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White paper

5G's role in transforming Kuwait into a digital economy

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RESEARCH

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1. Executive summary

Kuwait has been one of the pioneering countries in the introduction of 5G services: the operators and government are giving 5G a central role in their digital strategies and all three mobile network operators (MNOs) – Zain, STC, Ooredoo – have been offering commercial 5G services since mid-2019.

Kuwait has high mobile penetration and, in the absence of widespread fibre, broadband usage is mainly cellular. This makes it likely that 5G will take a leading role in providing the connectivity to underpin digital transformation by enterprises, and on a national scale as part of Kuwait's ambitious Vision 2035, or 'New Kuwait' socioeconomic programme.

1.1 B2B services are important to MNOs and to national objectives in Kuwait

It is essential then, for the achievement of the goals of the New Kuwait programme, that 5G networks are built out rapidly and with the capabilities to enable high-value enterprise services. Enterprise revenue will also be important to maximise the return on investment for MNOs as they expand their 5G networks and start to invest in the 5G core platform. However, 5G networks will need to support a huge diversity of potential use cases, each with its own connectivity requirements, its own ecosystem and its own challenges.

This report assesses the most attractive industry verticals and use cases for 5G operators to target in the first stage of commercial 5G (2021–2024), in order to kickstart a strong business model, and lay the foundations for an increasingly broad range of applications and services that will meet evolving enterprise demands throughout the 2020s, delivering a constant stream of improvements for the digital progress of Kuwait.

1.2 5G B2B use cases were assessed to identify attractive short-term opportunities

We evaluated a long list of B2B use cases according to a range of criteria to identify the best near-term opportunities in Kuwait, including the following.

- **Socioeconomic considerations,** that is, mapping the 5G B2B use cases to the key objectives of the seven pillars of Kuwait's Vision 2035, such as sustainable living and diversification of the economy.
- **Connectivity requirements,** including the throughput, device density, availability, latency and mobility requirements of the use case. From this analysis, we determined the extent to which the application requires 5G, and how many advanced 5G capabilities – on top of generic mobile broadband – would need to be supported.
- **Commercial considerations,** taking into account complexity and cost to implement (based on the analysis above); timeline for large-scale adoption by key verticals; readiness of the ecosystem of applications, analytics, devices and services providers.

High growth in wireless Internet of Things (IoT) services is expected in Kuwait between 2020 and 2028 – in that period, the total wireless IoT market will grow at a CAGR of 17% in Kuwait, but revenue from IoT use

cases using 5G[1] will grow at a CAGR of 42% and will reach USD39 million by 2028. More broadly, revenue from 5G-enabled services (including IoT applications, mobile broadband and fixed) will reach almost USD1.1 billion by 2025 in Kuwait, accounting for 43% of total revenue from services using cellular technologies.

The objective of the analysis was to select six use cases that scored most highly in terms of their contribution to the transformation of enterprises and the goals of Kuwait's Vision 2035, and longer-term growth via expansion into further industries or applications. The results are summarised in the figure below and full details of the assessment of each use case are provided in Chapter 4 of the report.

Figure 1: Results of 5G B2B use case prioritisation analysis for Kuwait

Selected use case	Relevance to Vision 2035	Key vertical(s) affected
Sensor networks for sustainable living (e.g. air quality, waste management)	Better living environment, clear outdoor air quality	Smart cities
Smart CCTV	Better living environment, smart infrastructure	Smart cities, public safety, critical infrastructure
Remote patient diagnosis and monitoring	Optimised healthcare quality, cultivate wellness and active life styles	Healthcare
AR/VR-based remote education	World-class education, skilled and efficient labour force	Education
Long-range remote control of unmanned aerial vehicles (UAVs)	Sustainable diversified economy – supports oil and gas and newer industries	Oil and gas
Sensor networks: asset tracking and monitoring (e.g. machine tools, heavy equipment, warehouse)	International leadership especially as manufacturing and logistics hub	Manufacturing and logistics

Source: Analysys Mason, 2021

1.3 Investments in partnerships and the 5G core are key enablers of success

There are challenges to be addressed before MNOs and enterprises can take maximum advantage of these and other 5G use cases. Operators, regulators, industry stakeholders and policy makers must work together to ensure that key enablers, such as spectrum and infrastructure, are accessible and affordable. This will give operators the confidence to continue to invest in their 5G networks in order to support all the capabilities required to deliver the best B2B experiences, such as ultra-low latency.

They also need to form relationships with ecosystem players in each vertical sector, and make partnerships in areas such as cloud computing and AI – capabilities that will enhance the impact of 5G. Most importantly of all, MNOs should plan now to migrate to standalone 5G and a cloud-native 5G core.

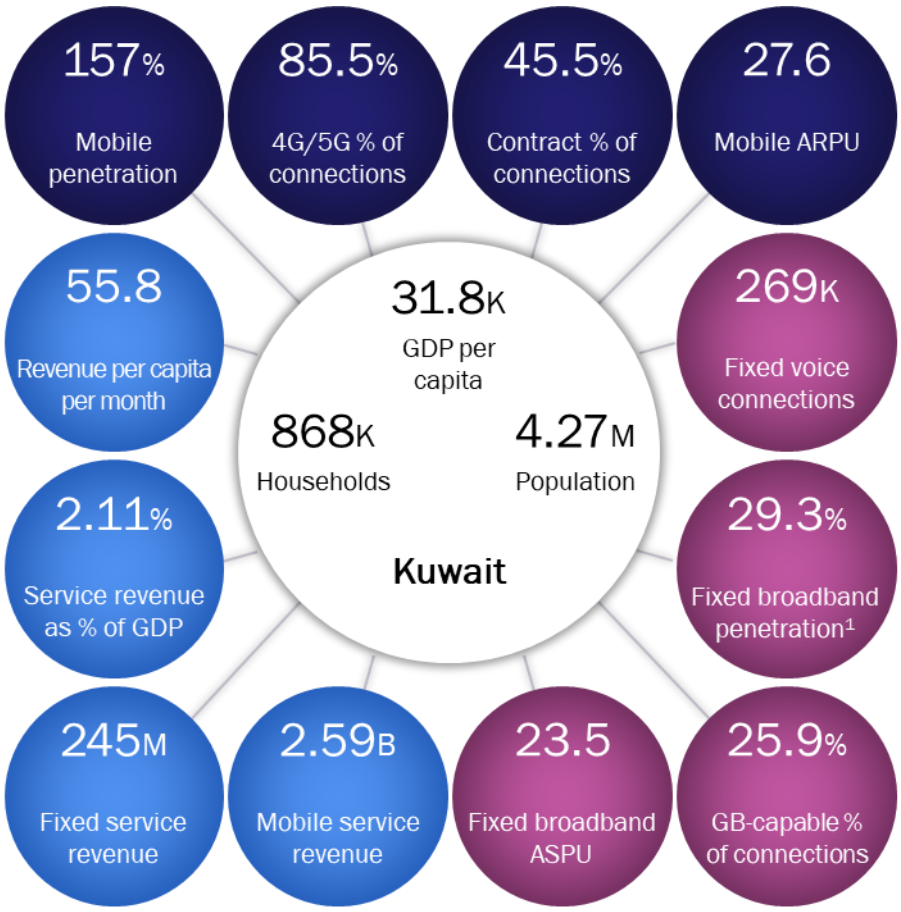
1 Note we include LTE-M and NB-IoT connections, when these are managed from a 5G core, because many operators are deploying this technology to support 5G services, before 5G-IoT standards are completed in 2021 or 2022.

This will enable MNOs to build a flexible platform that can support the different requirements of hundreds of use cases, each one generating incremental revenue. It will also provide options that will greatly improve the business case, such as provisioning virtual network slices to support specific customers or connectivity capabilities. Eventually, that will allow operators to take a strong position in the overall 5G B2B value chain, providing a full platform with potential to generate far higher revenue than connectivity alone.

2. Context to 5G in Kuwait

Kuwait is a highly developed mobile market, but fibre penetration is low. An overview of Kuwait's telecoms market at the start of 2020 is provided in the figure below.

Figure 2: Key metrics[2] in the Kuwait telecoms market, 2Q 2020



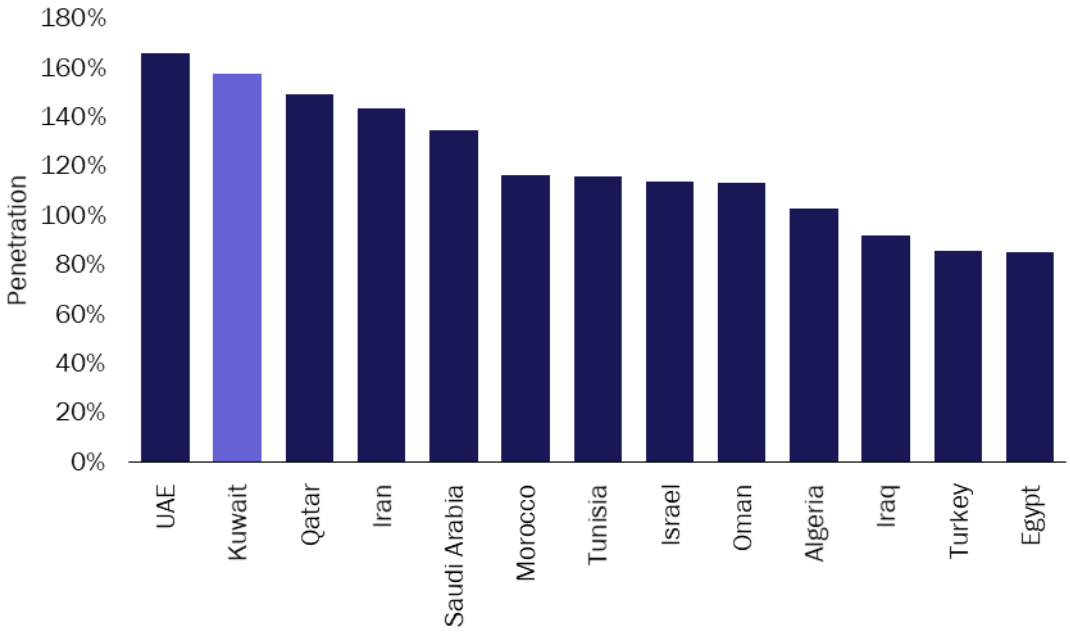
[1] This includes FWA connections on mobile networks.

Source: Analysys Mason, 2021

2 Note: revenue and ARPU are in USD.

Alongside other GCC markets, Kuwait has been one of the pioneering countries in the introduction of 5G services, with all three operators and the government giving 5G a central role in their digital transformation strategies. The 5G deployments will build on a strong mobile base. Kuwait had mobile penetration of almost 157% of its population in the second quarter of 2020, which is higher than most countries of the Middle East and North Africa (MENA) region (see figure below).

Figure 3: Mobile penetration in countries in the Middle-East and North Africa, 2Q 2020



Source: Analysys Mason, 2021

Significant investments have already been made in 5G infrastructure by the three mobile network operators (MNOs), Zain, STC and Ooredoo. To gain optimal return on those investments, MNOs need to target a wide variety of revenue streams, including those generated by industrial and enterprise sectors. It will be important for the MNOs to understand the industries where the near-term demand will be highest, to enhance the early-stage business case and lay strong foundations for future growth. They must also understand the use cases that will attract the most interest and drive take-up among businesses in the next few years, and that will play the biggest role in supporting enterprises' digital programmes, and contributing to broader socioeconomic objectives, as set out in the New Kuwait agenda.

This report assesses the most attractive industry verticals and use cases for 5G in the first stage of commercial 5G (2021–2024), which will lay the foundations for an increasingly broad range of applications and services that will meet evolving enterprise demands throughout the 2020s, delivering a constant stream of improvements for the digital progress of Kuwait.

2.1 All three operators in Kuwait launched commercial 5G services in 2019

5G commercial services were introduced in June 2019, when all three operators launched fixed-wireless access (FWA) offerings. This was followed, in July 2019, by mobile services. By the first quarter of 2020, at least two MNOs had reported near 'nationwide' 5G population coverage in Kuwait.

All three operators have 5G operations in other countries in the region and will plan to support roaming. For instance, Ooredoo is implementing 5G networks in five countries in 2020.

Some key milestones in Kuwait's 5G progress to date include the following.

- January 2019: Ooredoo makes 5G call between Kuwait and Qatar.
- March 2019: STC announced a 5G innovation centre to explore, develop and launch new 5G applications in Kuwait.
- May 2019: The three operators are each awarded 100MHz of commercial 3.5GHz spectrum, which was allocated to them the previous year for trial operations.
- June 2019: All three operators launch fixed modems for residential and business sectors on networks running in the 3.5GHz spectrum band.
- July 2019: Smartphone packages are launched. Zain offered postpaid plans ranging from 2TB/month for KWD75 to 100GB for KWD37; Ooredoo's postpaid plans started at KWD36 for 100GB/month; STC offered an entry-level postpaid tariff of KWD35 for 100GB/month or KWD45 for 250GB. STC has since expanded its KWD35 tariff to offer 500GB/month and a free home router.
- October 2019: STC launches '5G Connectivity' services for enterprises, including Dedicated Data Access, Dedicated Internet Access, and on-demand services such as CCTV and Cloud PBX.
- November 2019: Zain launches the first intra-region 5G roaming service, between Kuwait and Saudi Arabia.
- February 2020: STC launches the Middle East's first end-to-end standalone 5G network.
- August 2020: STC trials 5G expansion into the 2.1GHz spectrum band, primarily to support improved indoor coverage.
- September 2020: Zain launches a new range of 5G postpaid broadband packages, with the option of using two SIM cards per subscription with fixed and mobile devices; and a free 1-year subscription to the OSN streaming service.
- November 2020: STC launches new 5G unlimited Internet plan including a 1-year free subscription to Jawwy TV, a home entertainment streaming service.

2.2 Operators are looking to expand their 5G services into high-value B2B areas

Initially, 5G services in Kuwait were mainly targeted at residential users and mobile broadband consumers, with the propositions centred around applications such as video streaming. In 2020, the operators have started to develop more business-focused services: for instance, they are offering 5G solutions such as dedicated data access and dedicated internet access, as well as on-demand services such as CCTV and cloud PBX.

Such services have generic applicability to many vertical sectors, but operators are also aware that they can increase the value offered by 5G if they support a wider range of use cases, and modify these to suit the specific needs of individual industries. For instance, many sectors are interested in connected CCTV to support security applications, but an operator can take a more strategic role in an enterprise's transformation, and so command higher revenue, if it customises the service for a particular sector, such as a smart city. This might entail bundling specific applications or devices, by working with partners that specialise in that industry vertical.

The operators have been working with industry representatives and members of their ecosystems to identify how to evolve their 5G networks and partnerships to address the most attractive B2B opportunities. For instance, STC is partnering with a vendor to develop advanced 5G and IoT solutions, leveraging 5G-enhanced capabilities such as AR/VR and ultra-HD video, to accelerate digital transformation across industries such as oil and gas, smart cities, manufacturing, logistics and public safety.

Use cases that have been trialled by one or more MNOs in Kuwait include remote surgery, drones, autonomous vehicles and artificial intelligence and there have been laboratory demonstrations, trials or proof-of-concept

trials in several verticals. The figure below shows the main verticals addressed, and how this compares with trials in the UAE, and in benchmark countries (selected because they are considered to be advanced 5G deployers).

Figure 4: Key sectors addressed by 5G trials and proof-of-concept trials in Kuwait and select countries

Country	USA	Australia	China	Singapore	South Korea	UAE	France	Germany	Switzerland	UK	Kuwait	Total no. of countries
Transport	✓	✓	✓		✓	✓	✓	✓		✓		8
Manufacturing	✓		✓	✓	✓		✓	✓	✓	✓	✓	9
Healthcare	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	10
Logistics	✓	✓	✓		✓	✓		✓		✓	✓	8
Agriculture	✓		✓				✓					3
Retail	✓		✓		✓					✓		4
Finance	✓	✓		✓				✓	✓			5
Others (5G laboratory, robotics)	✓		✓	✓	✓	✓	✓	✓		✓	✓	9

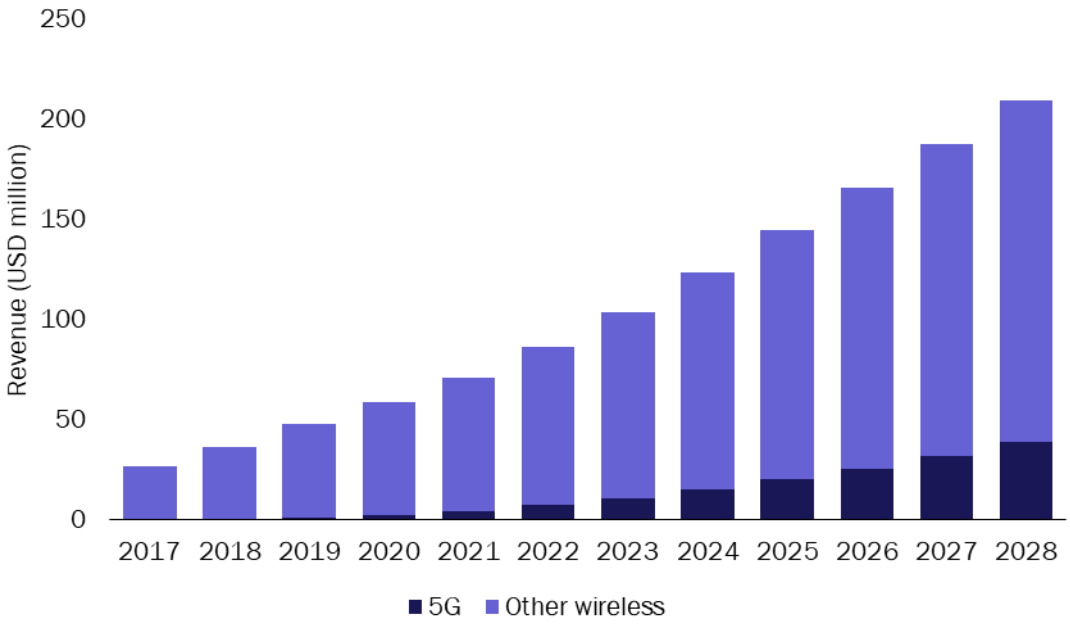
Source: Analysys Mason, 2021

In most countries, tests, trials and early deployments have focused first on manufacturing, logistics, robotics and transport because these sectors' requirements rely on wide, often national coverage and on mobility, and so are particularly aligned to mobile rather than wireline. The COVID-19 pandemic has increased activity in the healthcare sector in many countries in 2020, which has highlighted requirements for remote and online health services.

Enterprise use cases will be important to deliver the maximum benefits to the wider economy. Many of these use cases will be enabled or enhanced by adding IoT capabilities to 5G mobile broadband, and many applications will rely on a combination of these different features. The figure below illustrates the high growth in revenue from IoT services using wireless access technologies in Kuwait between 2017 and 2028. While the total wireless IoT market will grow at a CAGR of 17% during 2020–2028, revenue generated by IoT applications using 5G [3] will grow at a CAGR of 42% and reach USD39 million by 2028. This revenue is incremental to enterprise and B2B revenue enabled by a generic 5G mobile broadband network.

3 Note we include LTE-M and NB-IoT connections, when these are managed from a 5G core, since many operators are deploying this technology to support 5G services, before 5G-IoT standards are completed in 2021 or 2022.

Figure 5: Total wireless IoT revenue by type of access technology, Kuwait, 2017–2028



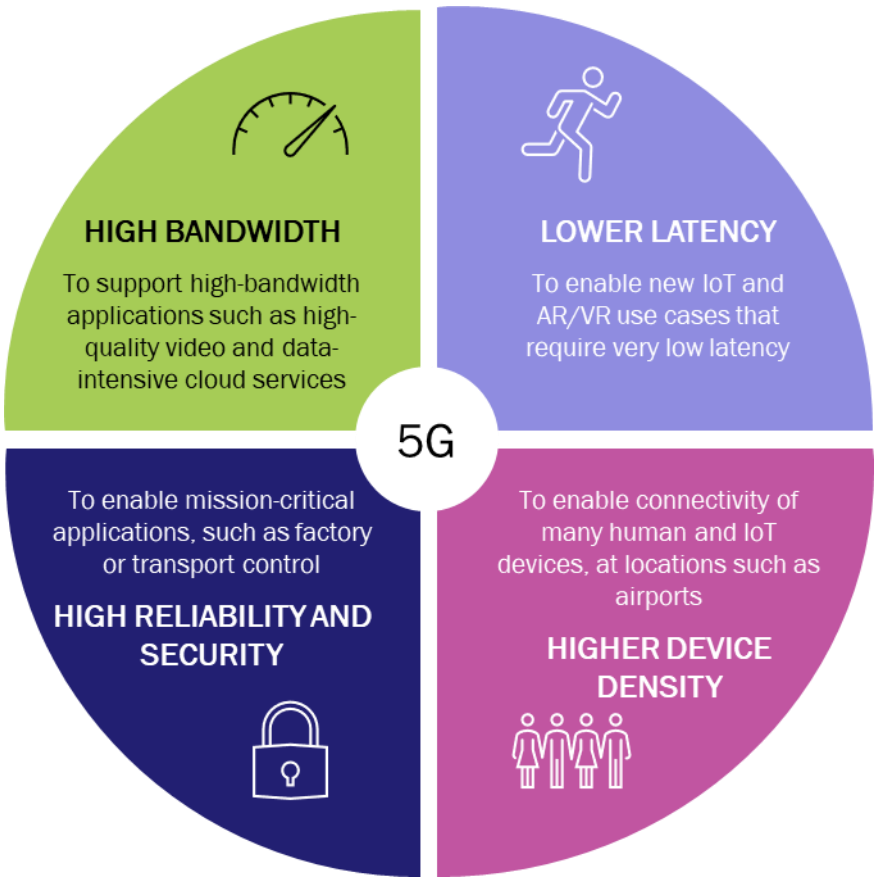
Source: Analysys Mason, 2021

3. The expected socioeconomic impact of 5G in Kuwait 2020 to 2025

3.1 5G has diverse capabilities, which enhances its economic impact

In many countries, including Kuwait, 5G is expected to play a broader role in enabling social and economic change than 4G or 3G did. This is because it supports not just higher data rates than its predecessors, but it has a variety of capabilities such as ultra-low latency, support for massive numbers of sensors and devices, and enhanced levels of reliability and security. These are capabilities that were only previously available with fixed networks such as FTTx, but of course, also enable high degrees of mobility and ubiquitous coverage.

Figure 6: Key capabilities of a 5G network



Source: Analysys Mason, 2021

The flexibility of the 5G access network is further increased by the implementation of a 5G cloud-native core. Operators worldwide started their 5G roll-outs by supporting 5G non-standalone (NSA), which continues to use the 4G evolved packet core. From 2020, some are starting to migrate to 5G standalone (SA), which uses a full 5G core.

This flexibility greatly increases the versatility of the network to support many consumer and enterprise requirements and use cases. The 5G core is multi-access, which means it can provide intelligent management of many connectivity types, not just 5G – many enterprise applications may use specific IoT connections such as LTE-M, as well as 5G and 4G. More importantly, the 5G core is implemented as microservices, which allow network resources to be scaled up and down on-demand to suit the needs of individual services or users, and enables the operator to create virtual 'slices' of the network, optimised for the needs of a particular sector, enterprise or use case. For instance, an ultra-low latency slice would ensure that sub-millisecond response times were guaranteed for users or applications that rely on that capability, allowing the operator to deliver high-value applications in sectors such as public safety.

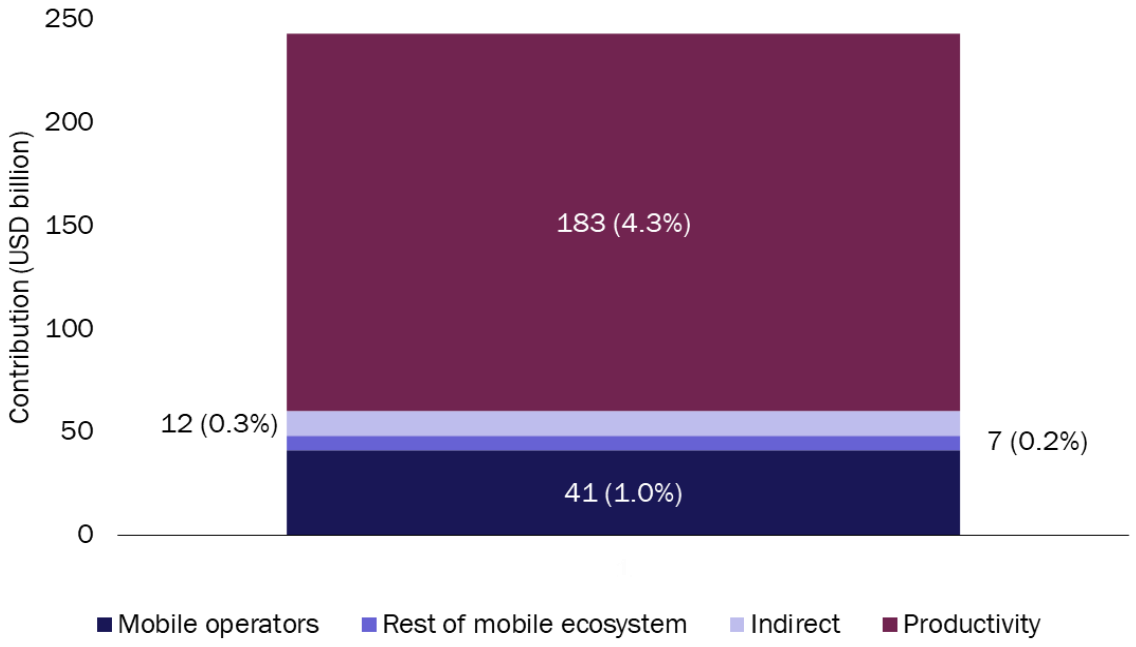
3.2 5G can drive significant socioeconomic change in the region

The flexibility of 5G networks means that the 5G RAN and core, together, can support digital enterprise applications with many different performance requirements, from multi-gigabit speeds to sub-millisecond response times to guaranteed availability levels. That has attracted the interest of many industries round the world, which have participated in tests and trials of a wide range of services. It has also led many governments

to give 5G a central role as an enabler of their national strategies for digitalisation, to support social and economic progress and to provide an environment in which industries can be as competitive as possible.

In 2019, mobile technologies and services generated 5.7% of GDP in the MENA region, according to the GSMA, a contribution that amounted to USD244 billion of economic value added (see figure below). A total of USD48 billion was contributed by the mobile ecosystem directly, most of that by MNOs, and USD183 billion from productivity benefits enabled by cellular networks.

Figure 7: Contribution of the mobile industry to GDP (in value and percentage of GDP), Middle East and North Africa, 2019



Source: GSMA, 2020

At the most foundational level, 5G is important to national socioeconomic programmes because it can extend penetration of high-quality broadband, which is especially relevant in countries with limited penetration – Kuwait has the lowest fixed broadband household penetration in the Gulf region (29.3% in 2Q 2020) and DSL accounts for around 72% of all fixed broadband connections in 2020.

The spectral efficiency of 5G, and the opportunity to use high-capacity, high-frequency millimetre wave spectrum, will greatly improve the economics of delivering gigabit services even to rural areas. The role of 5G in expanding broadband access is particularly important in countries in the Gulf region because there is a significant preference for mobile rather than wireline technologies.

As in other parts of the world, extending high-speed broadband access can have a significant social impact, and 5G can accelerate the increase in coverage and average speeds across a country. The impacts include the following:

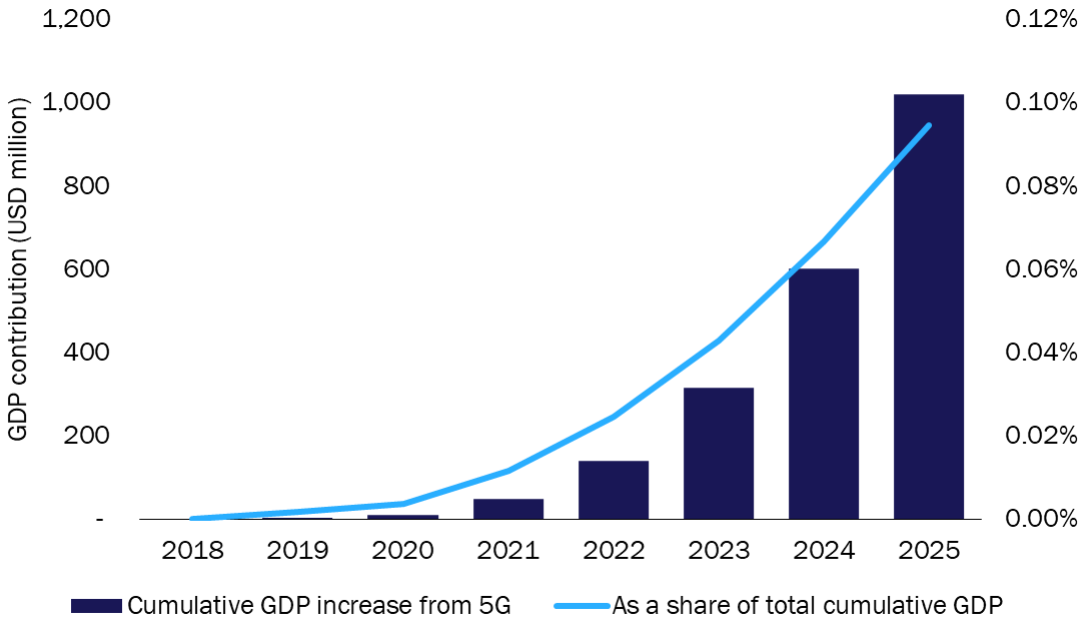
- Improved access to affordable healthcare and social care using remote telemedicine, which reduces the overall cost of providing healthcare to individuals.

- Improved access to affordable education at all levels via online schooling and interactive lectures, which can be consumed anywhere via fixed or mobile 5G links.
- Intelligent transport management to reduce congestion on the roads, with knock-on effects of reducing pollution and road accidents.
- Smart cities that will provide safer, healthier and more attractive places to live and work.
- New ways to communicate, including virtual reality calls, which can improve relations with family and friends, and improve work/life balance.

There are also many industry-specific ways to use 5G to improve efficiency and communications, and enable new ways to work with employees, partners and customers.

Analysys Mason estimates that 5G will drive a cumulative increase of more than USD1.0 billion in GDP during 2018–2025 in Kuwait (see Figure 8) – that is, about 0.09% of the cumulative total GDP of Kuwait over the same period (USD1.1 billion).

Figure 8: Cumulative increase in GDP generated by 5G, and as a share of total cumulative GDP, Kuwait, 2018–2025



Source: Analysys Mason, 2021

This is in line with the typical trajectory envisioned by other countries that have produced estimates on the likely impact of 5G on their economies – for example, the UK expects the cumulative increase in GDP generated by 5G to account for 0.13% of its cumulative GDP by 2035, France about 0.14% by 2035, Australia about 0.20% by 2030 and China about 0.24% by 2035. In terms of job creation, we estimate that 5G will create almost 25 000 new jobs cumulatively in Kuwait by 2025, accounting for almost 1% of Kuwait's overall workforce by then (over 2.5 million).

3.3 5G will have a valuable role in delivering Kuwait Vision 2035

In January 2017, the Government of Kuwait unveiled the country's Vision 2035 and National Development Plan, branded as 'New Kuwait'. This aims to transform Kuwait from a heavily oil-based economy to a regional

leader in many businesses as well as in financial stability and cultural and social progress. It is based on five strategic directions and seven pillars:

- public administration
- economy
- infrastructure
- living environment
- healthcare
- human capital
- global position.

An important enabler of progress in all seven pillars will be advanced communications, including 5G. The Communication and Information Technology Regulatory Authority (CITRA) has set a goal of making Kuwait into a global communications hub, while also modernising its digital and physical network infrastructure in the process.

Figure 9: Overview of the seven pillars of Kuwait Vision 2035[4]

Source: Kuwait government, 2018

Based on interviews with Kuwait's MNOs and more broadly with operators and regulators in the region, it is clear that 5G is expected to play an important role for Kuwait to achieve the goals of Vision 2035. The figure

4 https://kif.kdipa.gov.kw/wp-content/uploads/khalid-mahdi-english.pdf.

below summarises some ways in which 5G can support these objectives, based on the results of these interviews and on experiences of MNOs in other countries with similar socioeconomic roadmaps.

Figure 10: 5G's role in achieving the goals of Vision 2035

Pillar	Potential role of 5G	Foreign examples
Effective public administration	Hyperconnected public services	South Korea's '5G+' plan, jointly developed by nine ministries
Sustainable diversified economy	Support for optimised connectivity for many industries	Germany's Industrie 4.0 5G platform programme to enable digitalisation in many sectors
Strong progressive infrastructure	5G drives investment in spectrum, fibre and converged connectivity and enables efficient management of other infrastructure	China's 5G smart grid projects
Sustainable living environment	Smart buildings and sustainable cities	First 5G 'smart town' – Wuzhen near Shanghai, China
High-quality healthcare	Remote diagnostics and treatments can make top-quality services available to all	Response to COVID-19 – 5G aided remote scans to diagnose the virus in China and elsewhere
Creative human capital	5G can improve education and training at all levels with remote, online and immersive services	Advanced 5G human capital initiatives in the Nordic countries of Europe[5]
Exceptional international positioning	5G can underpin greater industrial competitiveness, and social and cultural change, improving overall international positioning	Germany's 5G-enhanced Industrie 4.0 initiative is designed to enable transformation in key industry sectors such as manufacturing

Sources: Kuwait government, press articles, 2021

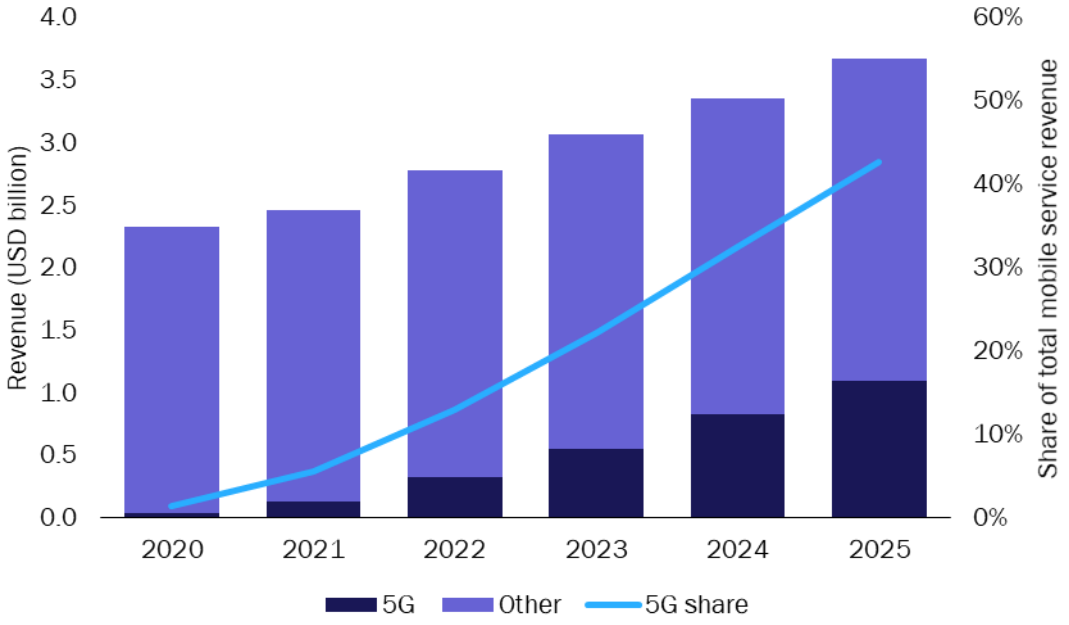
3.4 To achieve these goals, 5G must first provide an attractive business case for MNOs

MNOs will be the largest investors in building out 5G networks and ensuring that they support all the capabilities needed to make a significant contribution to Vision 2035. If 5G standalone, in particular, is to be deployed at the pace and quality that the national objectives demand, it is essential that there is a powerful business case for the operators to make the investments.

The growth potential of the 5G market looks healthy in Kuwait. The figure below shows Analysys Mason's forecast of mobile service revenue – by 2025, 5G will account for 43% of total service revenue across consumer and business markets.

5 https://www.incites.eu/incites-map/Europe_5G_Readiness_Index_Report.pdf.

Figure 11: Mobile service revenue and 5G as a share of total mobile service revenue, Kuwait, 2020–2025



Source: Analysys Mason, 2021

Achieving this revenue growth will require MNOs to have 5G standalone networks that can address the needs of many industries and the national objectives set out in Vision 2035. The business case for 5G NSA has mainly been driven by enhancing consumer services with features such as AR/VR for cloud gaming, in order to meet traditional key performance indicators such as improving ARPU or market share, or reducing churn. But in a market with a mobile penetration of 157%, monetisation and return on investment are very challenging, so the operators need to identify other markets and services that could provide new revenue opportunities and new customer bases. Zain Kuwait, for instance, has said that its three main 5G opportunities revolve around enhanced consumer entertainment, FWA (in a country with low rates of FTTx), and enterprise services, with a particular emphasis on cloud and managed services.[6]

4. Key 5G use cases for Kuwait

As outlined in Chapter 3, the strength of 5G is that it can support a wide diversity of enterprise applications and use cases. However, it can be challenging for operators or governments to identify which use case will have the biggest, or most immediate, impact. Operators need to build platforms, enabled by the flexibility of the 5G core, that will support many use cases over the coming decade. The 5G business case does not rely on a few 'killer apps', but on being able to generate incremental revenue from a large number of different use cases, especially in enterprise markets. However, operators need some 'leading use cases' that will generate returns in the near term, or have significant potential for demand in the medium-term to justify early investment in the appropriate capabilities. These leading use cases make the initial justification for expanding and enhancing 5G and

6 https://telecomreview.com/articles/exclusive-interviews/4268-zain-kuwait-leading-the-region-s-5g-revolution.

migrating to 5G standalone, and then the business case can be further improved when additional services are layered on.

In Kuwait, where 5G will be critical to achieving wider socioeconomic objectives, it is especially important that operators are motivated to invest in the new platforms, and that the leading use cases also contribute to the wider goals.

The objectives set in the Vision 2035 programme are expected to affect several vertical sectors (including smart cities, utilities, healthcare, education, finance, industry) in Kuwait. In each sector, we have shortlisted key use cases that we believe will have most impact, in the short-to-medium term, on the digital progress of these verticals and the achievement of Vision 2035 objectives. These use cases are summarised below.

Figure 12: Overview of key 5G use cases with relevance to Kuwait Vision 2035

Selected use case	Relevance to Vision 2035	Key vertical(s) affected
Sensor networks for sustainable living (e.g. air quality, waste management)	Better living environment, clear outdoor air quality	Smart cities
Smart CCTV	Better living environment, smart infrastructure	Smart cities, public safety, critical infrastructure
Remote patient diagnosis and monitoring	Optimised healthcare quality, cultivate wellness and active life styles	Healthcare
AR/VR-based remote education	World-class education, skilled and efficient labour force	Education
Long-range remote control of unmanned aerial vehicles (UAVs)	Sustainable diversified economy – supports oil and gas and newer industries	Oil and gas
Sensor networks: asset tracking and monitoring (e.g. machine tools, heavy equipment, warehouse)	International leadership especially as manufacturing and logistics hub	Manufacturing and logistics

Source: Analysys Mason, 2021

The following sub-section provides a discussion of each those six use cases, including:

- a description of their benefits
- their impact on Kuwait's socio-economic objectives
- the technical capabilities required to enable those use cases
- a high-level overview of the associated addressable market
- their importance to MNOs' business models
- examples of trials or implementations in other countries.

4.1 Sensor networks for sustainable living

Description

Sensor networks collect data and use predictive analytics to improve efficiency and sustainability in many aspects of city life. Examples include sensors for smart waste management, street lights, smart parking and air quality monitoring. This is a near-term opportunity – there are already deployments in many countries, so the market is well-understood and the ecosystem starting to mature. Many early sensor networks use non-5G connectivity, such as NB-IoT, and some city networks may continue to use multi radio access technologies, but the capabilities can be greatly enhanced by a 5G platform because it can support higher densities of sensors per square kilometre and real-time data feeds for advanced analytics enabled by artificial intelligence (AI).

Impact on socioeconomic objectives

Sensor networks are expected to have a significant impact on socioeconomic objectives. These sensor networks relate directly to a key pillar of Vision 2035, to create a sustainable and pleasant living environment within smart cities. A key benefit is that common sensors and analytics can be used to monitor all kinds of city infrastructure, devices and environmental factors. An operator may start by supporting one application, such as air quality monitoring, and then use the same platform to add others, such as waste management or smart lighting. Each new application increases the benefits to the citizens with limited additional investment required.

Capabilities and requirements

The connectivity capabilities required for this use case are summarised in the figure below.

Figure 13: Connectivity requirements for sensor networks for sustainable living

Capability	Requirement
Throughput	Very low (<1Mbit/s)
Device density	Very high (>1 million / km^2)
Availability	High (99.1%–99.9%)
Latency	High (> 50ms)
Mobility	Very low (<1km/h)
Overall 5G criticality	Enhanced by 5G (e.g. range of services that can be supported)

Source: Analysys Mason, 2021

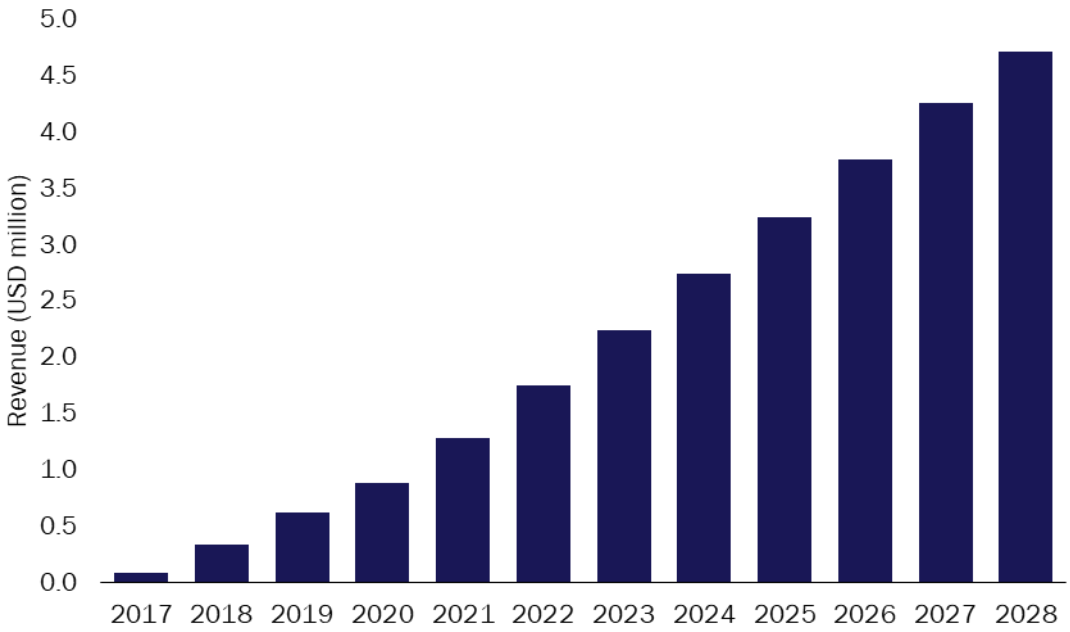
These applications can be delivered on a 4G or LPWAN network, but the requirement for high device density means that 5G considerably enhances the performance and the range of services that can be delivered. In addition, the 5G core provides the operator with the flexibility to add new sensor-based services in future that may require more demanding capabilities such as real-time feeds to AI-enhanced analytics engines, or high security/privacy ratings. Deploying 5G from day one will enable the operator to enhance the service in this way, without having to replace the network.

Market size

Sensor networks can improve quality of living in all environments, but the impact will be felt most strongly in cities, especially in an urbanised country like Kuwait, where smart city programmes are underway even with pre-5G technologies. The figure below shows Analysys Mason's forecast of total mobile IoT revenue from

smart city applications between 2017 and 2028 in Kuwait – revenue is expected to grow at a CAGR of 44% over the period and to reach USD4.7 million by 2028.

Figure 14: Wireless IoT revenue from smart city solutions, Kuwait, 2017–2028



Source: Analysys Mason, 2021

Importance to MNO business model

As the table shows, this use case is attractive to MNOs. Although each individual service may have relatively low revenue potential, the MNO gains the opportunity to add more and more applications to the same platform over the years to ensure that revenue increases with limited additional investment. Creating that common platform is a more complex task than establishing a simple connectivity network for one or two applications, but gives the MNO a much enhanced role in the value chain and strategic importance to stakeholders such as city governments or public health bodies. As some services already exist on 4G or LPWA networks, the ecosystem is already developing and the timescale to large-scale adoption will be short, given the direct impact that these services could have on Kuwait's sustainable living goals. That should ensure support from key stakeholders as well as from citizens.

Figure 15: Impact of sensor networks for sustainable living on MNOs' 5G business model

Aspect	Comment
Complexity of implementation	Medium
Timescale to large-scale adoption	Short term
Ecosystem readiness	Pilots in 5G, commercial in 4G
Market size	Medium – USD4.7 million in 2028

Source: Analysys Mason, 2021

Examples from other countries

Sensor networks have been established and 4G IoT systems have been made 5G-ready in many cities round the world.

- Tilburg in the Netherlands has worked with wireless sensor manufacturer Libelium to develop an environmental control platform that will be connected to the 5G core when that is deployed, to support a future-ready, multi radio access network.

- China Mobile has developed an online air pollution monitoring system, which will also be integrated into a broader analytics platform supported by a 5G core in future.

- The GSMA reports[7] that MNOs have led a range of initiatives supporting air quality monitoring, including China Mobile in Chongqing, Telefónica Brasil in Luca, and Deutsche Telekom in Croatia and Greece.

4.2 Smart CCTV

Description

Distributed, city-wide CCTV and IP cameras are networked via wireless connections for advanced analytics. This use case is generally implemented first for public safety applications but can also be applied to private enterprise and industrial sectors for security, which can enhance the revenue potential for MNOs.

Impact on socioeconomic objectives

The safety and security of citizens and their possessions is fundamental to the goal of a sustainable and pleasant living environment, which is a pillar of Vision 2035. It is also important to the development of strong and sustainable infrastructure and industries that assets can be protected from theft or damage. Although CCTV and security cameras are in common usage in Kuwait, a 5G-enabled system can support superior identification of criminals, issue alerts and make preventative decisions before crimes occur.

In July 2018, the Kuwaiti government announced the implementation of smart city strategies covering intelligent infrastructure networks, security, virtual systems and the smart city applications in the Silk City and Kuwaiti islands development project.

Capabilities and requirements

The connectivity capabilities required for this use case are summarised below

7 https://www.gsma.com/iot/wp-content/uploads/2018/02/iot_clean_air_02_18.pdf.

Figure 16: Connectivity requirements for smart CCTV

Capability	Requirement (basic)	Requirement (advanced)
Throughput	Medium (<100Mbit/s)	High (<1000Mbit/s)
Device density	High (<1 million / km^2)	High (<1 million / km^2)
Availability	High (99.1–99.9%)	Very high (99.9–99.999%)
Latency	Medium (<50ms)	Low (<10ms)
Mobility	Low (<10km/h)	Low (<10km/h)
Overall 5G criticality	Enhanced by 5G	5G critical

Source: Analysys Mason, 2021

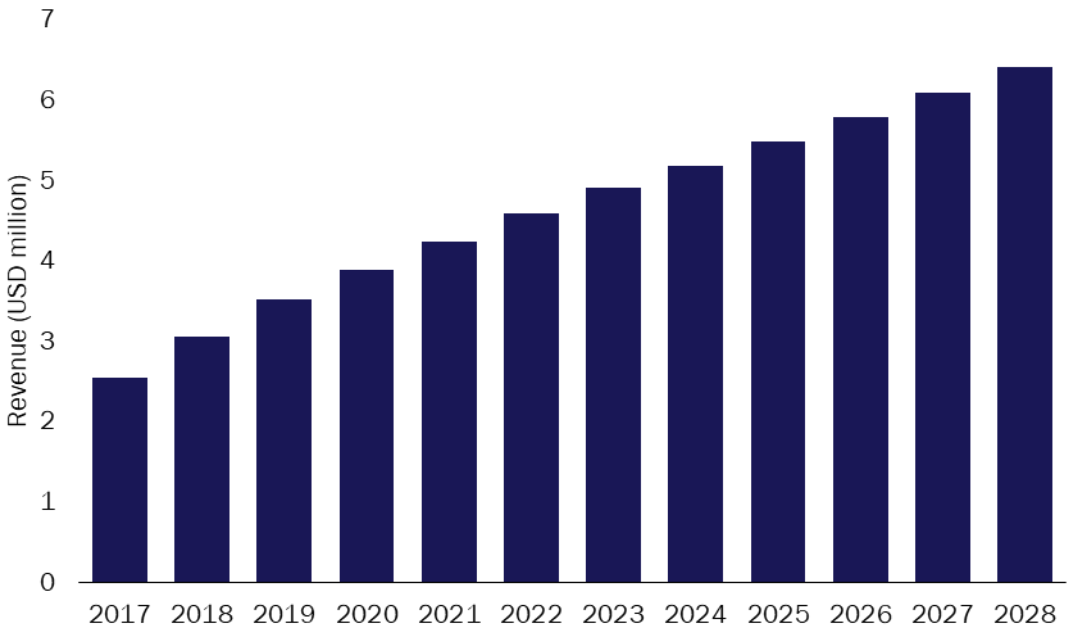
This is an example of a use case that can be supported in the near term by building a relatively simple implementation, which can then be enhanced as 5G capabilities are evolved, in order to enable more complex services in the future. Those would provide improved capabilities for users, increasing the economic impact and improving the revenue for MNOs.

When an MNO deploys advanced 5G capabilities such as ultra-low latency and high availability, enabled by 5G standalone, it can enhance the connectivity offered to the same cameras, and the 5G core can improve the integration with real-time analytics and AI capabilities such as preventative action. Network slices can be defined to guarantee the required QoS and latency characteristics for high-quality real-time video, adding to the value of the service and the revenue.

Market size

The revenue from enabling smart CCTV and security cameras with 5G or 5G-ready connectivity will grow at a CAGR of 9% between 2017–2028 to reach almost USD6.4 million by 2028. More enterprises and property owners are expected to implement 5G security cameras in the medium to longer term, which will have a positive impact on adoption. Advanced 5G capabilities will enable value-added services such as image analytics, driving revenue growth further.

Figure 17: Wireless IoT revenue from public CCTV and security cameras solutions, Kuwait, 2017–2028



Source: Analysys Mason, 2021

Importance to MNO business model

By taking a multi-phased approach to the services, and by extending the target market from public safety to private enterprise and property protection, MNOs can future-proof the implementation of smart CCTV services. While some CCTV applications can be supported by non-5G connectivity, if they are deployed on 5G from day one, MNOs have a good chance of extending the business case with only moderate extra investment, especially by taking advantage of the capabilities of the 5G core when that is deployed. This approach will also progressively improve the benefits for users and for stakeholders such as city governments. Because of the criticality of public safety applications, MNOs will need to work closely with multiple organisations within the value chain (see Chapter 5 for an outline of this chain).

Figure 18: Impact of smart CCTV on MNOs' 5G business model

Aspect	Description
Complexity of implementation	Medium
Timescale to large-scale adoption	Basic: short term Advanced: medium term
Ecosystem readiness	Basic: commercial Advanced: pilots
Market size	Basic: medium (USD6.4 million in 2028) Advanced: high

Source: Analysys Mason, 2021

Examples from other countries

- 5G-capable smart cameras are being installed in Barcelona and Singapore in order to take advantage of the bandwidth and quality-of-service capabilities of the new networks when they are available.

- In Hanoi in Vietnam, video feeds from cameras are analysed for public safety applications.[8]
- Korea Telecom has demonstrated AI-equipped connected cameras for public safety applications in Seoul.
- Foxconn has conducted trials combining edge computing and AI for payments security and will integrate the same technology in to CCTV.

4.3 Remote patient diagnosis and monitoring

Description

Wireless connectivity is used to deliver healthcare services to patients remotely, providing wider access to experts while reducing the need for travel or hospital beds. This enables a variety of services, including remote diagnostics supported by AI, and monitoring of key indicators for chronic healthcare complaints, such as sugar levels in diabetics. 5G enables additional options such as immersive, consultations using augmented reality (AR) or virtual reality (VR) and diagnosis.

Zain has launched Zain Health, a digital healthcare platform for corporate customers, enabling doctors, nurses and other medical treatment providers to monitor patients remotely using smart devices over Zain's network.

Impact on socioeconomic objectives

This use case relates to the prevalence in Kuwait of chronic conditions such as diabetes. Better monitoring can improve the control and management of such conditions. The data can be analysed by an AI-enhanced platform to warn of potential problems and suggest preventative action. The same combination of 5G connectivity and AI can provide access to high-quality diagnostics and medical advice, without the patient having to travel, stay in hospital or wait many weeks for an appointment. In addition, the COVID-19 pandemic has highlighted, on a global basis, the advantages of being able to diagnose and treat patients without the need for them, or their doctors and nurses, to travel. All these factors can ensure a significant impact on society through improved healthcare and reduced stress on hospital resources.

Capabilities and requirements

The connectivity capabilities required for this use case are summarised below.

Figure 19: Connectivity requirements for remote patient diagnosis and monitoring

Capability	Requirement (basic – no AR/VR)	Requirement (advanced – with AR/VR)
Throughput	Medium (<100Mbit/s)	Very high (>1000Mbit/s)
Device density	High (< 1 million per km^2)	High (< 1 million per km^2)
Availability	High (99.1%–99.9%)	High (99.1%–99.9%)
Latency	Medium (<50ms)	Low (<10ms)
Mobility	Medium (<50km/h) – option to support patients on the move	Medium (<50km/h)
Overall 5G criticality	Enhanced by 5G	5G critical (new services such as video fees and AR/VR consultations)

Source: Analysys Mason, 2021

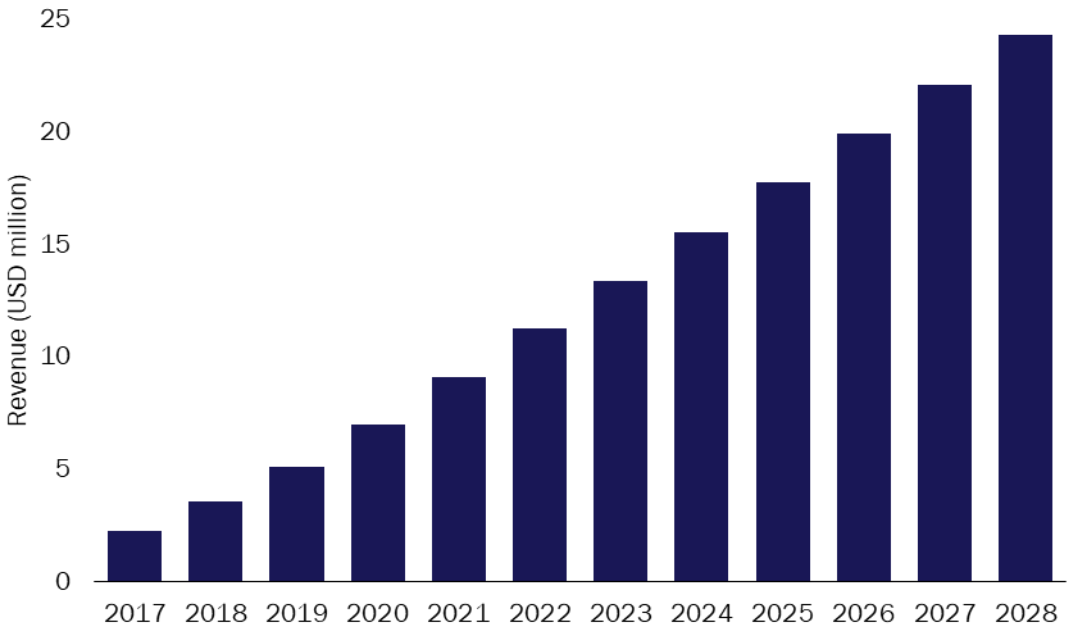
8 https://www.mobileworldlive.com/asia/asia-news/nokia-demos-smart-city-platform-in-hanoi.

This is a challenging use case from a technical point of view if the full range of capabilities is deployed. Some online vital signs monitoring services are already in commercial use in many countries via 4G, but while these are a useful tool for doctors, they cannot substitute for the in-person experience. By contrast, combining video feeds, AR/VR and AI analytics can support highly accurate diagnosis, preventative actions and immersive consultations between doctors and patients. Those services require the low latency, high bandwidth and high reliability of 5G, and with 5G standalone, a slice could be enabled to guarantee high levels of data privacy.

Market size

In Kuwait, revenue from IoT networks to support remote healthcare will grow steadily from 2017 to 2028, and from 2021, the growth rate will accelerate as a result of 5G driving new services and adoption. This market will deliver revenue growth at a CAGR of 24% in this period, to total over USD24 million by 2028 (including non-5G IoT connections from a 5G core, but excluding value-added services or mobile broadband healthcare applications).

Figure 20: Wireless IoT revenue from healthcare solutions, Kuwait, 2017–2028



Source: Analysys Mason, 2021

Importance to MNO business model

The demand for these services is high both from healthcare providers and end users, and interest and willingness to invest has been stimulated by the pandemic. In a compact country like Kuwait, the implementation challenges of reaching most of the population with suitable 5G connectivity are only moderate, and there is an immediate revenue opportunity for MNOs based on chronic conditions monitoring and online consultations, which will be enhanced when preventative analytics and rich diagnosis are added. These will help healthcare authorities to save significant amounts of money while improving services, so the willingness to pay a premium will, in our opinion, be high.

Figure 21: Impact of remote patient diagnosis and monitoring on MNOs' 5G business model

Aspect	Description
Complexity of implementation	Medium
Timescale to large-scale adoption	Short term
Ecosystem readiness	Commercial
Market size	High – USD24 million in 2028

Source: Analysys Mason, 2021

Examples from other countries

UAE's Vision 2021 programme provides for investment in connected healthcare infrastructure and personalised healthcare, while Qatar 2030 is developing initiatives for personalised patient monitoring for preventive and curative healthcare, both physical and mental.

The UK government has allocated GBP3.5 million to a project in the city of Liverpool, which is using 5G, AI, virtual reality and IoT to support patient monitoring in older adults and aid communication between hospitals and deprived communities.

4.4 AR/VR-based remote education

Description

AR/VR capabilities can be used to deliver education and training services to people who cannot attend physical classes, delivering classes to multiple schools or workplaces online to increase access to experts, and enhancing all education and training via immersive learning from any location. In some countries, many classes would be delivered via fixed connections, where the attendee is stationary, but in Kuwait, 5G is expected to be the primary medium for all broadband usage.

Impact on socioeconomic objectives

Kuwait has an urbanised population and high standard of education, so to the demand for delivering school classes remotely is limited, except in special circumstances such as people confined to home by the pandemic or other illness. However, remote and immersive learning can contribute to the Vision 2035 objective of achieving a world-class skilled workforce. It enables all students, from elementary school to university to workplace, to access classes run by experts who could not attend every physical location, or may be abroad. These remote classes are greatly enhanced by AR/VR-enabled immersive learning. With 5G, people can study in any location that is convenient, or on the move. During the pandemic, Kuwait University offered 98% of its courses remotely to minimise disruption to education. For workplace training, augmented reality supported on mobile devices enables one-to-one training and guidance to be offered to every worker, accelerating the learning process.

Capabilities and requirements

The connectivity capabilities required for this use case are summarised below.

Figure 22: Connectivity requirements for AR/VR-based remote education solutions

Capability	Requirement
Throughput	Very high (>1000Mbit/s)
Device density	Medium (<10000 per km^2)
Availability	Medium (99.5–99.9%)
Latency	Very low (<1 millisecond)
Mobility	Medium (<50km/h) – option to support students on the move
Overall 5G criticality	5G critical, as it will be the main broadband connection for many, and to support AR/VR in all locations

Source: Analysys Mason, 2021

The connectivity requirements are quite challenging but most operators expect to support advanced AR/VR as a core use case for their 5G networks, which improves the cost model for enabling these capabilities for education and training.

Market size

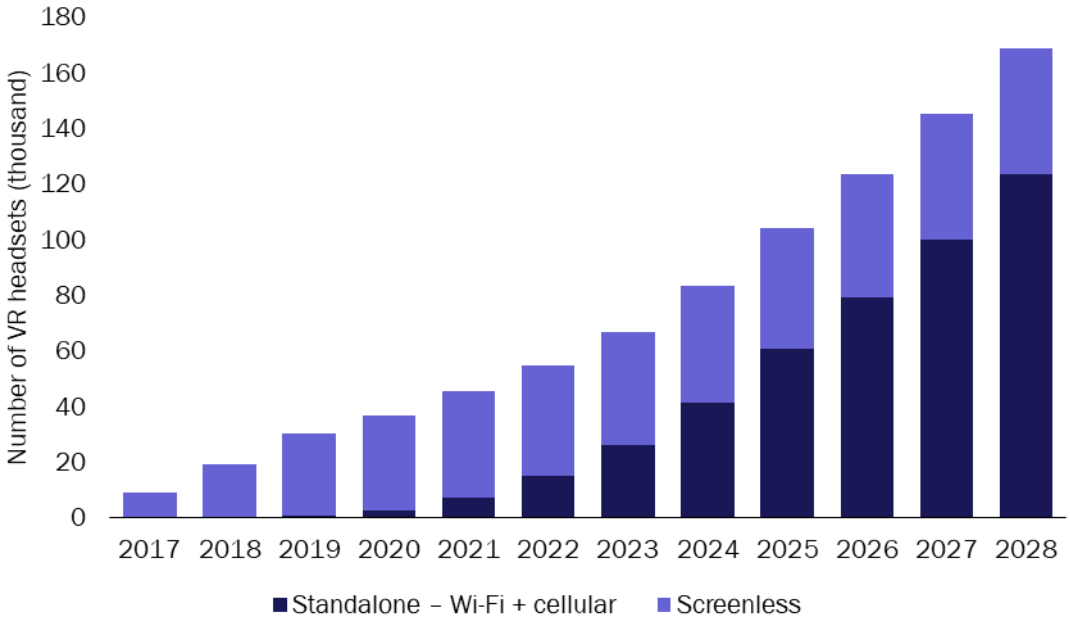
When 5G standalone is implemented, some operators expect to have a dedicated slice for AR/VR applications, and this capability can support a wide range of applications and revenue streams. Leveraging an AR/VR slice for multiple sectors improves the business case for education while also contributing to important national objectives.

Some of these applications, such as industrial digital twin or gaming, are likely to have higher ARPU than AR/VR-enabled education, especially at school level. However, the services apply to a high proportion of citizens including children and workers, so the take-up would be expected to be high, especially as people become accustomed to immersive experiences in all areas of life. Some of the workplace training services will have higher ARPU than school education, especially as these will help industries to achieve their training objectives more quickly and cheaply than by engaging on-site experts at all times.

The potential addressable market in terms of connections, therefore, consists of all school or college students, plus about one-third of workers – those in junior roles or moving between grades or professions.

Analysys Mason estimates that the number of VR headsets in Kuwait will grow at a CAGR of 31% between 2017 and 2028 and will exceed 170 000 by 2028. Most (over 70% in 2028) of those will be standalone handsets (that is, with cellular connectivity built in), while the rest will be 'screenless viewers' (that is, using a smartphone).

Figure 23: VR headsets (excluding tethered and Wi-Fi only) by type, Kuwait, 2017–2028



Source: Analysys Mason, 2021

AR/VR-enabled 5G education is expected to generate revenue of USD700 million by 2025, globally.[9] We estimate that the revenue available to Kuwait's operators in the same year could total USD5.5 million, which would provide a significant incremental return on investment in AR/VR and will also support additional revenue from gaming, video services, industrial services and so on.

Importance to MNO business model

For this reason, investments in AR/VR, and a diversity of services based on that capability, are central to MNOs' 5G business models, in our opinion. This is a near-term opportunity because the pandemic has increased demand for education and training organisations to be able to reach students in any location, and this is unlikely to be reversed even when COVID-19 has abated.

Figure 24: Impact of AR/VR-based remote education solutions on MNOs' 5G business model

Aspect	Description
Complexity of implementation	High, but will support many revenue streams
Timescale to large-scale adoption	Short-term
Ecosystem readiness	Commercial, high demand
Market size	Medium – USD5.5 million 2025, but AR/VR platform will support many other applications and sectors

Source: Analysys Mason, 2021

9 Goldman Sachs Global Investment Research.

Examples from other countries

- Zain Bahrain has rolled out augmented reality on a 5G network to support mobile learning for staff.[10]
- In the UK, multiple universities have started using 5G-enabled VR platforms to deliver interactive seminars to remote students. For example, Coventry University is working with Vodafone.[11]
- Verizon plans to bring 5G to 100 US schools in a pilot of VR/AR learning to support digital inclusion.[12]

4.5 Long-range remote control of UAVs

Description

Unmanned automated vehicles (UAVs) such as drones can be controlled remotely over a 5G network, to support inspection and monitoring of industrial infrastructure. In the oil and gas industry, for example, this could include oil rigs, petrochemical plants or power stations. In ports, drones could be used to monitor terminal operations and traffic flows. The cellular network provides the broad coverage for sites that may be out of reach of other networks, and 5G enables near-real-time data feeds, including images, which can be used by an AI analytics engine for applications such as preventative maintenance and digital twin. 5G also removes the line-of-sight requirement for other methods of controlling drones.

Impact on socioeconomic objectives

UAV-based applications are being used extensively in industrial sectors round the world to improve resilience, productivity, cost-effectiveness and safety. Oil and gas, ports, telecoms, manufacturing and construction are particularly heavy users of these services and all are important to the Kuwaiti economy. Oil and gas account for 50% of its GDP, and manufacturing 10%, and although Vision 2035 seeks to diversify the economy away from relying on oil, it will remain an important element of the economy for many years. Any moves to improve efficiency will boost the competitiveness of Kuwait's oil industry and that will generate benefits for the wider economy too.

One estimate is that drones save the oil and gas industry 85% in the cost of inspection and maintenance by enabling preventative actions and spotting potential problems before they occur.[13] They are also up to 80% cheaper for routine and emergency maintenance work than human labour.

Capabilities and requirements

The connectivity capabilities required for this use case are summarised below.

Figure 25: Connectivity requirements for long-range remote control of UAVs

Capability	Requirement
Throughput	Medium (<100Mbit/s) to high (<1000Mbit/s), depending on reliance on images
Device density	Low (<1000 per km^2)
Availability	Very high (>99.9%), with near real time support for critical infrastructure
Latency	Very low (<1 millisecond)

10 https://www.bh.zain.com/en/zainbahrain/m-learning.

11 https://newscentre.vodafone.co.uk/features/5g-standalone-takes-virtual-reality-teaching-to-the-next-level/.

12 https://www.verizon.com/about/responsibility/digital-inclusion/verizon-innovative-learning.

13 https://www.fircroft.com/blogs/droning-on-the-rise-of-drones-in-the-oil-and-gas-industry-62911710322.

Mobility	Medium (<50km/h)
Overall 5G criticality	5G enhanced (e.g. near-real time monitoring and image processing)

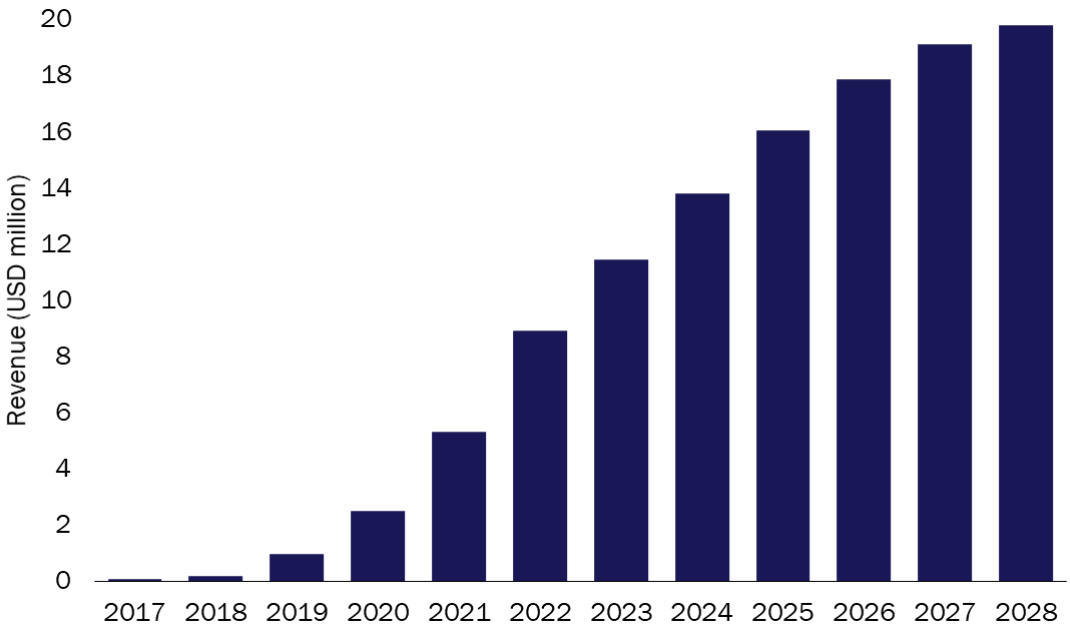
Source: Analysys Mason, 2020

Basic levels of infrastructure monitoring can be achieved using drones controlled over 4G or a low-power WAN, but the maximum impact for the industry will be achieved by enhancing the applications to include near-real-time data feeds and significant amounts of image processing. That will require 5G levels of reliability, latency and throughput, all supporting highly mobile devices. Another requirement is coverage of remote areas that would not necessarily be addressed by the main mobile broadband 5G network. Some operators will work with partners to build out private or semi-private networks in these locations.

Market size

According to PwC, 43% of service revenue in the drones market will come from the oil and gas sector in the period from 2020 to 2026. Our forecasts indicate that the revenue potential for drones in Kuwait's oil, gas and industrial sectors will grow at a CAGR of 63% during 2017–2028 to reach almost USD20 million by 2028, driven by 5G capabilities, which will also generate additional revenue, for telecoms operators and the wider ecosystem, from value-added services such as analytics.

Figure 26: Wireless IoT revenue from UAV-based inspection and maintenance solutions, Kuwait, 2017–2028



Source: Analysys Mason, PWC, 2021

Importance to MNO business model

Some operators will support the specific requirements of drone inspection within a dedicated slice. This slice, combined with ubiquitous coverage to industrial locations, could provide competitive edge in many industry sectors, and enable the operator to adapt its UAV capabilities for multiple customers in oil and gas, manufacturing, telecoms and other businesses, enhancing the revenue potential.

Figure 27: Impact of long-range remote control of UAVs on MNOs' 5G business model

Aspect	Description
Complexity of implementation	High, extended coverage and integration with AI
Timescale to large-scale adoption	Short term
Ecosystem readiness	Commercial
Market size	High – USD20 million in 2028

Source: Analysys Mason, 2021

Although it may be challenging to achieve full coverage, this is less of an obstacle in Kuwait than many countries because of its compact geography. The timeline for the oil and gas industry to adopt remote inspection is short, and so revenue will be available immediately. For instance, in 2019, Japan's Terra Drone formed a joint venture with Saudi inspection services company NDT Corrosion Control Services to offer drone-based services to various industries in Kuwait and other GCC countries. 5G will enhance the services of such partners.

However, to maximise the revenue opportunity, operators need to form alliances now with key partners in the value chain, such as applications and analytics providers, drone-as-a-service operators and drone manufacturers. If the operator can provide end-to-end services to the whole chain, its revenue potential will be far higher than providing connectivity alone. Analysys Mason estimates that, in a wide area IoT application like drone inspection, about 14% of the revenue is captured by connectivity services (see section 5.3 for more on value chains).

Examples from other countries

- China Mobile used a 5G cellular network to pilot a drone remotely in Wuxi (China's Jiangsu province) over a long distance by using 'handover' technology, and the drone also took 4K pictures. China Mobile conducted the first 5G drone field trial in 2016.
- In the UAE, the drone market is estimated to reach USD122 million by 2023 due to expected demand for military and commercial UAVs, according to global think tank TechSci Research.

4.6 Sensor networks for high-value asset tracking and monitoring

Description

The use of 5G sensors for tracking and monitoring high-value assets such as machinery, vehicles and heavy equipment. This is particularly relevant for complex industrial environments such as ports, airports and large manufacturing and logistics plants. Data from the sensors can be fed in near-real-time to AI-enhanced decision support systems for applications such as equipment security, goods tracking and preventative maintenance.

Impact on socioeconomic objectives

Efficient near-real-time tracking and analysis can significantly improve the productivity of large industries and reduce problems caused by lost or damaged equipment and goods. This will be important to Kuwait's manufacturers and particularly important to help make its ports competitive at a regional and global level. Being a world-class hub for trade and logistics is an important part of the Vision 2035 objective to support diverse and sustainable industries with global impact. The Kuwait Ports Authority operates three major locations in Shuwaikh, Doha and Shuaiba, and is building a new major port in the south of the country.

5G capabilities and requirements

The connectivity capabilities required for this use case are summarised below.

Figure 28: Connectivity requirements for sensor networks for high-value asset tracking and monitoring

Capability	Requirement
Throughput	Medium (<100Mbit/s) to high (<1000Mbit/s), depending on reliance on images
Device density	Medium (<10 000 per km^2)
Availability	High (99.1–99.9%), with near real-time support
Latency	Low (<10 millisecond)
Mobility	High
Overall 5G criticality	5G enhanced (e.g. support of high mobility and mission-critical applications)

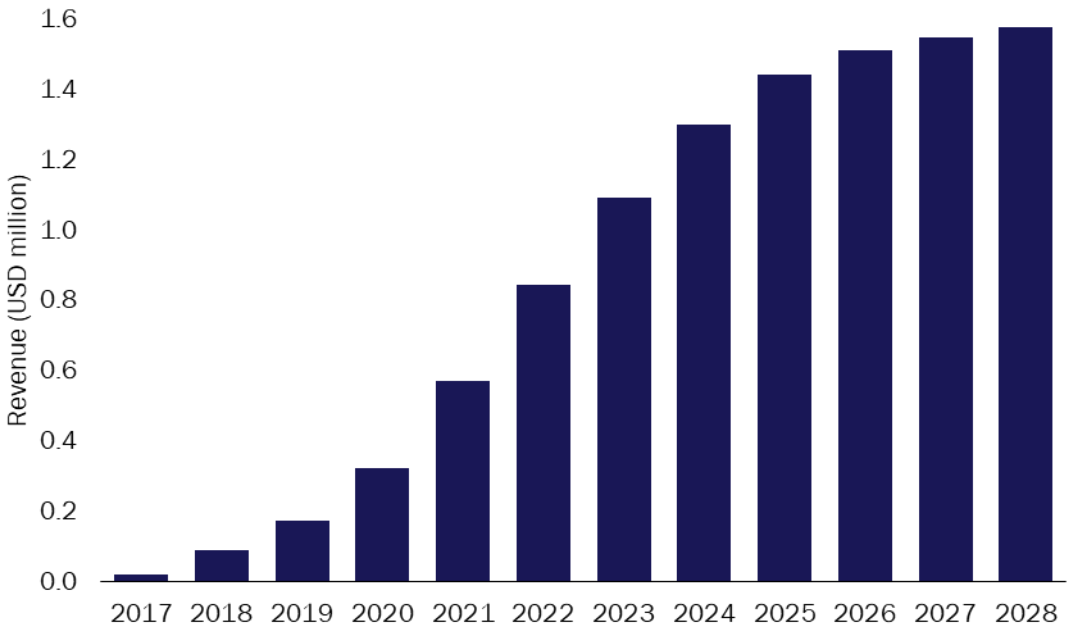
Source: Analysys Mason, 2021

Some ports and other hubs already have wireless networks for asset tracking, based on 4G or Wi-Fi, but 5G allows for a far wider diversity of applications to be layered on a port's platform, including those that rely on near-real-time image processing or require mission-critical levels of reliability.

Market size

The revenue generated by tracking high-value assets has a high growth rate (51% CAGR between 2017–2028). The incremental revenue of USD1.6 million a year by 2028 are just one element of a model that an MNO could build around a broader services and connectivity platform for a complex environment such as a smart port.

Figure 29: Wireless IoT revenue from tracking and monitoring high-value assets, Kuwait, 2017–2028



Source: Analysys Mason, 2021

Importance to MNO business model

The value of a 5G-enabled system, to the port operator and all its customers and stakeholders, could be three times higher in terms of productivity and business KPIs than a 4G or Wi-Fi system, according to a European Union study of smart ports. That should be reflected in the revenue potential for the MNO, especially if they guarantee reliability and accuracy, as set out in service level agreements (SLAs). This can be done in 5G by using the 5G core to support a slice or a virtualised private network for a particular hub location.

Figure 30: Impact of sensor networks for tracking and monitoring high-value assets on MNOs' 5G business model

Aspect	Description
Complexity of implementation	Medium
Timescale to large-scale adoption	Short to medium (requires 5G SA)
Ecosystem readiness	Commercial
Market size	Low – USD1.6 million in 2028

Source: Analysys Mason, 2020

Although the connectivity requirements are demanding, this scenario applies to limited geographical areas, reducing the implementation time and cost and ensuring that build-out cost is well aligned to the demand. Smart ports with 5G networks are starting to appear in some parts of the world such as Hamburg in Germany and Hong Kong, which means an ecosystem of applications and analytics providers is starting to emerge on a global basis. With Kuwait's ports aiming to become world-leading trade centres, we expect demand to materialise quickly but this application would be best deployed when MNOs have built their 5G SA and core, to support a slice.

Examples from other countries

- Hamburg in Germany was the testbed for the European Union's 5G-Monarch project and is now implementing 5G-enabled sustainable asset tracking and logistics.[14]
- The Port of Qingdao, one of the 10 busiest in the world, is deploying a 5G smart harbour system.[15]
- China Mobile and, ZPMC are trialling 5G at multiple ports in China including Shanghai Yangshan.

5. 5G readiness and key drivers to 5G adoption in Kuwait by 2026

The use cases outlined in Chapter 4 hold significant potential for Kuwait's industries and broader society. However, many of these use cases will be challenging to deploy. These challenges fall into three broad categories:

14 https://sustainableworldports.org/project/port-of-hamburg-5g-monarch/#:~:text=The%20future%20of%20mobile%20communication,the%20Horizon%202020%20Framework%20Programme.

15 https://www.ericsson.com/en/networks/cases/5g-smart-harbor-at-the-port-of-qingdao.

- the readiness of the current 5G networks to support the required capabilities such as low latency
- the access to key enablers such as spectrum and fibre to support these services
- the ability of the operators to establish a position in the value chain and ecosystem for each different vertical.

5.1 Network capability readiness

As outlined in Section 4, some 5G capabilities are particularly important for supporting the selected use cases, which may require investment and network optimisation on top of the deployment of a 5G network for generic mobile broadband.

The figure below indicates the areas in which the maximum capabilities of 5G, for throughput, device density, availability, latency and mobility will be required to be supported. It shows that, to support all six selected use cases, operators would need to support most of the key performance capabilities of 5G, rather than just those required for consumer mobile broadband applications.

This indicates that the more demanding use cases an MNO can support, the better return it will receive on its investment in advanced 5G capabilities, and the more high-value revenue opportunities it will be able to address.

Figure 31: Summary of 5G network requirements of each selected use case

Use case	Very high throughput >1Gbps	Very high device density >1m/km²	Very high availability >99.9%	Ultra-low latency <1ms	High mobility >100km/ hour	Universal coverage
Sensor networks for sustainable living		✔				✔
Smart CCTV			✔			✔
Remote healthcare	✔ 16					✔
AR/VR-based education	✔			✔		
Remote control of inspection UAVs			✔	✔		✔
Tracking high-value assets						✔

Source: Analysys Mason, 2021

16 If used in combination with AR/VR, high throughput requirement (<1Gbps) otherwise.

Kuwait's MNOs score highly multi-gigabit speeds and on coverage – all three claim near-universal population coverage. It would be only a moderate investment to extend that coverage to unpopulated areas to support, for example, an remote petrochemical facility or power plant.

Importantly for Kuwait's desire to be an economic hub for the region, the MNOs have already started to support cross-regional 5G roaming and integration. This will be key to supporting B2B customers that operate across multiple Middle Eastern countries. For instance, in January 2019, Ooredoo made the first 5G call between two GCC states, Qatar and Kuwait.

The next stage will be to build on these advantages by enabling IoT-centric capabilities such as ultra-low latency and critical availability. That will mean investing in Release 16 and 17 features and in 5G Standalone. MNOs will also need to increase bandwidth continually, especially indoors, to support the rising use of AR/VR and high-quality video in IoT and enterprise applications, and that will rely in part on access to additional spectrum (see below).

The business case may be significantly enhanced by the deployment of 5G Standalone with a full 5G core, as that will enable a service-based architecture with flexible support for a wide diversity of applications. For use cases with high availability or very low latency requirements, a dedicated slice can be implemented to guarantee SLA compliance and greatly improve the value of the use case to the operator's revenue mix and to the customer.

STC was the first operator in Kuwait to launch an end-to-end 5G SA network based on a cloud-native core. It is also conducting trials to increase bandwidth, uplink speed and indoor penetration by aggregating its 2.1GHz 3G spectrum to its 3.5GHz 5G band.[17]

Ooredoo has started to deploy a 5G cloud-native core in Qatar and could extend this technology to its other operating countries including Kuwait; similarly, Zain has deployed 5G SA and core in Saudi Arabia first, and may roll it out in other operating markets in the region in the future.

5.2 Infrastructure and regulatory readiness

Kuwait, along with other Gulf countries, has taken a leading position in terms of 5G availability, with the regulator issuing spectrum licences in the 3500MHz band (C band) to MNOs in May 2019, and all three MNOs introducing 5G commercial services (fixed-wireless and mobile) over the following two months. By the first quarter of 2020, at least two MNOs had reported near 'nationwide' 5G population coverage in Kuwait. A survey conducted by mobile analytics company Opensignal between July and September 2020 reported that individuals with a 5G plan in Kuwait had access to 5G connectivity over 25% of the time, placing Kuwait in second place in terms of 5G availability among the 15 countries benchmarked by Opensignal.

17 https://www.commsupdate.com/articles/2020/08/24/stc-kuwait-trials-2100mhz-5g/.

Figure 32: 5G commercial services availability and frequency bands deployed for 5G in the Gulf countries (as of January 2021)

Country	Operator	5G service type	Launch date	5G coverage	Frequency bands deployed for 5G
Bahrain	Batelco	FWA and mobile	June 2019 (FWA), July 2019 (mobile)	95% population (October 2020)	2600MHz[18]
	STC	FWA and mobile	June 2019 (FWA), July 2019 (mobile)	>50% territory (April 2020)	2600MHz
	Zain	FWA and mobile	June 2020	Unknown	2600MHz
Kuwait	Ooredoo	FWA and mobile	June 2019 (FWA), July 2019 (mobile)	45% population (March 2020)	3500MHz
	STC	FWA and mobile	June 2019 (FWA), July 2019 (mobile)	100% of 'populated areas' (December 2019)	3500MHz
	Zain	FWA and mobile	June 2019 (FWA), July 2019 (mobile)	80% population (March 2020)	3500MHz
Oman	Omantel	FWA	December 2019	Parts of selected cities	3500MHz
	Ooredoo	FWA	May 2020	Parts of selected cities	3500MHz
Qatar	Ooredoo	FWA and mobile	July 2019	90% population (September 2020)	3500MHz
	Vodafone	FWA and mobile	July 2019	70% of Doha (February 2020)	3500MHz
Saudi Arabia	Mobily	FWA and mobile	1Q 2020	Over 50 cities (December 2020)	2600/3500MHz
	STC	FWA and mobile	June 2019	Main cities (October 2020)	2300/3500MHz
	Zain	FWA and mobile	October 2019	Over 50 cities (December 2020)	2600/3500MHz
UAE	du	FWA and mobile	June 2019	Main urban areas (February 2020)	2600/3500MHz
	Etisalat	FWA and mobile	May 2019	Main urban areas (February 2020)	3500MHz[19]

Source: Operators, Telegeography, GSMA, STC, 2020

The use of 3500MHz spectrum has allowed MNOs to achieve significant 5G coverage in Kuwait, but no roadmap has been published yet for awarding millimetre-wave spectrum in Kuwait (above 20GHz) which some regulators in other countries in the region are allocating to enable MNOs to add high-capacity hotspots. Millimetre-wave spectrum may become valuable to Kuwaiti MNOs that want to support high bandwidth applications for enterprises within limited footprints, such as industrial AR/VR services in a port or factory

18 Early reports in 2018 suggested that 3500MHz spectrum was being considered for 5G use in Bahrain, but no further developments have been publicly released since then

19 Etisalat has also spectrum in the 2600MHz band, but reportedly uses it for 4G services only

complex. The expansion to the 2300MHz and 2600MHz bands is a matter of regulatory discussion in Kuwait, and more broadly in the Gulf region.

More serious is the lack of fibre in Kuwait, which has the lowest fixed broadband household penetration in the Gulf region, at almost 30% in 2020, with 72% of these connections relying on DSL. That limits some of the operators' options for deploying emerging virtualised RAN architecture, which relies on high-quality fibre to link radio units to shared baseband units in the cloud. It also limits their ability to use a combination of fibre and 5G access, controlled from a common 5G core, to support some enterprise services. Operators that have converged access can steer traffic across either network dynamically in order to deliver data in the most cost-effective and best-suited way for a particular task. We note however that some MNOs have made acquisitions to enhance their fixed broadband offering (e.g. internet service provider Qualitynet has been acquired by STC in 2019). In addition, some operators have launched 5G connectivity services for businesses with the aim of complementing their existing fibre connectivity offering.

Operators that wish to offer cloud-based enterprise services also have more limited infrastructure choices than their counterparts in 5G leadership countries such as China or the USA. AWS is present, but the other web-scale cloud providers, such as Azure and Google Cloud, do not operate in Kuwait. MNOs need to invest in their own telco clouds to support 5G cloud or edge services, or use more localised providers including Zajil Telecom. Zain recently announced cloud services in Kuwait, and Ooredoo also has a telco cloud. These build-outs may have added value to enhance the telcos' business models since one of the goals of Vision 2035 is to turn Kuwait into a regional data centre.

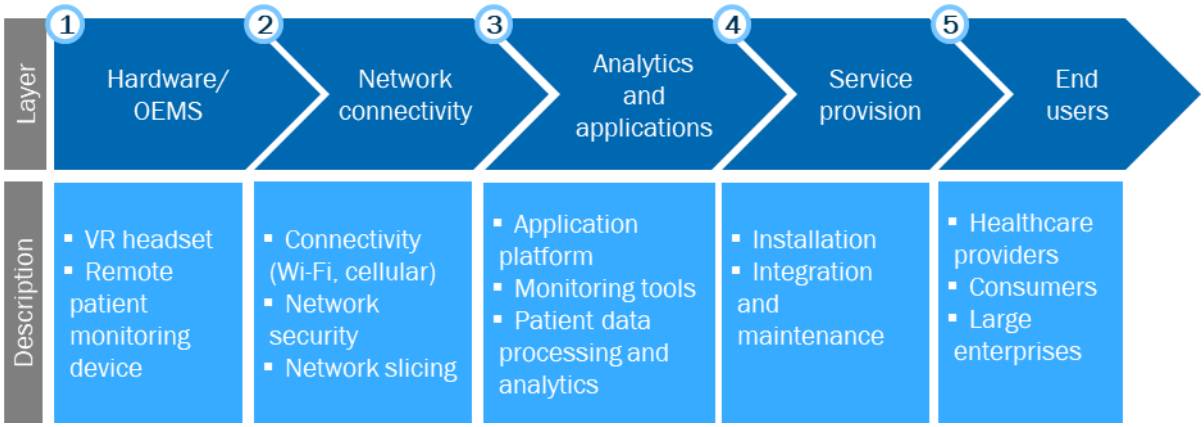
5.3 Ecosystem readiness

If MNOs are prepared in terms of their network capabilities and access to spectrum and infrastructure, an other critical success factor will be for 5G use cases to be supported by a strong value chain ecosystem.

Each use case has a different value chain, and that value chain may vary in different verticals where the services are adopted. Ecosystem readiness is important since device manufacturers, application developers and others will be key to enable the services on top of the 5G capabilities. An important criterion for selecting the six target use cases for Kuwait was that they have an ecosystem, local and global, which is maturing rapidly. Sometimes it is evolving from earlier services delivered in 4G or Wi-Fi, as in smart city sensor networks; sometimes partners are responding to particularly urgent demand, as with pandemic-driven changes in healthcare and education.

As an example, the figure below shows a typical ecosystem for remote healthcare diagnostics and monitoring case, including hardware providers, MNOs, analytics and applications specialists, providers of services such as billing, systems integrators as well as healthcare organisations themselves.

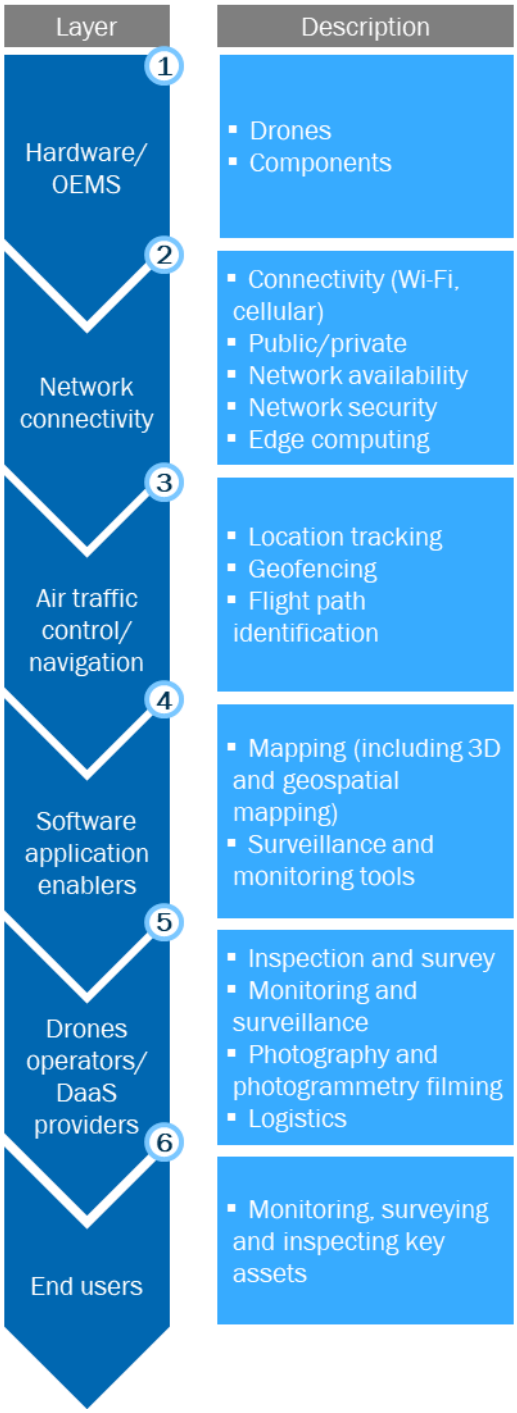
Figure 33: Illustrative value chain for remote healthcare diagnostics and monitoring



Source: Analysys Mason, 2021

In each value chain, the operator must select the role that will satisfy its KPIs most effectively, and that will help to determine its relationships with other members of the ecosystem. In the example of the UAV-based inspection use case, an MNO may decide to provide connectivity, and related services such as network security, alone; or may aim to pull together an end-to-end service, providing a one-stop shop for the customer. The right balance of ecosystem partners will help to optimise the business case for a particular service, from the operator's point of view. For instance, strong partnerships may reduce the cost of entering a new sector by building on existing relationships, and enable the operator to address more revenues than just those from connectivity. The revenue from added value services, such as integration services or analytics in the example above, will have to be shared with other value chain participants, but can still enhance the overall revenue case for the operator.

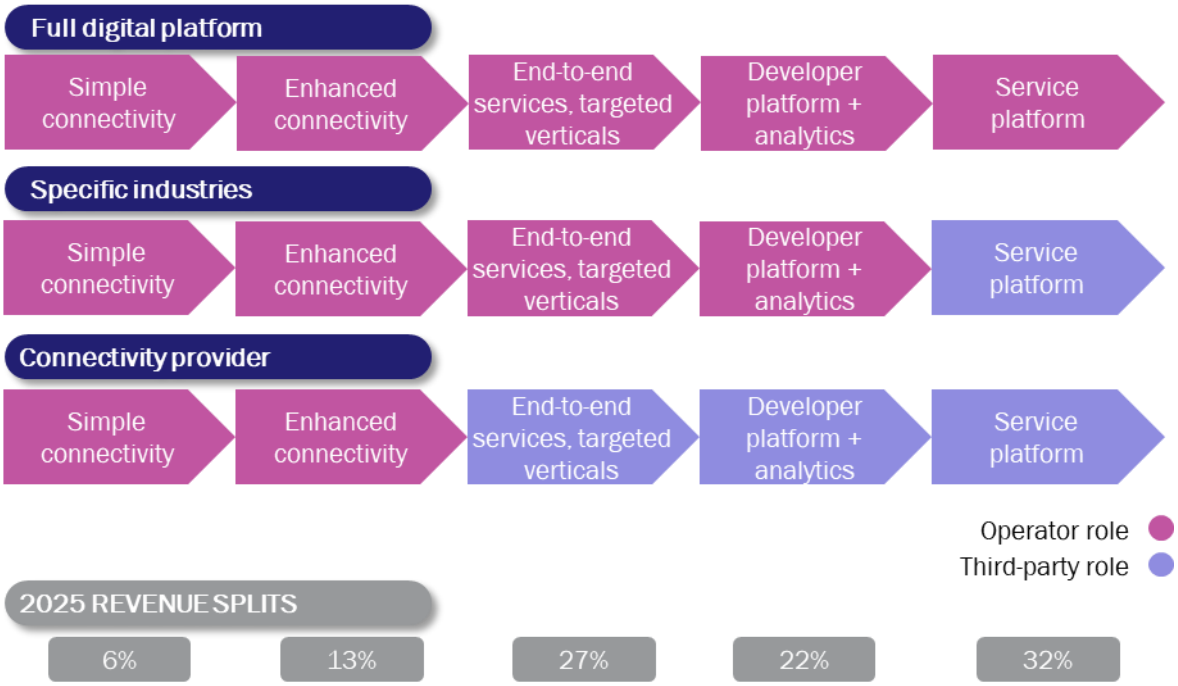
Figure 34: Illustrative value chain for UAV-based inspection



Source: Analysys Mason, 2021

Analysys Mason models that, in 5G/B2B markets in the Gulf region, the typical value breakdown between the different roles is summarised in the figure below. Connectivity and value-added services such as access control or SLA-based latency guarantees amount to 21%. An MNO that can offer end-to-end services for a single vertical industry can access an additional 45%, while an operator that builds a cross-industry service platform will be able to adapt its 5G offering easily for different verticals and ecosystems, and so address the entire commercial opportunity. In 5G enterprise markets, almost half of the total value (about 45%) could be accessible to MNOs, according to Analysys Mason calculations.

Figure 35: Value chain breakdown for 5G B2B and IoT services in the Gulf region



Source: Analysys Mason, 2021

In some scenarios, the relatively low risk of offering connectivity alone can still support a strong business model, especially because a high-performance, low-latency 5G network is a unique differentiator for MNOs compared to other players in the market. However, for maximum opportunity, the solution is to build a flexible platform that can accommodate not only a wide variety of use cases, but many partners. This will also allow the operator to choose the best role in each value chain, according to its particular skills and economic objectives, and to make the biggest impact on the broader social and economic objectives of Kuwait.

6. Recommendations

The maximum impact of 5G on Kuwait's economy and society will be achieved if a wide variety of stakeholders work closely together and start planning now for implementing 5G-enabled changes. These include operators, enterprise service providers and application developers, large and small businesses, government departments and regulators.

Operators in Kuwait should move quickly to identify the strongest near-term opportunities for 5G B2B services and to ensure that they have the best network capabilities, partnerships and ecosystems in place to address them.

Businesses in all sectors where digital transformation will be underway soon should collaborate with operators and influence their roadmaps, in order to ensure the 5G networks support enterprise requirements, such as performance and location, optimally. Businesses should study best practice in markets where 5G is already well-established in order to understand how to leverage 5G most effectively.

To address the needs of these diverse businesses most efficiently, and to future-proof current investments, operators should invest in a sliceable 5G core, which will enable them to build a broad services platform that can support huge numbers of use cases and associated providers of applications, data analytics and services.

Regulators and policy makers should devise a roadmap to make spectrum and infrastructure assets available to operators in a timely manner, to facilitate the build-out of high quality 5G networks for enterprise and IoT use cases. This will help to ensure that 5G fully supports enterprise and government transformation strategies, and will make a significant contribution to achieving the goals of New Kuwait in the 2020s.

7. About the authors

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