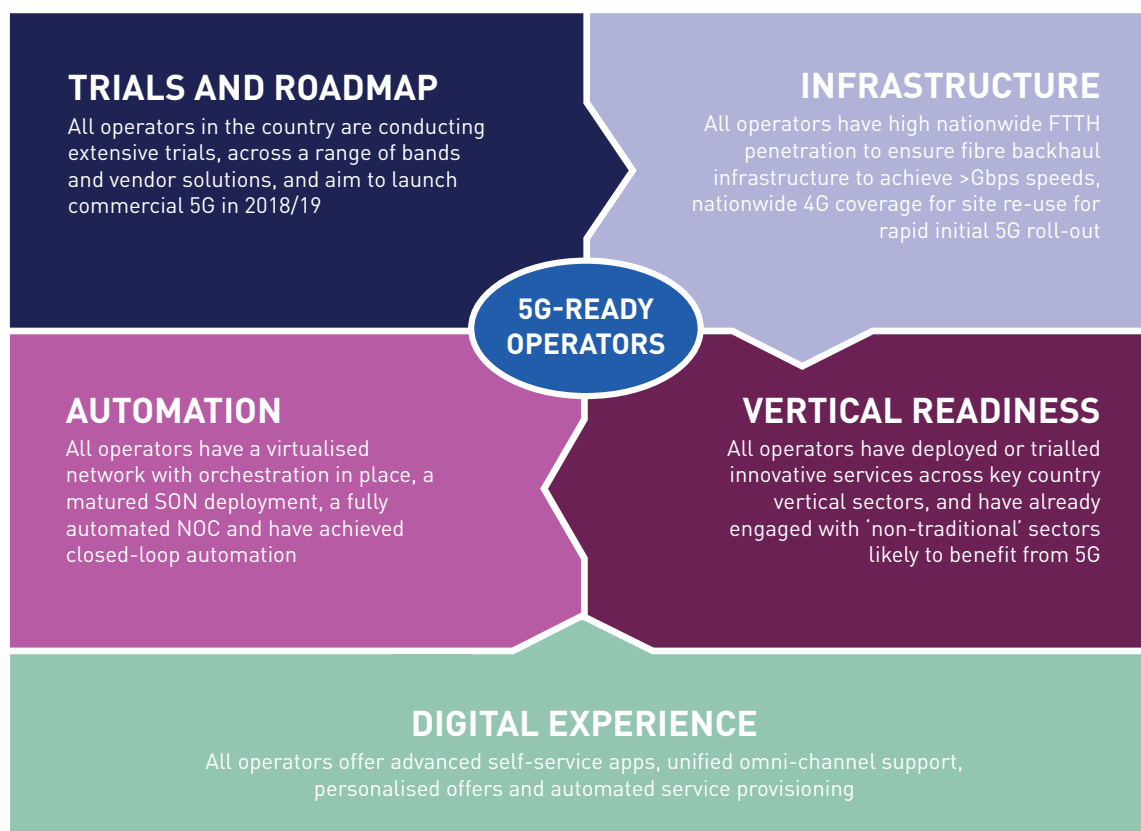
Figure 3.5: Best practices on operator 5G readiness

country's operators are committed to service launch before 2020. Some of operators in the GCC region have been carrying out 5G trials since 2016 and announced roadmaps to launch full 5G services during 2018/19. Other countries score slightly less because they have conducted fewer trials and plan to launch commercial services from 2020 onwards. The benchmark countries – particularly South Korea and the US – score highest, as they have run a significant number of trials and plan to launch services in late 2018 and early 2019, while China and Japan are set for later service launches in 2019 and early 2020.

GCC countries have extensive 4G and fiber coverage, two critical elements for successful 5G service launch

Access to mobile infrastructure sites for radio masts and fiber optics to connect these sites to MNOs' core networks are a pre-requisite for successful and timely 5G service launch. For this category we have taken a view on existing 4G coverage and the availability of fiber footprint for fixed broadband networks. The highest-scoring countries demonstrate high 4G coverage and nationwide fiber-to-the-home (FTTH) penetration. Operators need to develop the existing infrastructure to at least 90% for 4G coverage, including expansion of fiber to the base station, and FTTH. In at least three GCC countries all the MNOs provide close to 100% 4G coverage, and FTTH availability exceeds 90% of households.

GCC operators have a mixed performance on customer experience and should increase focus to drive customer satisfaction

The delivery of ultra-fast mobile broadband is only part of the 5G story. The commoditization of data and declining ARPU are constant challenges for most operators around the world. For this reason, operators must focus on improving customer experience and reduce churn. Our analysis of the GCC countries to understand their progress in offering a modern digital experience to customers indicates that most GCC operators have developed a basic self-service app with the ability to provide bill and usage view; however, only some have developed an advanced version which would enable changes to be made to tariff plans. Also, few operators are able to deliver personalized offers or have developed automatic capabilities within customer care and marketing departments. A top score in this category would require the provision of a fully digitalized app with full omni-channel capabilities that meets the major needs of the consumers.

GCC countries have taken bold enough steps with network operations automation, but need to focus on building intelligent operating models

The opportunity to virtualize the network is one of the key transformations that will be enabled by 5G architecture. If operators are to take full advantage of 5G capabilities such as network slicing and edge computing, they need to adopt NFV, SDN technologies and platform capabilities. Many trail-blazing operators have already embarked on the virtualization journey, based on 4G network elements. Such operators will gain the full benefits of a virtualized network and will be able to introduce new revenue-generating services sooner.

In most GCC countries, operators are at the beginning of their network virtualization and automation journeys, and so the average GCC score on this criterion is rather low. Among the benchmark countries, most have been on the virtualization journey for several years and have performed trials and accumulated learnings. These operators understand that the road to network virtualization and automation is long, requiring both operational and organizational changes.

Only a few GCC operators have taken steps to partner with vertical sectors

As previously discussed, involvement with vertical sectors must be a priority for operators, and those that develop these relationships with industry sectors (such as enterprise and healthcare) to trial projects will be best placed to deliver early benefits. The highest scores in this category are awarded to those countries where all operators have deployed or trialed services with key vertical sectors. Among the GCC countries, two have achieved high scores, as their operators have engaged businesses in several key vertical sectors (such as retail, smart cities and energy). In other GCC countries, however, operators have had limited or no exposure to other industries. Activities in the IoT area (e.g. connected cars, video surveillance, telemedicine, smart metering, and energy data management) are the most common.

3.4 GCC governments can play a significant role in creating the environment for 5G to achieve these goals

Governments and regulators in the GCC regions can make a significant contribution to the ability of operators and enterprises to leverage 5G, and thus deliver benefits for the whole society and economy. Some leading 5G-ready markets provide examples of best practice. Best practices from our 5G readiness analysis fall into four main categories:

- **National policy and vision.** A government can position 5G at the centre of national ICT strategy and economic vision, because 5G will be a critical enabler of many socio-economic objectives. Where its vision is very ambitious, a government can consider new investment models, including public–private partnership (PPP), to remove some of the burden of financing the networks from operators, and so accelerate deployment.

- **Spectrum and regulation.** Early access to 5G spectrum, in bands which support early use cases effectively, and at affordable cost, is an essential enabler of timely roll-out. Other areas of regulation are also important, and may involve government departments beyond telecoms – for instance, local planning regulations should be simplified to ease access to new sites for city networks; departments such as transport, agriculture and industry can review their own regulations with a view to lowering barriers to deployment of 5G services in these sectors.

- **Testbeds and innovation zones.** An important government role is to facilitate, and help fund, testbeds, sandpits and innovation zones, in which operators, enterprises and other stakeholders can evaluate the real impact of 5G capabilities and trial services. This creates a knowledge base and increased confidence to launch new services.

- Sustainable ecosystem. Governments are in a strong position to facilitate understanding, partnerships and shared investments, between operators and other entities. These include: vertical industry players and their supply chains; start-ups and other innovators; application developers and others engaged in 5G-enabled value chains. If a government drives a strong early ecosystem, there should be a 'snowball effect', with those first connections leading to wider and richer ecosystems.

In summary, our 5G readiness benchmark analysis suggests that the GCC region is behind the leading 5G countries on both regulatory readiness and operator readiness criteria, with the UAE being, on average, the most 5G-ready country in the region. To truly benefit from the vast 5G opportunity discussed in Section 1, GCC countries will have to address the readiness gaps and become as 5G ready as possible as soon as possible. In particular, the region needs more focus on industry vertical policies for 5G. In the following section we analyze the most attractive 5G use cases, with particular focus on those use cases that operators should favor in the next ten years.

5G leadership country	Examples of best practice	Government role
USA	Spectrum Frontiers program and 5G Fast Plan	FCC drives early release of new spectrum, including m-wave
	Multi-city testbed: Platform for Open Wireless Data-driven Experimental Research (POWDER)	National Science Foundation funds of USD27.5 million, working with cities and universities
	US DOT Connected Vehicle Testbed	Funding up to USD100 million in two waves from DOT, facilitator of co-operation between auto industry, operators and others
UK	5G testbeds and trials program – five testbeds in place in phase one	Government committed GBP16 million to first phase of testbeds
	5G innovation center established at University of Surrey	Public–private partnership to facilitate advanced 5G technology development, tests and ecosystem development
South Korea	Government investment in 5G technology and deployment	USD1.5 billion committed over 2014 to 2020 to co-fund developments by local organizations and accelerate operator trials and deployments
European Union	EU 5G-PPP	Joint initiative with ICT, telecoms, enterprise and academia. EUR1.4 billion to fund two phases of R&D and trial projects
Germany	BMVI (5G Network Initiative for Germany), 2017–2022	Five elements – invest in infrastructure, release spectrum, support 5G R&D, facilitate links between operators and applications industries, drive energy efficient networks

Figure 3.6: Examples of government-supported testbeds and trials in countries taking a strong lead in 5G

Chapter 4. Platform thinking will enable large numbers of new services – don't wait for the 'killer' 5G app

4. Platform thinking will enable large numbers of new services – don't wait for the 'killer' 5G app

4.1 Operators with serious plans for digital transformation and 5G have platform- and ecosystem-driven strategies

To really benefit from 5G capabilities, telcos need to tie their 5G vision and roadmap closely to their digital transformation strategies. Traditional business models and 'ways of doing things' will not enable 5G opportunities for operators. Network slicing, the key enabler of 5G use cases, will revolutionize business models and service pricing.

Operators, and the industry as a whole, should not be looking for a single 'killer' 5G use case; rather, operators will need the agility that digital transformation will bring about to enable and benefit from many possible 5G digital services, through new partnerships and new models.

To date, only the most advanced operators, with aggressive digital-transformation strategies, have experimented with both offering digital services themselves and enabling third parties in their communities or ecosystems to offer services: most other operators still earn the bulk of their revenue from traditional connectivity services. While the current 'digital service enablers'[i] are working towards becoming 'digital service providers', in our view no telecom operator globally has fully transformed into one just yet.

We believe that, alongside network virtualization and modernization of the customer experience, 5G is one of the key tools that will help operators transform into digital service providers. However, 5G should not be considered outside the context of ambitious digital transformation plans. The notion that 5G, virtualization, platform thinking, and ecosystem are inseparable components of operators' transformation journeys is captured well in a recent statement by Enrique Blanco, Telefónica's Chief Group Technology and Information Officer [9]

technology platform and an ecosystem of partners around it, they will become agile enough to try out many different 5G use cases involving minimal time to market, not much risk and limited additional cost. Furthermore, they will be able to 'cherry-pick' services and features offered on their platform and make targeted investments to deliver those services in an end-to-end fashion (as illustrated in Figure 4.1).

Below, we discuss various 5G use cases that are already available to operators or will become available in the next several years. We then discuss their relevance for the GCC region.

"Telefónica remains committed to the development of 5G technology, which will necessarily open up our telecommunications ecosystem to a wide range of vertical industries. We have devoted many years to creating and transforming our networks, because we understand that it is essential to be flexible and scalable, and because only through virtualization we can respond to the requirements posed by the industry, which are radically varied and even contradictory among themselves"

As operators virtualize their networks, build a strong
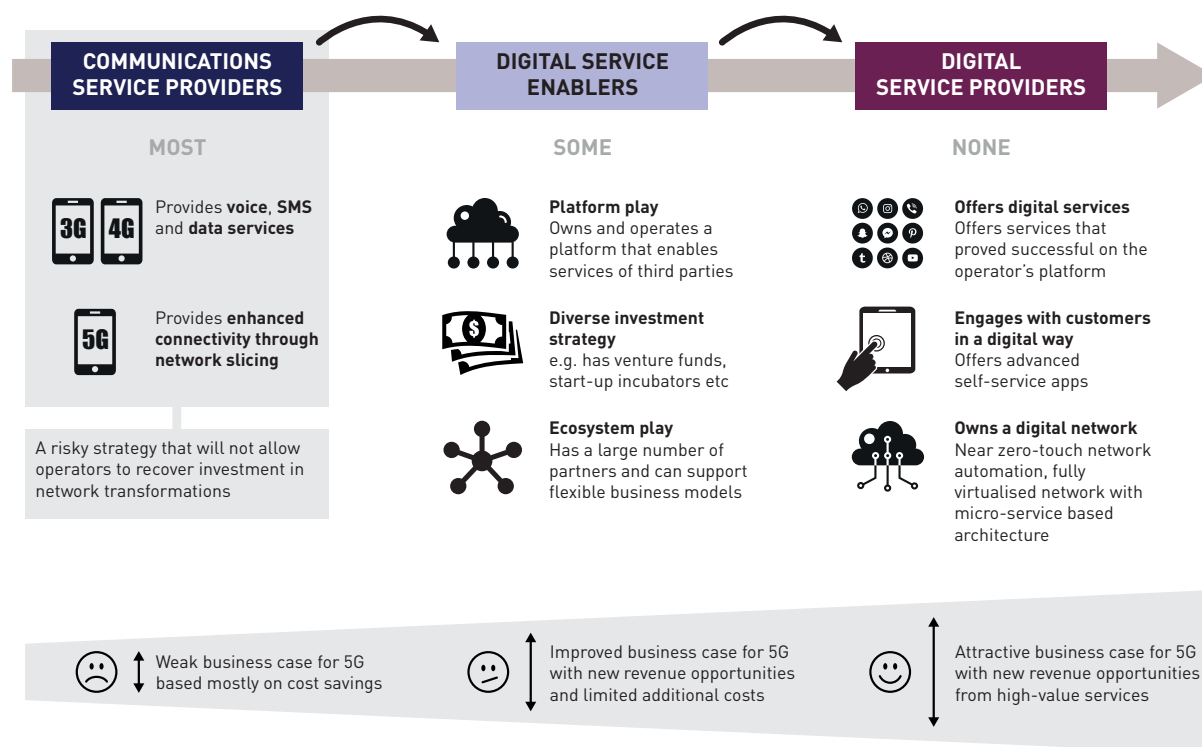
Figure 4.1: Operators' digital transformation path and the link to 5G opportunities

4.2 Operators can pursue a large and growing number of possible 5G use cases

Over 50 5G use cases could be attractive to GCC operators

Our in-depth analysis of the available 5G use cases and trials suggests that there are more than 100 use cases solving urgent business and societal problems in today's world which could see significant performance improvements when migrated from legacy 2G/3G/4G networks to 5G (e.g. remote patient monitoring, in-car video entertainment), or which can only work with 5G (e.g. remote surgery, remote control of factory robots). Annex B provides a list of 50 use cases that may be the most attractive across key vertical sectors.

Operators will need to prioritize 5G use cases, particularly in the short term

Given the many possible industries that could benefit from 5G and the variety of use cases in each industry segment, many operators may struggle to identify those 5G use cases that may be relevant to them in the short, medium and long term. When selecting use cases to focus on, operators will have to consider a range of factors: such as their existing relationships, the services they currently offer to industry segments, the technology requirements of particular use cases, the investment requirements, and the revenue opportunities presented by each use case. Some of these considerations will become irrelevant once operators' networks are fully virtualized and their operations fully automated – at that point, operators will be able to trial and offer many new services at the same time, with relatively little risk and incremental investment. However, in the first three to five years of 5G deployment it will be crucially important for operators to sequence the deployment of use cases in the optimum way.

Figure 4.2 provides a possible sequence for deployment

2019 - 2022	eMBB	FWA	Location analytics services	Remote patient care	Facial recognition smart CCTV
	5G in-vehicle entertainment	VR for live video streaming	VR for on-demand video streaming		Wireless smart grid
	Wearables for crowd management		5G-based V2X services		Drones for inspection
2023 - 2025	VR for telemedicine		Immersive VR for gaming		Ultra-high frequency mobile trading
	Blockchain-based banking		AR for operations support		Precision farming
2026 - 2030	AR for financial data visualisation		Remote surgery		VR for enterprise live training
	V2X services for self-driving cars			Remote control of factory robots	

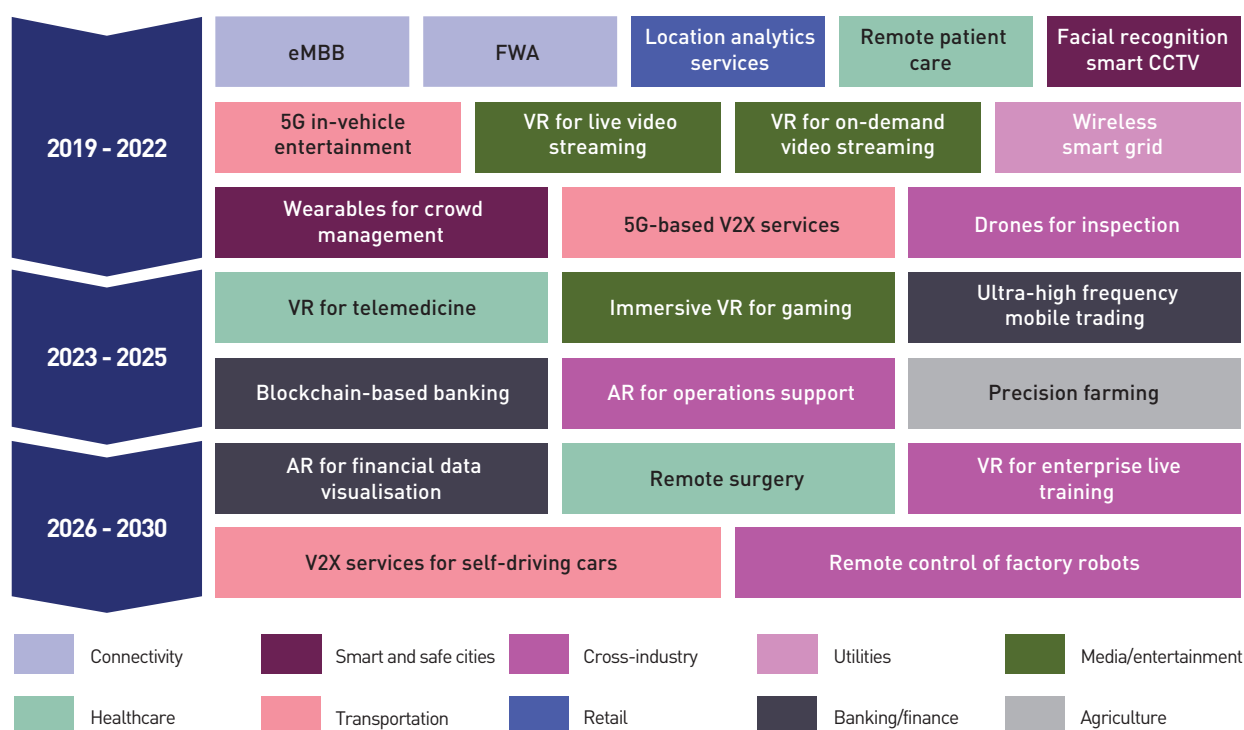|				
Connectivity	Smart and safe cities	Cross-industry	Utilities	Media/entertainment
Healthcare	Transportation	Retail	Banking/finance	Agriculture

Figure 4.2: Variety of 5G use cases that will become available to GCC operators in the next ten years

of 5G use cases over a ten-year period for GCC operators to consider, broadly based on the overall size of each industry sector (e.g. larger sectors such as transportation likely to be addressed first), operator relationships with customer segments (e.g. consumer segment more familiar than enterprise), and the timing of availability of underlying technologies (e.g. self-driving cars unlikely to see significant adoption until after 2025). This sequence will need to be adjusted slightly for individual GCC countries, to reflect the specific macro-economic context and industries in each market. For instance, while agriculture may not be a priority area for the UAE, it may matter slightly more for Saudi Arabia.

4.3 GCC should focus on 5G use cases delivering the highest benefits in the short term and consider smaller-scale initial deployments to generate essential knowledge

The ten most attractive short-term 5G use cases for the GCC region are presented in Figure 4.3. Not all of them will be equally attractive across all countries, though the two media/entertainment use cases (VR for on-demand

video streaming and VR for 4K/8K live video streaming) should be considered by most operators in the region. Mobile VR will offer flexibility, user convenience and higher connectivity bandwidth to deliver a high resolution with a 360-degree immersive user experience which is difficult to achieve with fixed / short-range wireless VR solutions.

Similarly, transportation and smart- and safe-city use cases are attracting a lot of attention among governments, operators and enterprises in the region. Some of the use cases below (particularly the smart- and safe-cities ones) can be tested and launched on a small scale, covering smaller areas such as key districts of large cities. Such an approach provides operators with key learnings that they can apply as they expand their coverage.

As noted at the very beginning of this section, to really

benefit from 5G capabilities, operators will need to tie their 5G visions closely to their digital transformation strategies. Only operators that transform into digital service providers, and deliver fully automated network slices for tens of different use cases simultaneously, will be able to benefit from a strong 5G business case. This is because 5G will be much more about enabling a variety of use cases than about one or two new 'killer' apps. In fact, we have identified more than 50 5G use cases that we believe will be attractive for GCC

operators. However, operators in the region (and elsewhere) will have to adopt platform thinking and intelligent operating models if they wish to address these use cases and reach the scale and agility needed for 5G success. These profound changes that operators will have to go through in the next five to ten years are discussed in Sections 5 and 6 below.

Vertical		Key Use Case
1	Connectivity	• eMBB • FWA
2	Media/Entertainment	• VR for on-demand video streaming • VR for 4K/8K live video streaming
3	Transportation	• 5G-based V2X services
4	Smart & Safe Cities	• Face-recognition cameras & analytics for CCTV • Location analytics services
5	Cross-Industries	• Remote control of drones for inspection
6	Manufacturing	• Long-range (remote) control of factory robots • AR for support to industrial operations
7	Utilities	• Smart grid
8	Healthcare	• VR-based telemedicine

Figure 4.3: Key short-term 5G use cases for the GCC region

Chapter 5. An intelligent operating model will enable operators to maximize their roles in many 5G-enhanced value chain

5. An intelligent operating model will enable operators to maximize their roles in many 5G-enhanced value chain

The previous section highlighted the top-priority 5G use cases for GCC operators, as well as the roadmap operators should adopt in order to support these applications (and future additional services). This section discusses how 5G will enable operators to support multiple use cases, in multiple vertical industries, with very different requirements, all from the same network.

Compared to 4G, two changes are essential to make a successful 5G business case:

• The operator must take on a wider variety of roles within an industry value chain, moving beyond connectivity

• The operator must support a high diversity of industries and services from a single platform.

Together, these two transitions will greatly increase the addressable market for a 5G operator, but both require a unified, flexible digital platform which allows such a large number of opportunities to be targeted without fragmentation of the operator's efforts and investments.

5.1 Operators can target brand new roles and expand their value-chain presence in new digital services

While operators will likely pursue the 'low-hanging fruit' of the connectivity role first, achieving some short-term return on investment (ROI) in their 5G network, most operators will expect to expand their role across other elements of the value chain to increase their addressable market and generate additional revenue (see Figure 5.1 below for a typical mobile services value chain). They will target different roles in different value chains, depending on the priority they are assigning to the industry, or the balance of opportunity and risk in different verticals.

Operator surveys carried out by Analysys Mason indicate that the most common approach will consist of four key stages, as illustrated in Figure 5.2. In some

cases these may be implemented over several years, while in others, some stages will happen in parallel.

AT&T is investing significantly in the telco vision outlined under role 4 in Figure 5.2. When discussing AT&T's recent acquisition of AR company Magic Leap, AT&T's Communications CEO John Donovan stated the following:[10]

"AT&T is excited to pair our pioneering technologies, unmatched network, content platform, and vast customer ecosystem with Magic Leap's efforts to build the next generation of computing […] We're designing and offering the future of entertainment and connectivity, and this exclusive arrangement – in combination with our 5G leadership position – will open up new opportunities and experiences"

To move further along the value chain and assume some of the roles discussed above, operators will need to achieve several challenging milestones, including:

• **Building sales and marketing organizations** with deep understanding of the business requirements of the relevant vertical industries

• **Enhancing the network** with capabilities which are important to a specific vertical, but may not be supported in the first wave of 5G technologies (e.g. ultra-low latency)

• Ideally, **developing a dedicated virtualized network slice** for the relevant vertical, which will require significant changes to the platform architecture

• **Negotiating a wide range of partnerships** with vertical-specific players such as applications providers and automotive manufacturers. This may involve acquisitions.
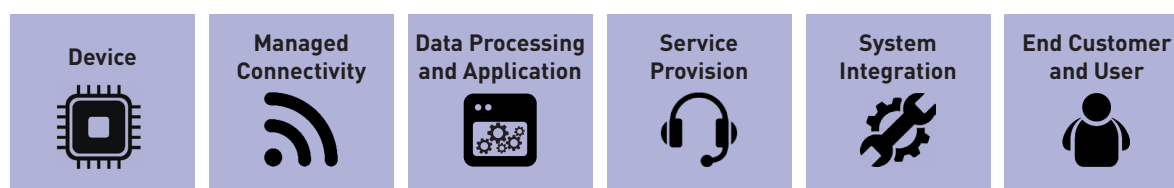
Device	Managed Connectivity	Data Processing and Application	Service Provision	System Integration	End Customer and User

Figure 5.1: Overview of the digital value chain of a typical 5G service

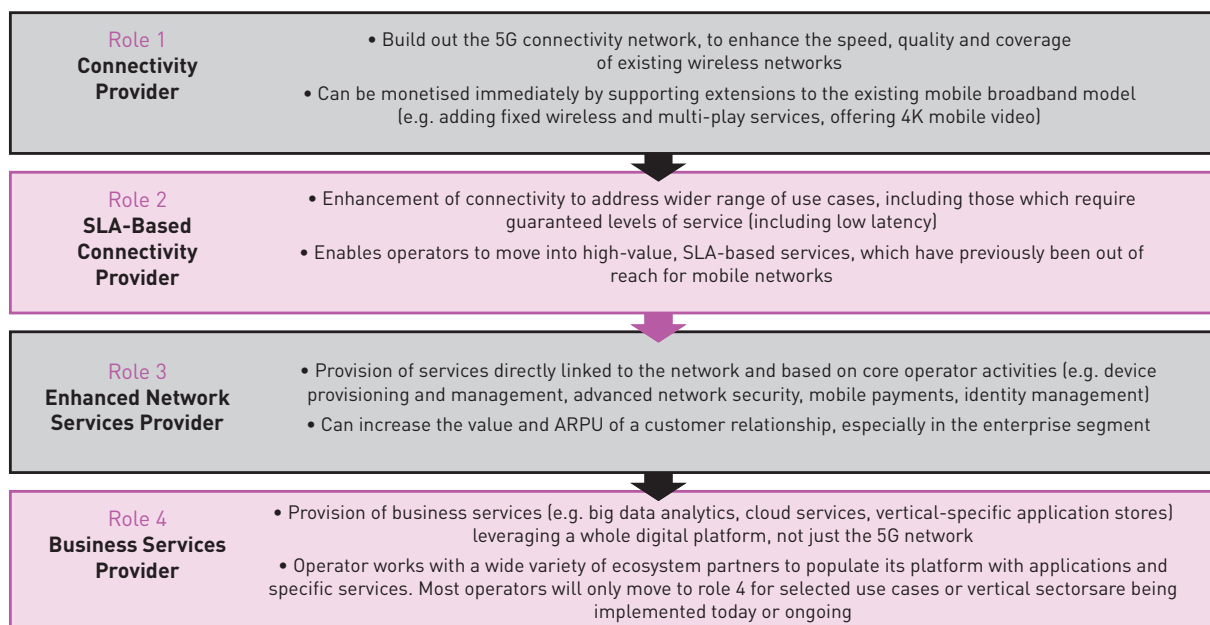|	
Role 1 **Connectivity Provider**	• Build out the 5G connectivity network, to enhance the speed, quality and coverage of existing wireless networks • Can be monetised immediately by supporting extensions to the existing mobile broadband model (e.g. adding fixed wireless and multi-play services, offering 4K mobile video)
Role 2 **SLA-Based Connectivity Provider**	• Enhancement of connectivity to address wider range of use cases, including those which require guaranteed levels of service (including low latency) • Enables operators to move into high-value, SLA-based services, which have previously been out of reach for mobile networks
Role 3 **Enhanced Network Services Provider**	• Provision of services directly linked to the network and based on core operator activities (e.g. device provisioning and management, advanced network security, mobile payments, identity management) • Can increase the value and ARPU of a customer relationship, especially in the enterprise segment
Role 4 **Business Services Provider**	• Provision of business services (e.g. big data analytics, cloud services, vertical-specific application stores) leveraging a whole digital platform, not just the 5G network • Operator works with a wide variety of ecosystem partners to populate its platform with applications and specific services. Most operators will only move to role 4 for selected use cases or vertical sectorsare being implemented today or ongoing

Figure 5.2: Typical progression of a mobile operator 5G operating model

Developing a sliceable platform and a new partnership ecosystem are the most important and challenging milestones for operators wishing to expand their operating model towards the most ambitious roles (roles 3 and 4). Adoption of roles 3 and 4 will require time and investment, hence the need to proceed in a step-by-step fashion, expanding the business model over the course of four to five years. Operators which start planning a new platform and a new ecosystem now can expect to gain major advantages in terms of market scale, future growth potential, first-mover advantage, and the ability to defend themselves against new competitors.

5.2 A digital, sliceable platform is critical to 5G success

It is critical to 5G success that an operator can support many use cases and industries. There is no 'killer app' for 5G, and each individual new service may deliver limited incremental revenue (compared to the core case of mobile broadband). The key to success is a virtualized, highly automated network and services platform, which will support network slicing. With a sliceable platform, operators can achieve the scale to support hundreds of different use cases from a single base, which cumulatively will transform revenues while radically reducing the cost of delivery.

A sliceable platform will facilitate expansion and interaction with other parts of the value chain

Today's networks have a uniform architecture that cannot be optimized to address the needs of individual services and ecosystems. In contrast, virtualization technologies can 'slice' the physical network into multiple, separate virtual networks, which provide differentiated latency, performance, reliability, availability and other characteristics, tuned to the needs of each use case/service. Different partners and service providers can be supported within each slice, which will automatically define the interfaces and relationships between the operator platform and third parties.
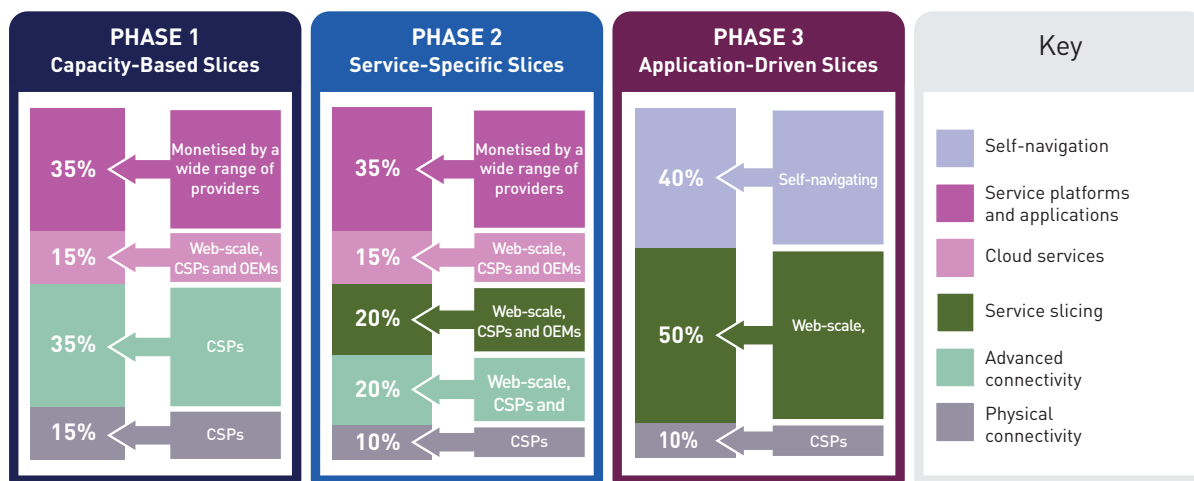
Figure 5.3: A sample value chain, with the opportunity for operators to move along the value chain by deploying successive generations of slicing

Network slices are created on demand and independently controlled, managed and customized, with a degree of isolation that could previously only be achieved with dedicated physical networks. As a result, partners can be integrated into the network platform with little integration effort. Network slicing will also enable an operator to expand its role from connectivity to other areas of the value chain (such as cloud and edge services, orchestration, and applications). In these areas, it will face new competitors too (as Figure 5.3 shows), and will have to fight harder for its new value-chain role. Having a high-quality 5G network will be a significant competitive asset against alternative providers.

Transitioning towards a 5G sliceable platform will require profound changes to OSS/BSS[i]

To develop network slicing capabilities, operators will need to implement a number of changes to their architecture, operational and business processes. Figure 5.4 provides an overview of the key steps and technologies required for operators to develop an intent-based operational interface and simplify their BSS processes.

[i] OSS refers to Operations support systems and BSS to Business support systems

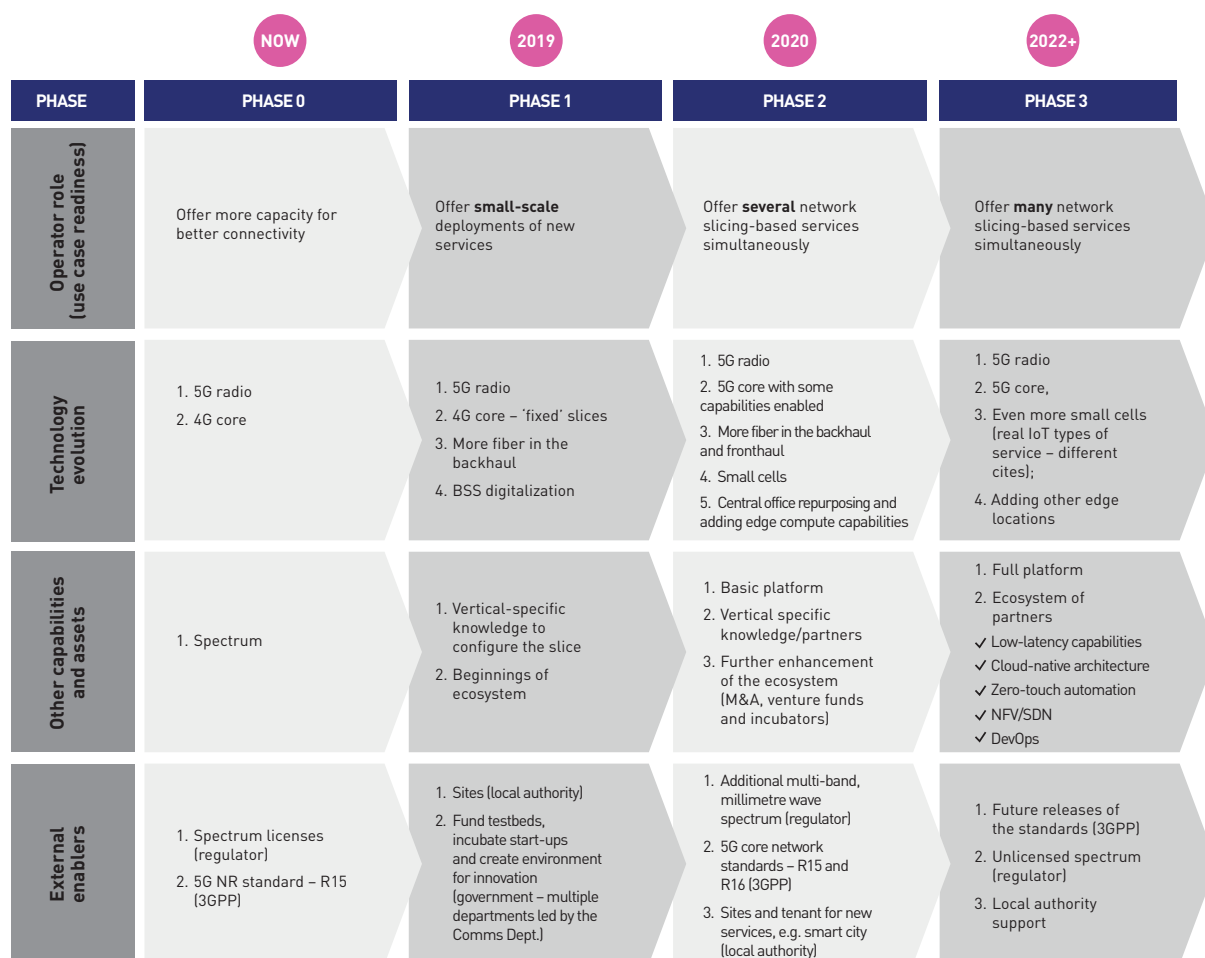|	NOW	2019	2020	2022+
PHASE	**PHASE 0**	**PHASE 1**	**PHASE 2**	**PHASE 3**
Operator role (use case readiness)	Offer more capacity for better connectivity	Offer **small-scale** deployments of new services	Offer **several** network slicing-based services simultaneously	Offer **many** network slicing-based services simultaneously
Technology evolution	1. 5G radio 2. 4G core	1. 5G radio 2. 4G core – 'fixed' slices 3. More fiber in the backhaul 4. BSS digitalization	1. 5G radio 2. 5G core with some capabilities enabled 3. More fiber in the backhaul and fronthaul 4. Small cells 5. Central office repurposing and adding edge compute capabilities	1. 5G radio 2. 5G core, 3. Even more small cells (real IoT types of service – different cites); 4. Adding other edge locations
Other capabilities and assets	1. Spectrum	1. Vertical-specific knowledge to configure the slice 2. Beginnings of ecosystem	1. Basic platform 2. Vertical specific knowledge/partners 3. Further enhancement of the ecosystem (M&A, venture funds and incubators)	1. Full platform 2. Ecosystem of partners ✓ Low-latency capabilities ✓ Cloud-native architecture ✓ Zero-touch automation ✓ NFV/SDN ✓ DevOps
External enablers	1. Spectrum licenses (regulator) 2. 5G NR standard – R15 (3GPP)	1. Sites (local authority) 2. Fund testbeds, incubate start-ups and create environment for innovation (government – multiple departments led by the Comms Dept.)	1. Additional multi-band, millimetre wave spectrum (regulator) 2. 5G core network standards – R15 and R16 (3GPP) 3. Sites and tenant for new services, e.g. smart city (local authority)	1. Future releases of the standards (3GPP) 2. Unlicensed spectrum (regulator) 3. Local authority support

Figure 5.4: Key technology and business transformation activities required to develop a 5G-enabled network slicing platform

Operators should aim to pursue 'best practices' in terms of technology implementation to improve the total cost of ownership, achieve streamlined operations, and ultimately ease the transition to a 5G slicing platform. These best practices are summarized in Figure 5.5 below.

Technology	Description	Maturity
Cloud-native architecture	• A modern software architecture where internal application programming interfaces (APIs) replace the three-tiered client-server architecture, creating a set of microservices for internal and external use and carrying the data in a journaled manner • More compute-intensive but provides far greater flexibility than existing approaches. Everything becomes a service that is available internally and (with proper security) can be made available as an external service	Proven in FANGA (Facebook, Amazon, Netflix, Google, and Apple) applications
DevOps	• An extension of the 'agile' software development methodology to include the post-implementation 'operations' phase where developers move to support the operational deployment phase, not just the build and test phase of the project	Agile has been proven. DevOps is looking good, but requires extensive retraining
Continuous integration/ continuous delivery (CI/CD)	• A software delivery methodology that, coupled with cloud-native architecture and DevOps, provides a continuous stream of bug fixes and feature evolution • Obviates the need for lengthy integration and includes highly automated regression testing	In use in FANGA. Being trialed by many CSPs today
Cloud deployment	• Deployment of the software on modern, virtualized data-center infrastructure. Could be on-premises, hybrid, or public cloud • Also includes managed services and software-as-a-service (SaaS) deployments on private clouds	Proven in enterprise. Moving quickly in CSPs
Artificial intelligence	• Encompassing a wide range of techniques, from well-understood big-data analytics and robotic mechanization to evolving deep search and machine learning through leading-edge natural language interfaces, cognitive computing and neural networks	Evolving very quickly in all industries

Figure 5.5: Software technologies for next-generation 5G operation

5.3 To succeed in 5G, operators need to start building their ecosystems now

It will be highly challenging for operators to take on an increasing variety of roles, in a rising number of vertical value chains. This multi-vertical 5G strategy will not be scalable and profitable if operators negotiate and manage every application or services partnership individually and manually. Instead, they need to be able to on-board and support a large number and variety of ecosystem partners as quickly and automatically as possible. Ultimately, operators' platforms will be the focal point of the ecosystem; as a minimum, they will need to offer self-service connectivity functions, as well as a catalogue of partners/services, advanced analytics and billing (partner settlement) functions.

To achieve this, there are some basic enablers which can be implemented immediately, such as a set of open APIs to connect any third-party software or service to the operator's platform. But the real breakthrough will come with slicing. A fully programmable, adaptive and sliceable platform will help them to support a wide variety of partners automatically and flexibly, within a single slice. This is illustrated in Figure 6.6, using the example of the automotive sector. The operator may build specific slices and sub-slices to support different players in a value chain – in the case of automotive, this might be an auto services provider, or a car manufacturer. In parallel, the operator can build sub-slices in which to offer high-value services such as fleet management for autonomous vehicles.

Network slicing will therefore underpin an intelligent 5G operating model, which will support the following features not available from the traditional model:

- **Massive scalability** to support hundreds of use cases, to maximise total revenue potential

- **A unified and automated framework** to support a huge diversity of ecosystem partners

- Maximum ability to **leverage the performance advantages of the 5G network,** e.g. by supporting SLA[i]-based network services for the first time

- **Flexibility to address new use cases** (even unforeseen ones) as they emerge, quickly and cost effectively, and to move away from those that fail without significant damage.

To craft an optimal 5G ecosystem, operators will need to balance their investment-driven activities (e.g. M&A, venture funds and incubators), marketing activities aimed at attracting new partners to the ecosystem, and organic growth through the development of their own production capabilities. Operators that have been successful in their growth strategies include:

- **AT&T,** which has used a mix of acquisitions over a decade to build an extensive portfolio of ICT capabilities, ranging from new business in healthcare to specialized products and personnel. This expansion has allowed AT&T to progressively offset some of the decline in legacy services, particularly fixed voice: ICT services accounted for almost 50% of its total fixed enterprise revenue as of 4Q 2017

- **Telefónica,** which has augmented and differentiated its ICT portfolio through an array of acquisitions to gain specific capabilities (e.g. technology, people), particularly related to security. Telefónica's approach appears to have been successful, with the decline in traditional enterprise connectivity partially offset by strong growth in ICT services.

In this section we have discussed the capabilities that operators must build in order to address 5G use cases and unlock the opportunities promised by digital transformation. A fully transformed operator will have an automated digital sliceable platform, a fully virtualized network, new operating models underpinned by DevOps and CI/CD and will be an ecosystem owner. While these are long-term goals for operators, we believe they need to begin working towards these goals as soon as possible, if they have not already made a start. In Section 7 below we discuss the importance of 5G platform for operators and present the key findings from our 5G business case analysis.

Key

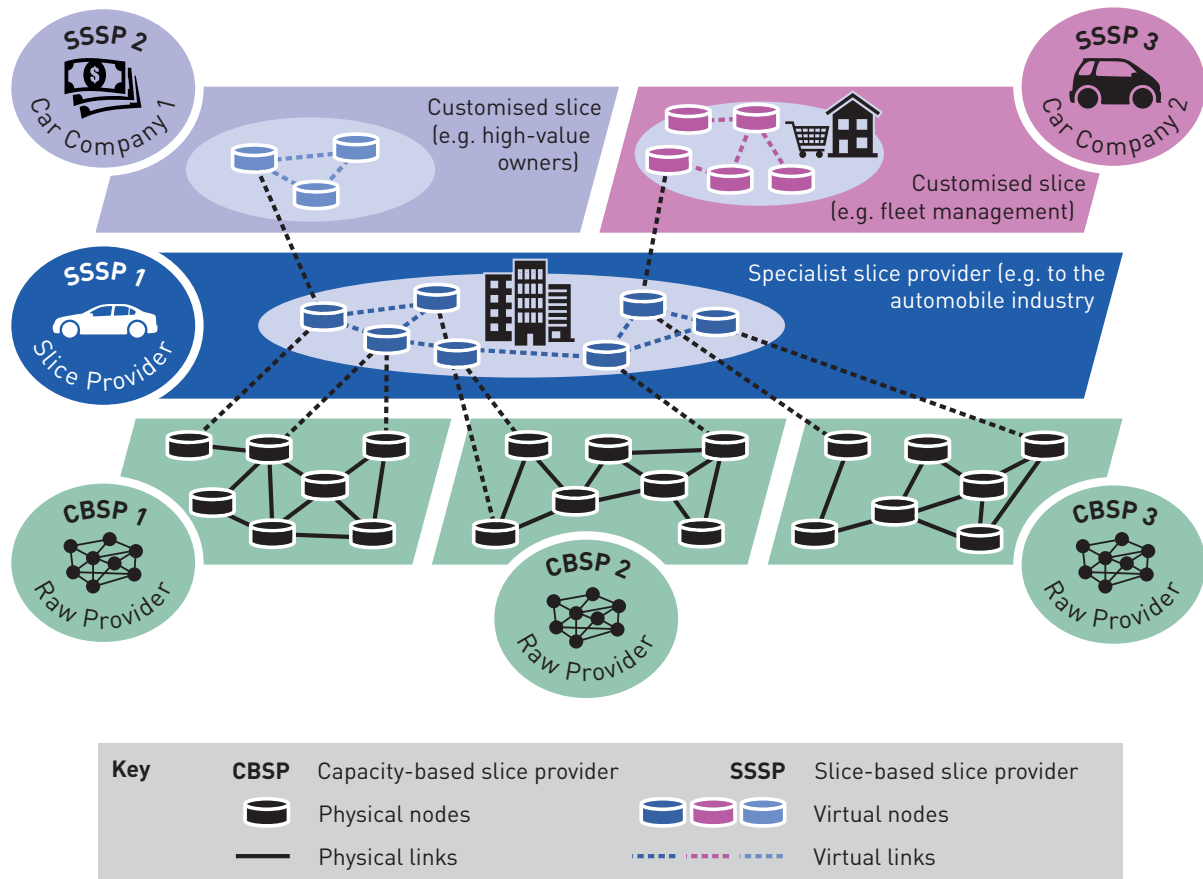|				
CBSP	Capacity-based slice provider		**SSSP**	Slice-based slice provider
Physical nodes				Virtual nodes
Physical links				Virtual links

Figure 5.6: A multi-layer network slice supporting third-party vertical slice providers, as well as specialized services offered by the MNO to various automotive stakeholders

Chapter 6. The transformed 5G platform will enable business success for operators in the long run

6. The transformed 5G platform will enable business success for operators in the long run

Once an operator has its 5G platform in place, it will be well positioned to take advantage of specific new business opportunities as they arise, more quickly than competitors. The investment into the platform and 5G overall is significant and will affect the operator's medium-term 5G return on investment (ROI), but operators which embark on these deployments now will be the best positioned to dominate the greatly expanded universe of 5G-enabled services.

6.1 Some international players are leading the way

Leading operators in this respect are already making heavy investments in their platforms, which are leading to capex patterns that are heavily weighted towards software. Some international examples highlight the opportunities for operators which invest in flexible 5G-enabled digital platforms now to support a growing pipeline of new revenues over the next ten years. A number of these operators are carrying out bold experiments to generate more revenue.

- **Reliance Jio,** an Indian mobile operator, is trying to gain and retain subscribers, not just by offering low prices, but also by providing an ecosystem of apps to deliver messaging, music, video and money services. It is also investing in an open digital platform supporting a diversity of services now, and plans to enrich these as 5G connectivity is added in future.

- Japanese operator **KDDI** and **Telus,** a Canadian telecommunications company, are also moving well beyond the traditional connectivity model. KDDI's 'Life Design' strategy extends to many vertical markets (energy, finance, health, education and commerce/retail) and is generating significant revenue for the operator (USD4.7 billion, or over 10% of its total revenue in 2017). Telus's investment in IT consulting and business process outsourcing is also unusual for an operator. These new activities now employ more people than Telus's core telecoms operations.

- 'Telstra Health' is **Telstra**'s standalone healthcare business. It offers a suite of solutions to healthcare providers and consumers, underpinned by Telstra's connectivity and platform assets. To deliver on its vision, Telstra has acquired companies with capabilities in several areas, including electronic health record companies and those specializing in medical cloud, data analytics, and software tools and applications. The company aims to generate AUD1 billion (USD725 million) in revenue by 2020 from its healthcare business unit.

- **Vodafone**'s growth strategy relies on new digital businesses in the areas of enterprise and consumer IoT, and data analytics. Vodafone is one of the largest IoT connectivity providers and has been active in the enterprise IoT market since 2007 with its own connectivity management platform. Since then, the operator has integrated data-analytics solutions in 2015 and launched a suite of consumer IoT services in 2017, including home security, family tracking and consumer devices.

6.2 GCC operators will have to adapt to new business models and investment patterns

5G business models will be very different from traditional 2G/3G/4G business models. For GCC operators, as for other operators worldwide, a strong 5G business model rests on the ability to pursue a mixture of short-, medium- and long-term business cases, which support a good variety of industrial, consumer and government users (spreading risk and reward, and maximizing socio-economic impact). This will involve a new pattern of investments between now and 2025.

Analysys Mason's forecast of mobile operator revenue and capex in the GCC region suggests that the addressable opportunity from 5G digital services could add up to 45% of operators' projected mobile service revenue in 2025, as illustrated in Figure 6.1. It also shows that while 5G capex will account for a significant proportion of 5G revenue in early years, this proportion will decrease rapidly as operators leverage their digital transformation investments to launch new 5G-enabled digital services rapidly and generate additional revenue (we refer to it addressable new 5G revenue in the below chart).

The new, platform-driven approach to 5G investment will also entail a new kind of return on that investment, with ROI being generated in multiple phases, linked to a series of business extensions based on the same programmable, virtualized and automated network.

When an operator's 5G deployment and business case plans are closely tied to a digital transformation program, it will consider its network and platform investments and objectives together. This will put the operator in a stronger position to derive short-term revenues from 5G, as well as providing the foundations to support a longer-term digital vision.
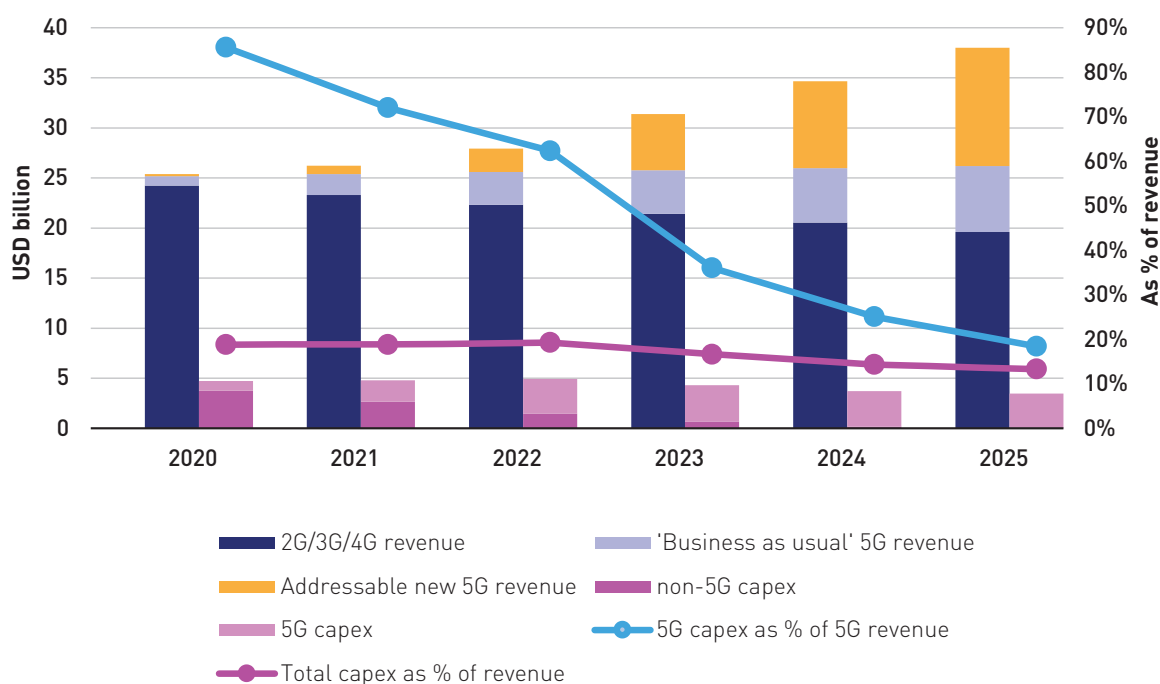

Figure 6.1: Forecast operator capex spend on transformation technologies in GCC and revenue from existing services and addressable revenue from new 5G services 2017–2025[i]

6.3 **The business impact of 5G will be maximized by the new platform**

The business impact of the new platform will be full flexibility to support new use cases as they emerge, and to build a model that combines some quick-win 5G services with longer-term prospects. This will enable a consistent pipeline of new revenues over time, with a smooth transition to new use cases supported by the sliceable platform.

Figure 7.2 illustrates operators' go-to-market ecosystem for a drone-inspection use case, i.e. how operators will leverage their platform to connect to various ecosystem partners to expand from offering connectivity to drone-based inspection service providers (role 1), to providing them with a platform of applications based on an ecosystem of third-party developers and analytics partners (role 2), to offering end-to-end drone-based inspection services to large enterprise in key vertical sectors (role 3), building on an even larger ecosystem of partners across the value chain (e.g. drone manufacturers, data collection operators, analytics solutions providers, application providers etc.)

The anchor business model is, of course, enhanced mobile broadband (eMBB). This will tend to address conventional KPIs – it can reduce churn, increase market share and support new services (such as enhanced video), which may increase ARPU. But eMBB must generate business returns in its own right, as well as providing the foundation for new revenue streams, potentially with higher growth prospects. An operator can build on an initial 'quick win' with eMBB in a certain market, and then continue to invest for longer-term growth and a steadily improving business case.
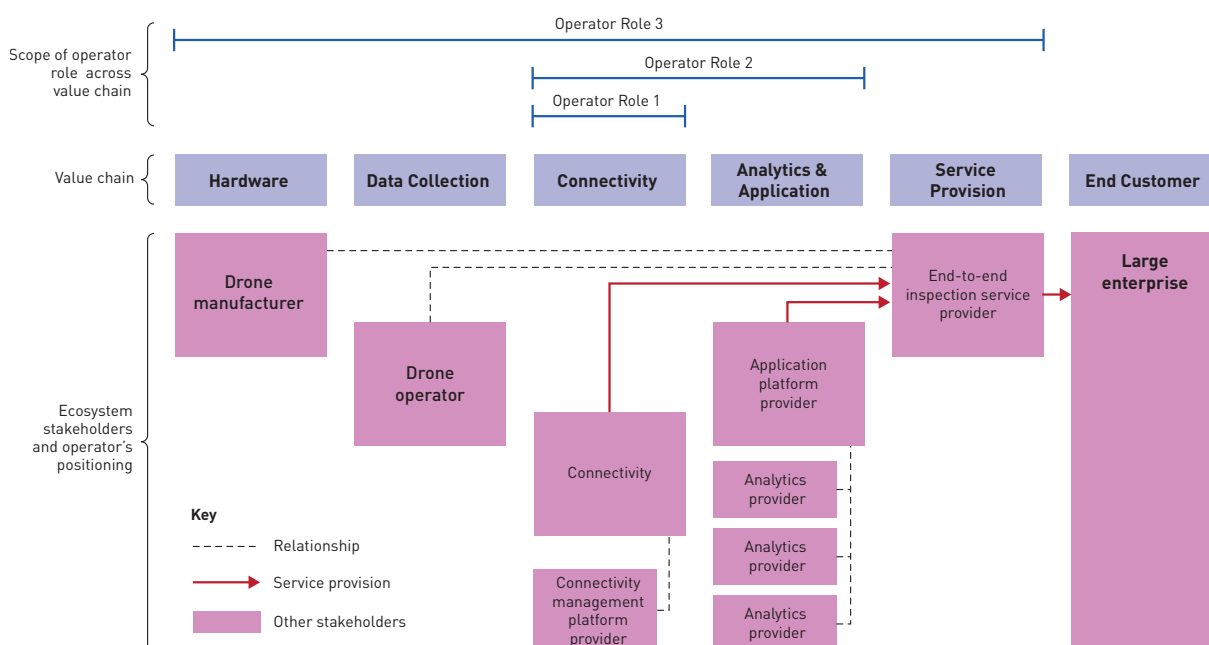

Figure 6.2: Overview of operator's go-to-market ecosystem for a typical 5G use case (cross-industry drone inspection use case is used as an example)

Figure 6.3 illustrates the evolution of operator typical roles in 5G with a summary of business modelling results across selected 5G use cases for the GCC region. As explained in Section 4, Analysys Mason identified a set of 5G use cases which are particularly attractive for GCC operators, as incremental opportunities to leverage the 5G network in addition to fixed and mobile broadband. The figure summarizes the range of revenue, net present value (NPV) and ROI results from business case models developed across all the selected use cases[i], considering a hypothetical operator in a country similar to the UAE in terms of its size and economic potential.

A number of key conclusions can be drawn from this modelling exercise:

- **Taken in isolation, no single new 5G use case is as attractive, in revenue terms, as eMBB.** The key success factor for operators expecting to benefit from the new 5G services will be having a single unified platform which can generate scores, or hundreds, of these incremental revenue opportunities over time

- **New revenue accrued from offering 5G-enabled connectivity depends on the importance of 5G for delivery of the use case.** The magnitude of operators' incremental revenue generated under role 1 is partly dependent on whether 5G is being used to enhance an existing service provided today over 3G/4G networks (e.g. CCTV monitoring, connected cars) which will migrate to 5G in the future or whether 5G is critical to the provision of the use case (e.g. remote control of drones). In the former case, the incremental connectivity revenue generated by 5G will be limited to some extent by the premium that existing customers pay for a connectivity service enhancement, which – for some use cases – is likely to remain limited or rapidly converge to 4G levels. While 5G capabilities may encourage faster adoption of some use cases than if these were to remain on 4G (therefore expanding the size of the market and generating potential large revenue for operators), this is far from being guaranteed across all use cases. On the contrary, those use cases that are critically dependent on the high-bandwidth, low-latency capabilities of 5G (i.e. they would not work with 4G) are likely to generate brand new and
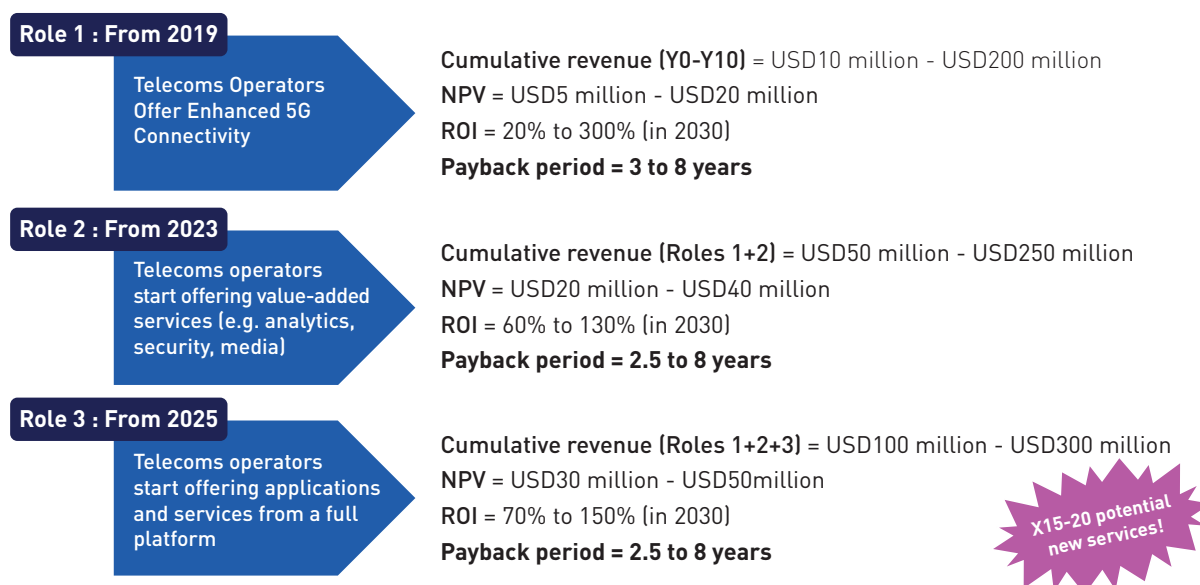
Role 1 : From 2019

Telecoms Operators Offer Enhanced 5G Connectivity

Cumulative revenue (Y0-Y10) = USD10 million - USD200 million
NPV = USD5 million - USD20 million
ROI = 20% to 300% (in 2030)
Payback period = 3 to 8 years

Role 2 : From 2023

Telecoms operators start offering value-added services (e.g. analytics, security, media)

Cumulative revenue (Roles 1+2) = USD50 million - USD250 million
NPV = USD20 million - USD40 million
ROI = 60% to 130% (in 2030)
Payback period = 2.5 to 8 years

Role 3 : From 2025

Telecoms operators start offering applications and services from a full platform

Cumulative revenue (Roles 1+2+3) = USD100 million - USD300 million
NPV = USD30 million - USD50million
ROI = 70% to 150% (in 2030)
Payback period = 2.5 to 8 years

X15-20 potential new services!

Figure 6.3: Summary of business modelling results for selected 5G use cases in the GCC region

[ii] Analysys Mason has developed business case models across ten unique 5G use cases across GCC countries –including VR for on-demand video streaming, VR for live video streaming, 5G-enabled V2X services, face-recognition cameras & analytics for CCTV, location analytics services, remote control of drones for inspection, long-range control of factory robots, AR for support to industrial operations, smart grid, and VR-based telemedicine

possibly significant revenue for operators (on a per-connection basis), only limited by the take-up of such use cases by various industry sectors.

- **Pure connectivity roles (role 1) provide high initial ROIs.** For 5G use cases other than traditional eMBB and FWA, initial ROI levels (role 1) are expected to be high, as the incremental network roll-out required to provide enhanced connectivity (i.e. in addition to the effort of deploying standard eMBB and FWA networks) is likely to be minimal. For example, offering enhanced connectivity to drone-inspection providers may require operators to slightly expand their network coverage in rural areas that would not be covered as part of their traditional eMBB/FWA deployment (e.g. to expand coverage along electricity power lines to provide good-quality inspection services to utility companies). Similarly, while operators may wish to expand their road coverage to guarantee a good 5G-enabled connected-car service, we expect this expansion to be limited as the high prevalence of urban areas and highways / large national roads in GCC countries means it is likely these are already covered as part of operators' eMBB deployments.

- **The unified, sliceable platform (network, cloud, analytics, partner framework, applications framework) minimizes the additional cost** of each new use case and allows rapid scaling. Moving from role 1 to role 2 over the course of the forecast period is expected to reduce the cumulative ROI as of 2030, due to the additional costs associated with moving to role 2 (e.g. platform development, analytics capabilities, engagement with ecosystem partners) and the fixed ten-year forecast period considered in the modelling exercise. However, moving from role 2 to role 3 is expected to be greatly facilitated by the existence of the unified platform, which in turn means a comparatively higher ROI by the end of 2030.

7. Summary of recommendations

7. Summary of recommendations

7.1 Key recommendations for operators

Develop 5G strategies in parallel with – and in the context of their plans for – digital transformation	The strongest business models for 5G rely on using the new network to support a wide range of digital services, enabled by a flexible software-based service platform. Therefore, both the network itself, and the platform, need to be planned and developed in parallel, as an integrated framework. This will result in far better ROI, with optimal delivery of the new services and efficient digital operations. Developing 5G and digital strategies separately increases the risk of sub-optimal results, misalignment of investments, and inferior user experiences. Without digital transformation, the 5G network will have less impact, and from the user perspective, 5G services will be less clearly differentiated from those of 4G.
Adopt NFV, SDN and platform capabilities to take full advantage of 5G features such as network slicing and edge computing	5G standards will enable some truly transformative ways to support and deliver new use cases and revolutionize user experiences. These include a highly flexible virtualized core, with the ability to disaggregate the network, separate control and user planes, slice the air interface and adopt varying splits between central and edge locations, and between physical and virtual functions. However, the impact of these new standards will be compromised if operators do not simultaneously invest in a broader software platform which goes beyond the 5G network and addresses other domains, as well as all the operators' processes and services. Fundamental to this platform are key enablers like NFV/SDN and new approaches to management and orchestration (MANO) with automation. These will allow the operator to take full advantage of cloud, edge computing and network slicing, to deliver innovative use cases.
Start planning for the new platform and ecosystem now to achieve key advantages in terms of market scale, growth potential, first-mover advantage, and ability to defend against new competitors	Operators that plan their 5G roadmaps immediately will gain several advantages over slower competitors. In particular, they will be able to deploy 5G very early and build their networks to scale quickly, because they have a clear plan in place. This, in turn, will provide them with first-mover advantages (e.g. greater ability to sign up early adopters, a potential price premium, the chance to recruit the most powerful partners). An operator which achieves scale quickly will have a bigger springboard for new services and future growth and will be better placed to secure market share and defend against traditional or new challengers. Because many 5G services will be aimed at complex industrial and IoT value chains, it will be essential to build up ecosystems of partners and application providers, so that the operator is well placed to monetize the network once it attains scale, via a broad set of ecosystem players.

Conduct extensive 5G trials, across a range of bands, technologies, and vendor solutions	The more extensive and diverse an operator's 5G tests and trials, the deeper its understanding of how the network will behave in real life. This will help it to identify the main challenges that need addressing, to deliver the best user experience and ensure customer satisfaction. It is important to gain this understanding by trialing 5G in many potential spectrum bands, and to test a wide range of technology solutions to identify the best combination of features for strong 5G services.
Actively pursue 5G research and development as well as cross-collaboration with vendors, industry segments and governments	Some of an operator's competitive edge will come from the quality of its network, and its ability to gain a significant network-based advantage can be supported by in-house R&D. The network-based advantage enables an operator to be a leader and an innovator in the way it deploys its network, and so enhance the customer experience. As well as internal R&D on networks and services, an operator can also enrich its network roadmap through active participation in cross-industry initiatives, and through collaborations with suppliers, industries and government bodies to understand how 5G can best support new use cases and experiences.
Explore new innovative digital services by pursuing a mixture of short-, medium- and long-term services, which support a variety of industrial, consumer and government users	The optimal business model for 5G relies on leveraging its support for very diverse behaviors, in order to support a wide range of different use cases. This means harnessing the flexibility of the 5G platform to support as wide a variety of use cases as possible, spreading risk and reward across multiple user groups and industries. It also means identifying some 'quick wins' and, in parallel, planning for medium- and long-term opportunities to generate a pipeline of new revenues that will continue throughout the lifetime of 5G.
Proceed in a step-by-step fashion, gradually expanding the 5G business model	The diversity of the 5G platform means an operator does not need to identify one 'killer app', but instead should build successive waves of incremental services to deliver significant cumulative revenue growth. An operator should build its initial network to support one or two anchor use cases, and then expand it step-by-step to enable additional services and broaden the revenue base. For instance, the first step might focus on targeted capacity to enhance LTE with 'hot zones' of very high-speed broadband. Then the operator can add more capabilities to support additional use cases (e.g. low-latency connectivity and services, millimeter wave-enabled speeds and density, etc.)

7.2 **Key recommendations for regulators**

Develop and publish a 5G roadmap strategy providing a clear ambition for 5G in the country in terms of technology development, regulatory framework and network deployment	Producing a formal 5G roadmap document that sets out a clear vision for 5G for the country and provides clear information regarding the path towards its introduction as well as action points and next steps will give an operator the necessary clarity to plan its trial activities and commercial successful 5G roll-out. Key aspects typically discussed in a 5G roadmap include: the expected schedule for spectrum release, possible evolution of regulatory frameworks, conditions of network deployment (e.g. sites, infrastructure sharing, coverage), technology and standards, etc.
Allocate mm-wave spectrum sooner rather than later, to enable FWA trials	While some operators are already trialing FWA services in the 3.5GHz spectrum, mm-wave frequencies (26–28GHz) are expected to enable higher speeds, particularly suitable for the provision of 'fiber-like' data rates over fixed wireless in areas with no or limited fiber coverage. As FWA is likely to be a priority use case for operators initially, regulators should consider awarding mm-wave spectrum to enable trials and accelerate the launch of services.
Publish policies aimed at encouraging new infrastructure developments and public infrastructure sharing	National governments and regulators that are taking a proactive approach to 5G deployments should encourage infrastructure developments such as small cells, as well as broader policies aimed at streamlining planning processes for mobile operators relating to macro sites used within today's 4G networks, which will also be important to 5G. Policy makers should also facilitate and encourage the use of network sharing to ease the total cost of ownership for operators of rolling out 5G networks, particularly given the level of investment required for network densification.

Allocate funding dedicated to the development of 5G technology	Governments should consider allocating direct funds to further accelerate research and 5G projects, for example for technology development and/or trials, that are expected to help stimulate demand for services and promote industry collaboration. Some countries have already committed significant funding towards these types of 5G (e.g. over GBP200 million investment in 5G infrastructure was announced in the UK's 2017 budget).
Set regulatory policies to facilitate cross-industry collaborative tests and the development and publication of a multi-annual national plan for development of key vertical sectors in the country	Governments and telecom regulators should set policies to facilitate collaborative tests between operators, enterprises and vendors, aimed at creating a vibrant ecosystem of local suppliers across the value chain and developing innovative 5G-enabled solutions. Governments should also continue to develop national strategies with clear objectives and roadmaps related to the development of key vertical sectors of the economy (e.g. smart cities, healthcare, utilities) and provide a clear description of the importance and role played by ICT in achieving these objectives, with an increasing focus on 5G.

7.3 **Recommendation for Enterprises/Industries**

Be prepared to co-invest with operators, in order to achieve the best 5G for your requirements.	It will be challenging for operators to optimise their networks to support the specific requirements of each industry vertical, especially before network slicing is fully mature. Enterprises which want early access to optimised connectivity should consider where they might accelerate the process by co-investing with operators – either directly with funding, or by contributing assets such as fibre or sites to the roll-out.
Support the operators in helping to define business cases	Some operators find it challenging to make strong business cases for certain enterprise and IoT use cases, especially if they have limited experience in a particular vertical. Enterprises can work closely with operators to arrive at mutually beneficial business models, especially by encouraging dialogue with relevant ecosystem players, such as the enterprise's IT departments or systems integrators.
Unlike 4G, 5G is a joint effort, and enterprises should participate actively in testbeds and 5G initiatives	In previous mobile generations, mobile operators built the networks to their own specifications, but with 5G, enterprises have the opportunity to drive some of the characteristics of the new connectivity and services. To grasp this opportunity, they should engage actively in initiatives in which they can share knowledge with mobile operators and other stakeholders, and engage in mutual testing of use cases. Government-backed testbeds, trials and workshops are some examples.

Annexes

Annex A: References and bibliography

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Annex B: Abbreviations used in this report

2G/3G/4G/5G	Second/third/fourth/fifth generation of mobile technology
3GPP	Third Generation Partnership Project
AI	Artificial intelligence
AR	Augmented reality
eMBB	Enhanced mobile broadband
FTTP	Fiber to the premises
FWA	Fixed wireless access
GCC	Gulf Cooperation Council
GSMA	GSM Association
HD	High definition
ICT	Information and communication technology
IoT	Internet of things
ITU	International Telecommunication Union
LTE	Long-term evolution
MANO	Management and orchestration
MBB	Mobile broadband
MIMO	Multiple input, multiple output
mm-wave	Millimeter-wave
MNO	Mobile network operator
NB-IoT	Narrowband internet of things
NFV	Network function virtualization
SDN	Software-defined networking
V2X	Vehicle-to-everything
VR	Virtual reality
WiMAX	Worldwide interoperability for microwave access

Annex C: 5G readiness index methodology

We developed a 5G country readiness index by amalgamating nine 5G assessment criteria used by recognized industry organizations and by scoring GCC countries – as well as the US, China, Japan and South Korea – against each of these criteria. Each country was given a score between 0 and 4 for each criterion. Four criteria correspond to 5G regulatory readiness and five to 5G operator readiness. Figure C.1 and Figure C.2 below provide an overview of these criteria and a description of each score level.

Metric	Description and scoring methodology				
	0	**1**	**2**	**3**	**4**
Amount and timeline for 5G spectrum release	Total amount of spectrum being released for 5G. Amount of spectrum being made available in different bands (low, mid, high). Timescale for spectrum being made available to operators for commercial use				
	No plans to release spectrum publicly reported	Spectrum release still at consultation stage	Mid-band spectrum to be released (in stages) by 2020/2022; limited details in high band – presumed to be released over a similar time-frame	Mid-band spectrum scheduled for early release; limited details on high band but presumed to be released before a commercial launch in 2020	Mid- and high-band spectrum scheduled to be released in 2018
5G roadmap published	Publication of a detailed 5G roadmap with indication of bands to be made available for 5G and/or under study, plans for equipment testing, schemes to facilitate commercial trials, detailed schedule for spectrum release, etc.)				
	No roadmap or discussion of 5G spectrum bands	Release of 5G spectrum is at an early stage with early published consultations. Limited roadmap regarding particular bands only	Specific details regarding licenses limited; some roadmap for 5G spectrum bands, but not covering all low/mid/high bands	Detailed plans for assigning spectrum in low and mid band made available, but no action regarding high bands	Low-, mid- and high-band spectrum explicitly mapped, with indication of statements/ next-steps/ action-plan
Government backing and infrastructure policy	Extent of proactiveness of national governments for 5G deployment, including policies aimed at encouraging further 5G technological development (e.g. direct allocation of government funding), early commercial launch of 5G services (e.g. through encouragement of collaborative trials) and easing 5G infrastructure deployment (e.g. development of small cells, streamlining planning processes for operators relating to macro sites used in today's 4G networks, which will be also important to 5G)				
	No data	Indication of government intention to aid 5G deployment, though limited actual investment	No specific 5G government funding, but some investment in next-generation connectivity funding	Large amount of generic next-generation connectivity funding, and some specific 5G investment	Large amount of specific 5G investment, as well as broader government backing of trials and research
Vertical policies	Publication of multi-annual national plans for the development of key vertical sectors in the country (e.g. utilities, healthcare, smart cities, transport). Importance of the role played by ICT to achieve targets and objectives set in the roadmap, and extent to which technology-enabled initiatives are already implemented today or ongoing				
	No government documents related to smart initiatives have been published	Roadmaps for smart initiatives in verticals have been published but details on the role played by technologies are absent	Roadmaps have been published and technology is an integral part in delivery, but no reference is made to 5G	Roadmaps have been published and 5G will contribute to selected vertical sectors	Roadmaps have been published and 5G will contribute to a substantial number of vertical sectors

Figure C.1: Description and scoring methodology for evaluating 5G regulatory readiness [Source: Analysys Mason, 2018]

Metric	Description and scoring methodology				
	0	**1**	**2**	**3**	**4**
Operator trials and roadmap to launch	Extent of 5G network and equipment trials conducted by operators and industry stakeholders to demonstrate 5G technology and/or establish technology capability ahead of commercial network deployment. Progress being made by network operators towards commercial 5G launch (e.g. public announcements, explicit commercial launch dates, widespread trials)				
	No commercial launches announced	One or more MNOs aim to launch commercial 5G in 2020	Most MNOs aim to launch commercial 5G in 2020	All MNOs aim to launch commercial 5G in 2020	All MNOs aim to launch commercial 5G in 2018/19
Pre-existence of required infrastructure	Extent to which operators already have an extensive 4G mobile network footprint and high-speed fixed broadband networks, which will both be crucial for the deployment of 5G (e.g. re-use of 4G sites for efficient 5G roll-out, importance of fiber transport networks to reach promised 5G speeds in the access network)				
	No pre-existing infrastructure mobile or fiber	3G or 2G network infrastructure for mobile only and no fiber available	One or more MNOs have access to the sites and have invested in fiber, necessary for 5G	Most MNOs have access to the sites and have invested in fiber, necessary for 5G	All MNOs have access to the sites and have invested in fiber, necessary for 5G deployment
Focus on customer experience	Progress being made by operators to offer a modern digital experience for customers. This includes the provision of self-service applications, social media and omni-channel support, delivery of personalized offers, and the extent of automation capabilities within customer care / marketing departments				
	Operators scored against seven digital experience criteria to assess their 'customer centricity' or focus on customers' experience, in relation to the operators' service applications, support channels, personalization and automation				
Network operations automation	Extent to which operators have implemented zero-touch automation in their network, including progress made in virtualizing their network and implementing orchestration, in deploying a mature SON and automated NOC, and in implementing closed-loop automation				
	Virtualization strategy in infancy for most operators, automation of physical network still immature (e.g. in siloes)	Most MNOs have just started network virtualization or SON deployments, but most network functions are virtualized in a siloed manner (i.e. no platform approach)	Most MNOs are well on the way towards network virtualization; some may already have orchestration and SON in place	Most MNOs have a virtualized network with orchestration but have not achieved closed-loop automation. Some may still run hybrid networks and have planned people transformation programs	All MNOs have a fully virtualized network with orchestration in place, a matured SON deployment, a fully automated NOC and closed-loop automation
Vertical readiness	Operator engagements across other verticals to trial and deploy new technologies or services. This includes partnering on or leading projects in other verticals, such as smart cities or retail				
	No MNO has engaged other verticals	One or more MNOs have trialed an industry service in one or two verticals	One or more MNOs have trialed a number of industry services across two or three verticals	Most MNOs have deployed or trialed services in all key verticals	All MNOs have deployed or trialed services in all key verticals

Figure C.2: Description and scoring methodology for evaluating 5G operator readiness [Source: Analysys Mason, 2018]

Annex D: Methodology for forecasting the addressable 5G market opportunity

We have developed a top-down and bottom-up methodology to forecast the 5G market value in each GCC market.

- The top-down methodology leverages reported third-party forecasts enhanced with Analysys Mason's 5G assessment to estimate the worldwide total digitalization revenue and the digitalization revenue enabled by 5G. These total figures were projected until 2030 and mapped against key vertical sectors. For each vertical, the opportunity addressable by operators was estimated based on third-party figures and Analysys Mason's analysis of the size and complexity of the value chain in each vertical. The digitalization revenue attributed to the Middle East region was then estimated leverage additional third-party sources. Finally, the regional digitalization revenue enabled by 5G and addressable by operators was divided among the GCC countries based on social and economic factors across the region.

- The bottom-up forecast then uses the local context in each country to redistribute the projected results from the top-down forecast by vertical. The revenue opportunity from each vertical was adjusted based on three new criteria, including the number of use cases, the revenue opportunity addressable by operators and the vertical readiness of operators.
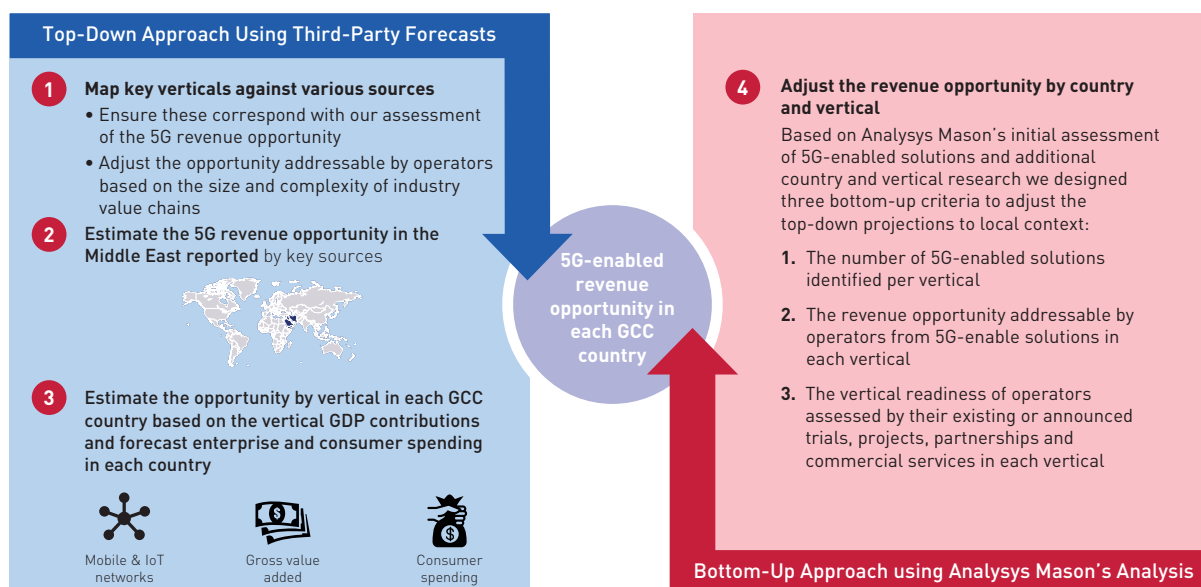
Figure D.1: Overview of market opportunity methodology

Annex E: List of use cases

Figure E.1: List of 50 5G use cases Analysys Mason believes could be attractive for GCC operators

Vertical	Use case
Transportation	5G-based V2X for passenger cars
Smart & safe cities	Sensor networks: face-recognition cameras and analytics for CCTV
Media / entertainment	VR for 4K/8K live broadcasting
Media / entertainment	AR for gaming
Healthcare	VR-based telemedicine
Media / entertainment	Enhanced mobile broadband
Media / entertainment	Remote control of drones for leisure / photography
Media / entertainment	5G for cloud gaming
Cross-industry	Long-range remote control of drones for inspection and exploration
Smart & safe cities	Sensor networks: tracking wearables for crowd management
Smart & safe cities	5G-based V2X for public transport vehicles
Healthcare	Remote diagnosis with force feedback
Healthcare	Remote surgery
Cross-industry	AR for support to oil & gas operations
Logistics	Sensor networks: fleet management for commercial vehicles
Healthcare	Sensor networks: AI-enabled remote patient diagnosis and monitoring
Manufacturing	Long-range remote (tactile) control of factory robots
Utilities	Sensor networks: smart grid
Smart & safe cities	AR for real-time text translation
Smart & safe cities	AR for information overlay during city tours
Transportation	5G for in-vehicle embedded entertainment services
Manufacturing	AR for support to industrial operations (digital twins)
Transportation	Sensor networks: after-market vehicle tracking & monitoring (usage-based insurance)
Smart & safe cities	'Digital sky' communications for taxi drones
Transportation	5G-based V2X for commercial vehicles
Transportation	Tele-operated driving
Smart & safe cities	5G for emergency communications
Smart & safe cities	VR for at-home virtual tourism
Smart & safe cities	Long-range remote control of drones for security monitoring
Smart & safe cities	Long-range remote control of drones for public infrastructure inspection
Manufacturing	Long-range remote control of drones for inspection

Vertical	Use case
Logistics	Long-range remote control of delivery drones
Banking / finance	Blockchain-based banking and payments
Banking / finance	Ultra-high-frequency financial trading
Utilities	Long-range remote control of drones for equipment and infrastructure inspection
Retail	AR for at-home product experience
Retail	AR for in-store shopping experience
Construction	Sensor networks: connected security alarms
Construction	Sensor networks: connectivity security cameras
Smart & safe cities	Digital signage in public venues
Media / entertainment	VR for gaming
Transportation	Sensor networks: after-market vehicle tracking & monitoring for consumers
Construction	VR for virtual property visits
Retail	VR for online shopping
Manufacturing	Long-range remote control of drones for CCTV
Logistics	Long-range remote control of drones for inventory management
Agriculture	Long-range remote control of drones for farm land inspection
Smart & safe cities	Sensor networks: public infrastructure stress monitoring
Smart & safe cities	Sensor networks: smart street lights
Smart & safe cities	Sensor networks: smart waste management

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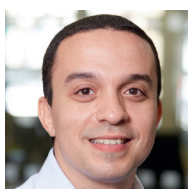
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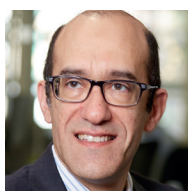
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