IRAQ NATIONAL ICT INDUSTRY DEVELOPMENT WHITEPAPER

The role and importance of broadband infrastructure development on Iraq's ICT sector and digitalisation

Communication and Media Commission Iraq

Executive Summary

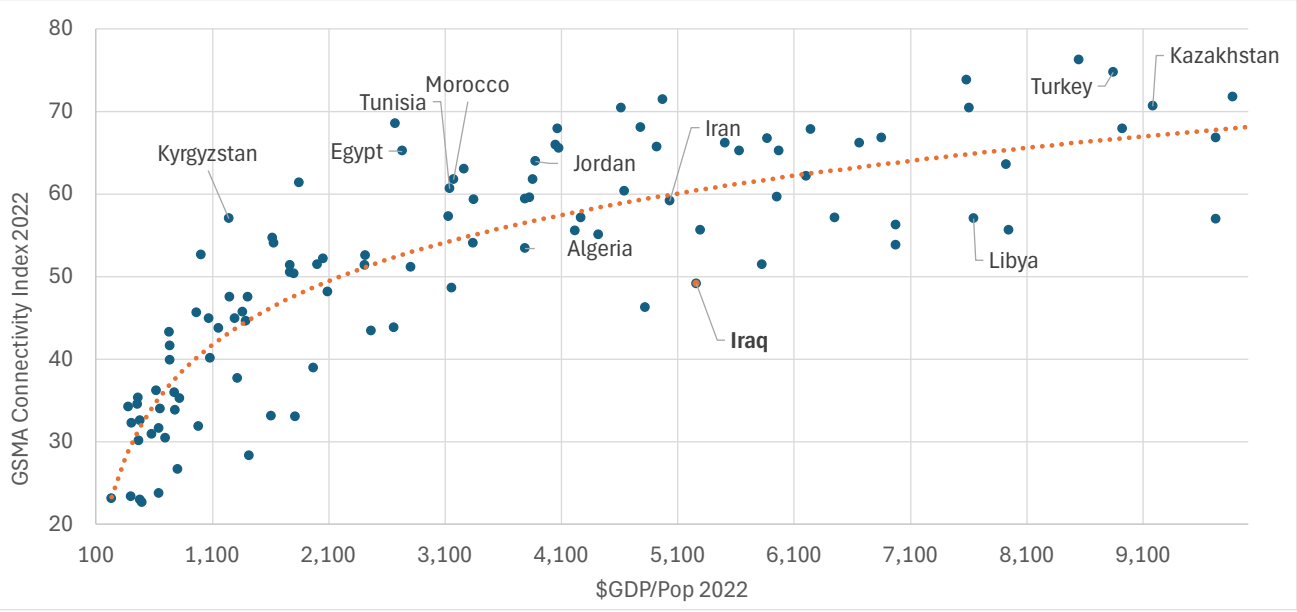
Broadband development plays a critical role in driving and accelerating digital transformation and, as a result, economic growth in Iraq. Connectivity acts as a foundation, facilitating the access and transfer of information, which is an essential pillar for driving economic growth. Enhanced, reliable and secure connectivity and the applications it enables can fundamentally change the way that individuals, businesses and government entities interact and operate.

In Iraq, despite facing extended periods of conflict and instability, infrastructure development has made important strides in recent years.

- Internet penetration and widespread adoption of mobile technology (3G and 4G) particularly in urban areas has been fuelled by the growing popularity of smartphones and mobile data services.
- Recent initiatives such as the National Internet Project have driven early developments in fibre infrastructure to meet the increasing demand for high-speed internet access.
- Digital transformation is underway across most sectors in Iraq, including and catalysed by the ICT sector, with the emergence of new digital services such as mobile banking and e-commerce platforms to meet the evolving needs of end customers.

However, there is still further progress to be made across mobile and fixed broadband availability and service quality. Iraq had a score of 49.1 in the 2022 GSMA Mobile Connectivity Index for example, which lags behind other countries and the general target benchmark (represented by the trend line in Figure 1) based on the index score relative to GDP per capita.

Figure 1: Comparison of Iraq vs. other countries on the GSMA Mobile Connectivity Index



Source: GSMA Mobile Connectivity Index (2022)

Despite investments in network expansion, coverage and quality of service varies widely across the country, with rural areas often experiencing severe limitations. Availability, a widely used measure of network reliability and consistency, has also been an issue, with 4G availability ranging from 64.4% to 87.4% across operators. Mobile broadband (MBB) download throughput is another important indicator for measuring user's experience. Iraq ranks 85th globally on this, compared its 51st GDP ranking, which indicates significant space for improvement. Development of fixed broadband infrastructure has also faced obstacles with limited availability and speeds. Fibre deployment has been slower than expected due to operational challenges, including the logistics of installing fibre across the country.

In spite of these challenges, there is a key opportunity for the country to drive better outcomes with 5G mobile broadand (MBB) and 5G fixed wireless access (FWA). Coupled with further developments in 4G and fibre, 5G can transform the country's telecommunications landscape, bridging the digital divide and providing universal, quality access. This will drive greater socio-economic development through digital inclusion and ICT sector stimulation across both urban and rural areas in the country.

This whitepaper sets out the CMC's proposals for developing the country's broadband infrastructure and target objectives that stakeholders in the telecoms industry should aim for, to close the gap highlighted in Figure 1 and to meet the Iraqi Vision 2030.

Figure 2: Key mobile broadband targets for the Iraqi telecoms sector

Target goals for mobile broadband	2024	2025	2026	2027	2028	2029	2030
4G availability	81%	86%	90%	94%	97%	98%	99%
5G coverage	0%	10%	25%	34%	43%	51%	60%
5G user penetration	0%	5%	13%	19%	26%	33%	40%
Average download speeds *(Mbps)*	24	38	53	80	103	161	235
Average upload speeds *(Mbps)*	8	12	16	25	32	50	78

In summary, these proposals outlined in this whitepaper centre on the issuance of 5G licenses and spectrum, 4G expansion and the adoption of facilitating measures to address the following obectives:

- Accelerate the coverage, availability and penetration of mobile and fixed broadband across Iraq, including 4G expansion and 5G launch, for universal access
- Significantly increase mobile and fixed broadband speeds for better user experience and innovation
- Establish a viable competitive broadband services market ensuring choice and access to quality, affordable services for Iraqi citizens and enterprises

The CMC looks forward to feedback and to completing our consultation with stakeholders in this critical exercise.

Table of Contents

Table of Figures

1. Importance of digitalisation and role of broadband development

Globally, we are in the midst of the fourth industrial revolution, which has accelerated digital transformation opportunities, creating value for societies and enterprises across many industry verticals. Adoption of new technologies, such as AI, automation, augmented reality, haptics, edge computing, and robotics is already underway and has allowed stakeholders across the value chain to become more efficient, utilise data to optimise processes, and find new ways to create value. Such technologies carry the promise of instigating a transformative yet potentially disruptive shift in everyday lives. With the capacity to empower individuals and communities, they open avenues for fresh opportunities in overall economic and societal development.

Digitalisation has nowadays been at the front of mind for both developed and developing regions across the world, largely driven by the desire to boost growth improve social outcomes (education, health, employment) and be part of a dynamic economy. Digital technologies and platforms have become increasingly important in today's society, accelerating development, fostering economic growth, promoting connectivity across citizens, and facilitating more efficient use of resources. Broadband technologies have been the forefront of digitalisation across regions as an enabler, closing the digital divide and connecting economies and societies.

Today, broadband contributes to economic growth on a three key fronts:

- Connecting people and assets within enterprises helps to **improve overall productivity** by highlighting opportunities to streamline the processes and applications
- Allowing enterprises and governments to **introduce innovation** on end-customer applications and services (e.g. B2B2C for consumers and B2B2B for other enterprise customers and eventually B2B2X)
- Allowing enterprises to be **more operationally efficient**, accessing both labour tools and raw materials in other markets

As part of its applicability to a wide spectrum of applications, broadband has the capacity to serve every facet of the society. Spanning economic stability, education, social support, healthcare, and other public services, broadband is intricately linked to social outcomes and well-being outcomes of societies via the digital services it enables. Nevertheless, beyond broadband, nations should strive to advance digitalisation by not only ensuring universal access to critical infrastructure but also leveraging its usage to facilitate the digital transformation of industries and enhance citizen well-being. This is particularly relevant for Iraq as it strives to enhance its economic and societal development by leveraging digitalisation, bridging technological gaps, and participating in the global evolution towards a more connected and technologically advanced future.

1.1 Impact of digitalisation on socioeconomic growth and development

The influence of digitalisation on socioeconomic growth and development is profound, impacting many aspects of both society and the economy:

- **Skills development and job creation:** The digital economy can create new job opportunities and foster the development of a workforce with advanced digital skills. As industries embrace digital technologies, there is a growing need for data analysis, programming, and digital marketing skills. The widescale adoption of digital collaboration over broadband means that remote work is now commonplace. This enables skilled, and potentially high-earning, individuals to be physically based in areas where there are traditionally few opportunities, and vice versa.
- **Access to education and information**: Widespread access to information and educational resources through online platforms and digital tools make educational materials, courses, and research accessible to citizens, promoting continuous learning and skills development.
- **Financial inclusion**: Digital financial services, such as mobile banking and digital payment systems, largely promote financial inclusion. Such technologies and platforms provide access to banking services for consumers who were previously excluded from traditional financial systems and processes, further fostering economic participation.
- **Access to quality healthcare**: Services such as telemedicine and health informatics enhance healthcare delivery and accessibility for society members. In addition, remote consultations, electronic health records, and digital diagnostics contribute to improved healthcare outcomes and better reach, especially in underserved areas.
- **Entrepreneurship and innovation:** Digitalisation empowers entrepreneurs by providing alternative routes for online business, e-commerce, and crowdfunding. This democratisation of entrepreneurship encourages innovation, allowing even smaller-scale businesses and startups to access global markets.
- **Government services:** Digitalisation streamlines administrative processes, reduces bureaucracy, and enhances service delivery. E-government initiatives improve citizen engagement, transparency, and the overall operational efficiency of public services.
- **Urban development:** Digital technologies contribute to the development of smart cities, integrating information and communication technologies for enhanced urban planning, transportation, energy efficiency, and public services, further improving the overall quality of life in urban areas.
- **Social connectivity:** Digital services and applications connect society members globally through social media and communication platforms, fostering social inclusion and cross-cultural understanding.
- **Sustainability**: Digital technologies contribute to environmental sustainability by enabling smart resource management, monitoring, and conservation efforts. For

example, Internet of Things (IoT) devices can be leveraged for efficient energy consumption and environmental monitoring.

1.2 Role of broadband access on digitalisation

Broadband access plays a crucial role in facilitating and accelerating the process of digitalisation, both globally and in the context of Iraq. In essence, broadband access is a fundamental infrastructure component that underpins the digitalisation of various aspects of society. Its widespread availability and affordability are essential for unlocking the full potential of digital technologies and ensuring that the benefits of the digital era are accessible to all.

In today's world, broadband access is critical to successfully participate in a digitalised society and create new government, consumer, and business opportunities. The three key pillars of broadband's access role to digitalisation are:

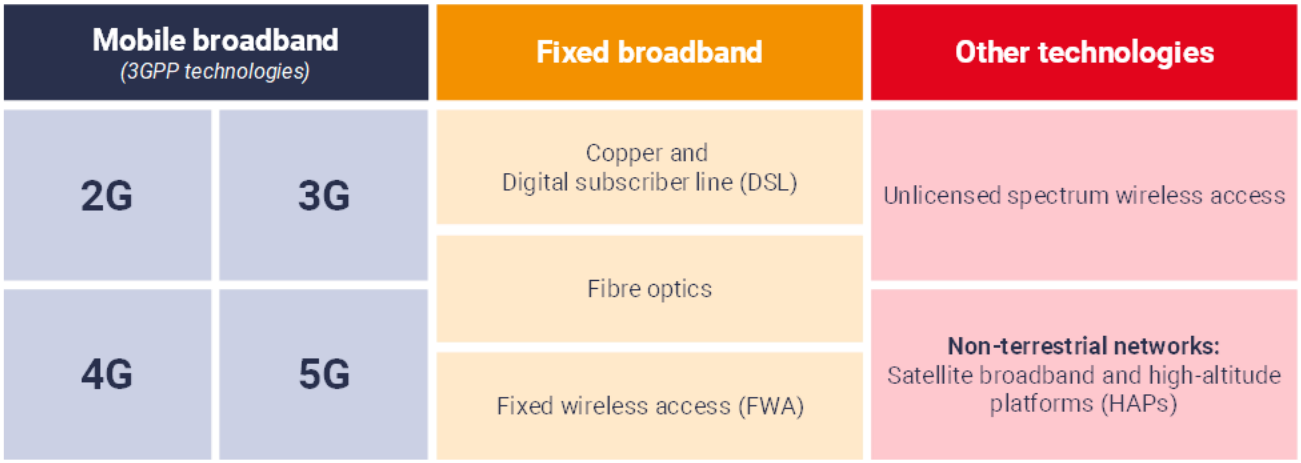
1. **Connectivity and communication:** Broadband access plays a crucial role in fostering seamless and efficient connections between individuals, businesses, and communities. It serves as the backbone for high-speed internet access, enabling quick and reliable communication through various platforms such as email, video conferencing, and instant messaging. The widespread availability of broadband enhances facilitates real-time collaboration and promotes global connectivity. In essence, broadband access is deemed instrumental in bridging distances, fostering collaboration, and promoting effective communication in the modern interconnected world. This is critical for businesses, individuals, and organisations that require instant and effective communication.
2. **Access to information:** Broadband enables quick and easy access to vast amounts of information online. This is important for public services, enterprises, and individuals who rely on up-to-date and relevant data for decision-making. In addition, broadband enables the distribution and consumption of digital publications, including e-books, e-magazines, and online journals. Readers can download or stream digital content without long waiting times, depending on broadband speed availability. It also enables fast and responsive internet browsing, allowing users to access websites, search engines, and online platforms quickly. This is critical for obtaining information on a wide range of topics. Finally, broadband enables the streaming of news articles, videos, and other media content in real-time, so users can stay updated on current events, news, and consume multimedia content without buffering delays.
3. **Economic growth**: Broadband access bolsters the growth of online businesses and e-commerce. It allows companies to reach global markets, streamline operations, and provide digital services, contributing to economic development. It supports research and development, collaboration among society stakeholders, and the implementation of cutting-edge technologies that drive economic growth. Broadband allows businesses to reach international markets by providing a platform for online

transactions, e-commerce, and digital marketing. Small and medium-sized enterprises can expand their customer base beyond local boundaries, contributing to economic growth. Broadband enables businesses to collect, analyse and leverage large volumes of data for informed decision-making. Data-driven insights contribute to operational efficiency, product development, and strategic planning, promoting economic growth.

1.3 Understanding broadband technologies and options

Broadband technologies vary from wired to wireless options, each of them with its own strengths and weaknesses. As technology continues to evolve, grasping the intricacies of broadband options becomes crucial for making informed choices. This exploration of broadband technologies is particularly relevant for economies like Iraq as the country embraces the digital era. Understanding the available broadband technologies and options will help Iraq to determine the best practice to develop its mobile broadband infrastructure and accelerate digitalisation in the nation. The following section delves into the diverse landscape of broadband technologies, exploring their nuances and providing insights to empower users in navigating the expansive realm of connectivity options.

Figure 3: Overview of broadband technologies



1.3.1 Mobile broadband (3GPP technologies)

Mobile broadband technologies encompass wireless communication technologies that facilitate high-speed internet access on mobile devices, as well as other platforms, such as smartphones, tablets, and laptops. Such technologies enable the seamless transfer of data across mobile networks, granting users the ability to access the internet, stream content, and partake in “on-the-go” diverse online activities. Multiple generations of mobile broadband technologies have emerged, for example 2G, 3G, 4G to more recently 5G, with each iteration introducing enhancements in speed, capacity, and overall performance. The Third Generation Partnership Project (3GPP) has played a crucial role in the transition from 2G to 3G, 4G, and 5G technologies.

- **2G:** Rolled out in the early 1990s, 2G brought digital communication, offering improved voice quality and the introduction of Short Message Service (SMS) and Multimedia Message Service (MMS). It also saw the transition from analogue to digital technology, enhancing efficiency and security.
- **3G:** Emerging in the early 2000s, 3G marked a significant leap from 2G with higher data transfer speeds, video calling capabilities and the onset of mobile internet services. It laid the groundwork for a more robust mobile data experience.
- **4G:** Introduced around 2009, 4G brought about substantial improvements in data speed, offering easy access to instant messaging services and social media, better multimedia streaming, and improved network efficiency. It facilitated the widespread adoption of smartphones and the rise of app-based services.
- **5G:** Marks the technological evolution beyond the 4G phase in mobile telecommunications standards, achieving sub millisecond latencies[1]. 5G technology boasts data transmission rates of at least 10 Gbps for upload and 20Gbps for download speeds[2]. Notably, devices and applications are equipped to intelligently choose the most suitable network to meet their specific requirements. 5G technology offers significant enhancements in coverage, signalling efficiency, transmission rates and latency. Unlike in existing mobile broadband networks, 5G incorporates various radio technologies, each tuned to address specific requirements, such as high device density IoT, critical communications, and energy infrastructure. 5G needs will further accelerate as new applications in need of vast capacities start to develop.

1.3.2 Fixed wireless access

Fixed wireless access (FWA) denotes a form of wireless technology with dedicated licensed spectrum. Fixed wireless access systems generally comprise a base station, along with numerous subscriber units distributed across an area. Utilising radio waves, the base station communicates with the subscriber units, enabling customers to take advantage of high-speed data services. Transmitters of FWA systems are largely attached to stationary units, such as towers and poles. FWA technology has been increasingly used by markets across the world, supporting 5G radio technology, hence, providing high speed, low latency, and vast capacity to enterprises and homes. One of the key benefits of using FWA is its ability to delivery ultra-high-speed internet to underserved areas, where cable-reach is limited, which is why FWA is deemed as the “future of wireless connectivity”.

1.3.3 DSL and fibre

Fixed broadband denotes high-speed internet access delivered via stationary infrastructure, such as cables or fibre-optic lines, rather than relying on connection to mobile devices. The

[1] Setting the scene for 5G: Opportunities and challenges
[2] Minimum requirements related to technical performance for IMT-2020 radio interface(s)

term "fixed" underscores that the non-mobile nature of the connecting, typically tying it to a specific physical location, such as a home or business. The most common fixed broadband technologies across the world are:

- **Digital subscriber line (DSL):** DSL encompasses a range of technologies that repurpose existing copper telephone lines to deliver internet connectivity. Copper, probably one of the most traditional forms of transmission in telecoms, has been adapted for broadband connectivity and the most prevalent form of copper-based technologies is DSL. DSL enables the concurrent transmission of voice and data over the same copper line without causing disruptions to telephone services. Despite being widely used in the past 20 years, there is a general move away from DSL, which is largely perceived as being less reliable, consuming more energy, and providing lower speeds than fibre and FWA services.
- **Fibre:** Fibre optics is an information transmission technology that employs pulses of light through strands of fibre made of glass fibre across long and short distances. Such optical fibres are extremely thin in diameter and once bundled into a fibre-optic cable, they can transmit more data at higher speeds, surpassing the capabilities of any other transmission mediums. There are a few different types of fibre-optic networks widely available and each of those involves optic cables extending from the network hub to different types of locations.

1.3.4 Unlicensed spectrum wireless access

Unlicensed spectrum wireless access refers to the deployment of wireless communication systems for broadband access without the need for specific licensed spectrum from regulatory authorities. It is essentially a form of a super Wi-Fi, requiring a specialist fixed equipment (e.g., small receiver dish) installed at home. This technology is commonly used as a cost-effective and flexible alternative to traditional wired broadband solutions, especially in areas where deploying wired infrastructure may be challenging or expensive. It is, by its nature, a contested services and liable to interference and reliability issues.

In Iraq, home broadband penetration is dominated by wireless leased lines mainly using unlicensed spectrum. As the country seeks to grow economically, it will be crucial to provide robust broadband infrastructure to improve customer experience and reduce the reliance on the unlicensed spectrum wireless access. It is therefore important to understand the rationales behind this broadband technology to facilitate Iraq’s digitalisation strategies.

1.3.5 Non-terrestrial networks (satellite, HAPs)

Beyond conventional wired broadband technologies discussed above, such as digital subscriber line and fibre, there exist other broadband technologies, including satellite and high-altitude platforms (HAPs). These technologies can play a potential role in expanding internet access to many places, particular to those in the most difficult-to-reach places:

- **Satellite broadband:** Operates through various types of satellites (e.g., GEO, MEO, LEO) orbiting the Earth. These satellites both transmit and receive signals from satellite dishes situated at users' premises. This technology is useful in providing basic connectivity in remote or sparse populated areas, where installation of terrestrial links is challenging and impractical. On the other hand, latency generally tends to be higher than terrestrial broadband, limiting applications that require real-time capabilities. In addition, bandwidth limitations can also impact the overall speed and capacity of satellite services. Satellite links have also historically been more expensive than terrestrial links where these are available and due to satellite systems being physically located above the airspace, which can lead to potential regulatory and jurisdictional challenges with governance and oversight in cross-border data security.
- **High-altitude platforms (HAPS):** Encompass hydrogen and solar-powered unmanned aerial vehicles or airships present in the stratosphere. Functioning as relay stations, HAPS enable broadband connectivity to the ground. These platforms generally cover expansive areas, surpassing those of conventional ground-based infrastructure. HAPS are generally considered more adaptable, as their position can be easily adjusted. However, there are inherent technical and engineering challenges associated with sustaining platforms at elevated altitudes, emphasising the imperative for efficient power sources—typically derived from solar energy—to ensure continuous operational functionality. Most HAPs are at an early stage of development and not fully commercialised.

These different broadband technologies offer versatile solutions for broadening internet access to regions, tackling geographical, economic, and logistical challenges. The selection of a particular technology hinges on factors such as the deployment needs of the area, financial considerations, and the extent of pre-existing infrastructure.

1.4 Analysing different broadband technologies and options

This section explores the different types of broadband technologies, their distinct characteristics and considerations that define their role in the broader digital ecosystem.

1.4.1 SWOT analysis of different types of mobile and fixed broadband

Mobile broadband (3GPP technologies):

Strengths	• Provides widespread internet access, including for rural areas • Access "on-the-go", allowing user flexibility across various settings, such as work and entertainment • Enable faster speeds, low latency	• Service quality is largely dependent on availability of network infrastructure • Network congestion resulting from high user density in some areas can lead to reduced speeds	**Weaknesses**
Opportunities	• Deployment of advanced technologies (i.e., 5G and beyond) and new spectrum bands to unlock new applications and business models • Mobile broadband enables growth of IoT apps and contributes to smart city development	• Regulatory challenges stemming from evolving regulatory regime, government policies, and spectrum allocation issues	**Threats**

The benefits of mobile broadband technologies are largely related to bridging digital divides, and offering high-speed internet access with relative convenience and mobility. However, challenges such as infrastructure dependence, in-building coverage, limited coverage in remote areas, and the potential for network congestion underscore some of its benefits.

Opportunities arise with the advent of technologies, such as 5G, by fostering broader innovation, supporting IoT growth, and opportunity for expanding into emerging markets. On the other hand, threats emerge from intense competition, regulatory complexities, security risks, and economic downturns.

Fixed wireless access (3GPP technologies):

Strengths	• Quick, cost effective and easy to install and deploy user connections • Not reliant on physical cables to premises • Suitable for last-mile connectivity • Supports residential, business locations • Stronger business case for rural connectivity	• Line of sight requirement to the cell tower for higher frequencies (e.g. mmWave) • Potential weather interference (higher frequencies) • Asymmetrical performance (compared to fibre with similar upload and download speeds)	**Weaknesses**
Opportunities	• Bridging the digital divide in rural and most underserved areas • Advancements in wireless technologies, e.g. 5G (especially mid-band frequencies) • Integration with smart city initiatives • Rapidly evolving technology standards	• Regulatory challenges and spectrum allocation limitations (can limit upload download performance) – requires mix of low-, mid- and high-bands	**Threats**

Fixed wireless access presents a variety of strengths, largely pertaining to ease of deployment and suitability for last-mile connectivity. FWA is probably the strongest case for enabling broadband connectivity to rural and underserved areas.

Opportunities for FWA include the ability to integrate with 5G technology, expansion into rural areas, and support for smart city initiatives and applications. On the flip side, threats to FWA primarily include regulatory challenges, the risk of technological capacity, and the financial burden of spectrum costs.

Fibre-optic access (FTTx):

Strengths	• High-speed, high-capacity (multi-gbps) • Symmetrical performance (similar upload and download speeds) • Minimal signal loss over distance • Sustainable: Low energy compared to cable/DSL	• Expensive infrastructure installation • Deployment challenges in rural areas and for last-mile connectivity • Fibre trenching can disrupt existing infrastructure • Susceptible to accidental or intentional disruption (e.g. to aerial lines, buried cables)	**Weaknesses**
Opportunities	• Growing demand for high-speed internet (e.g. for content consumption, smart home, immersive collaboration) • Potential market expansion in urban areas	• Practical deployment challenges (e.g. gaining access to ducting/poles/roads) and permitting delays	**Threats**

Fibre technology generally boasts high speed, high capacity, low energy capabilities. Opportunities potentially arise in supporting urban areas as well as higher overall demand for high-speed, high reliable internet connection.

However, high installation costs and deployment (especially in rural areas) are the main challenges. These mainly include practical deployment challenges, such as getting access to ducting, roads, etc. and permitting delays that can typically arise. To adjust these challenges, many regulators released the policies including “dig-once policy”, “fibre/duct pre-deployment”, rights of way to reduce the cost of fibre deployment globally.

Digital Subscriber Line (DSL):

Strengths	• Existing copper infrastructure in place • Provides both data and legacy voice services • Widely available in urban areas • Cost-effective (lower incremental costs) compared to some alternatives	• Speeds may degrade with distance • Limited bandwidth compared to fibre and FWA • Higher operational costs, higher energy & maintenance (e.g. versus fibre) • Quality highly dependent on line conditions • Susceptible to accidental or intentional disruption (e.g. lines)	**Weaknesses**
Opportunities	• Upgrading technologies like VDSL for higher speeds • Bridging the digital divide in underserved areas where copper lines are present and of good quality	• Competition from faster technologies • Limited growth potential in areas without copper infrastructure • Copper infrastructure degrading • Consumer preference for higher-speed options	**Threats**

DSL benefits from widespread availability and existing infrastructure, as well as its relatively lower incremental investment cost compared to other technologies. DSL technology faces challenges related to limited bandwidth and competition from faster alternatives, such as fibre. Opportunities lie in potential upgrades and affordability, but DSL must address threats posed by technological advancements and evolving consumer preferences.

1.5 Global mobile and fixed broadband industry trends

The global mobile and fixed broadband markets are currently experiencing shifts driven by technological improvements and innovations, dynamic customer behaviours, and evolving regulatory requirements. In the mobile segment, the widespread deployment of 5G networks has unlocked a new era of high-speed connectivity, enabling faster data transfer, low latency and higher capacity. 5G deployment has accelerated growth of mobile applications and services, as well as the overall digital transformation for governments. In the fixed segment, several countries globally are moving away from copper and towards fibre infrastructure to

deliver ultra-fast and reliable internet access. Growth of bandwidth-intensive applications, such as video streaming or gaming, is expected to further shape the fixed broadband market, as demand for higher bandwidth will continue to persist. As the world becomes more interconnected, mobile and fixed broadband will continue to play a stronger role in driving economic growth and development, innovation and connectivity for governments.

Here are some global trends and developments in key regions:

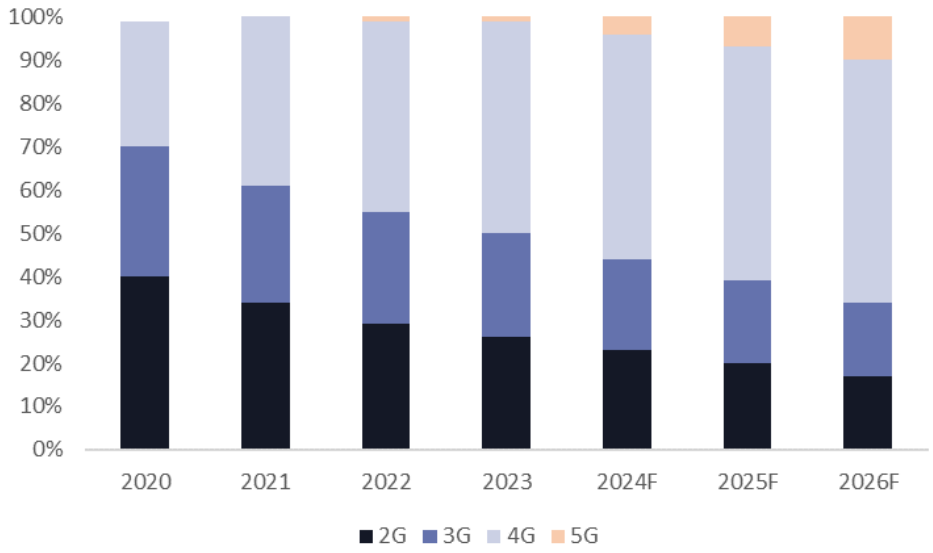
Figure 4: Mobile connections by network type in 2023, in %[3]

Region	3G and below	4G	5G
Asia Pacific	*23*	*52*	*13*
Central and Eastern Europe	*31*	*50*	*2*
Latin America	*37*	*50*	*2*
Middle East and Africa	*73*	*22*	*1*
North America	*1*	*45*	*17*
Western Europe	*13*	*43*	*16*

Middle East: Most countries in the region are focused on broadening coverage of fixed broadband infrastructure, complementing the existing coverage provided by mobile networks. In addition, rising data demands from customers and enterprises have resulted in a transition from DSL to fibre-based networks in many Middle Eastern markets, mainly within the Gulf states. Eight countries in the Middle East are now also being served by commercial 5G services as of March 2023, including in the UAE with the first launch, Bahrain, Kuwait, Qatar and Saudi Arabia[4]. As mobile network operators accelerate their deployment of 5G, fixed networks are being linked to mobile base stations for necessary backhaul. Several countries acknowledge the essential role of high-speed fixed broadband infrastructure in supporting the ongoing evolution of 5G and serving as the backbone for smart city initiatives.

[3] Annual Internet Report (2018-2023)
[4] Tracking 5G deployments in the Middle East and Africa

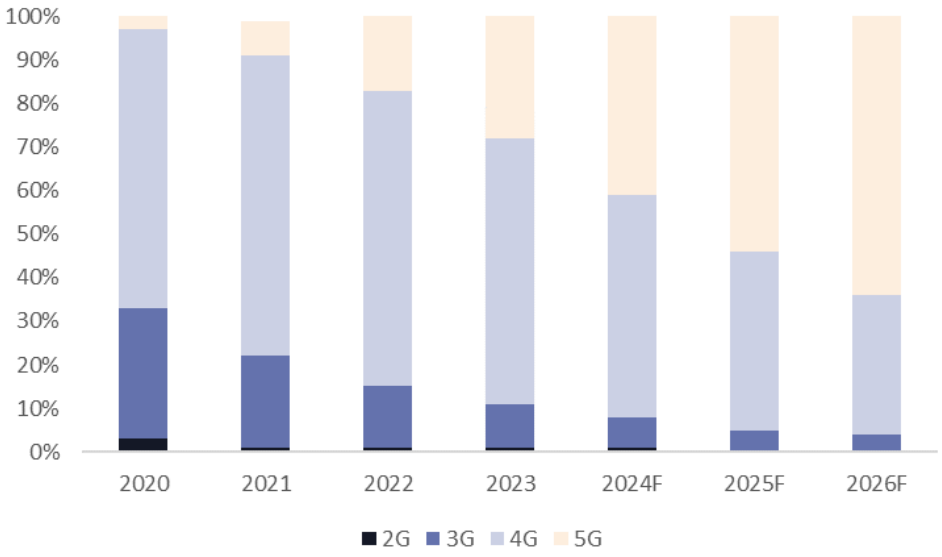
Figure 5: Subscribers % share by technology, Middle East



Source: GlobalData

The Gulf Cooperation Council (GCC) nations, in particular, have been proactive in shifting away from older generations of mobile technology (including decommissioning of 2G and 3G) and transitioning towards newer ones (4G and 5G).

Figure 6: Subscribers % share by technology, GCC countries

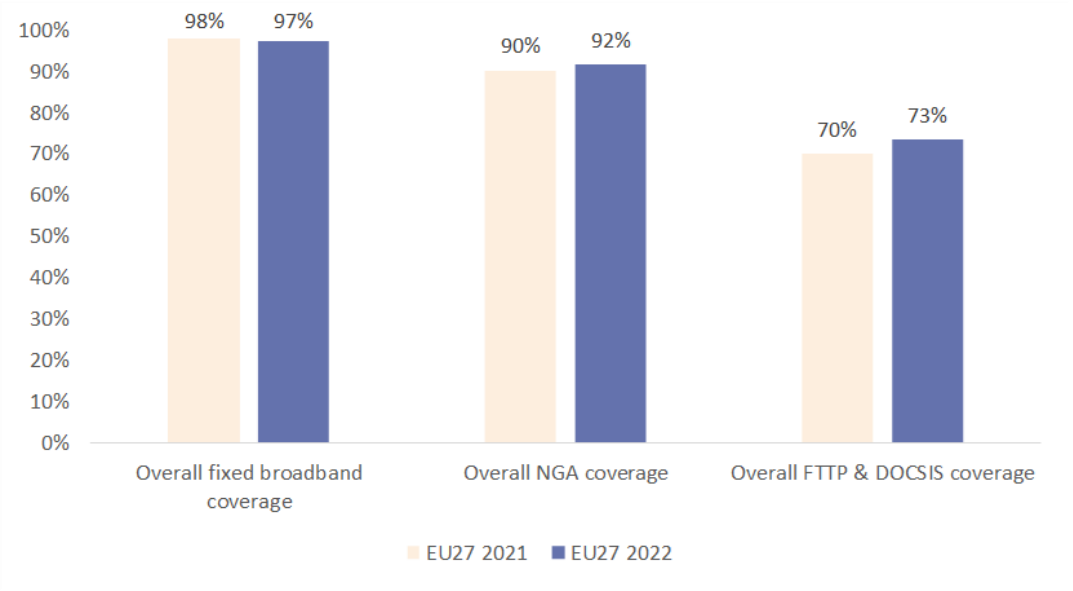


Source: GlobalData

Europe: Access to fast broadband services in rural areas has remained a focal point for Europe. At the end of June 2021, 91.5% of rural households across the EU27 had access to at least one fixed broadband technology, up from 89.6% in mid-2020. DSL is still the most

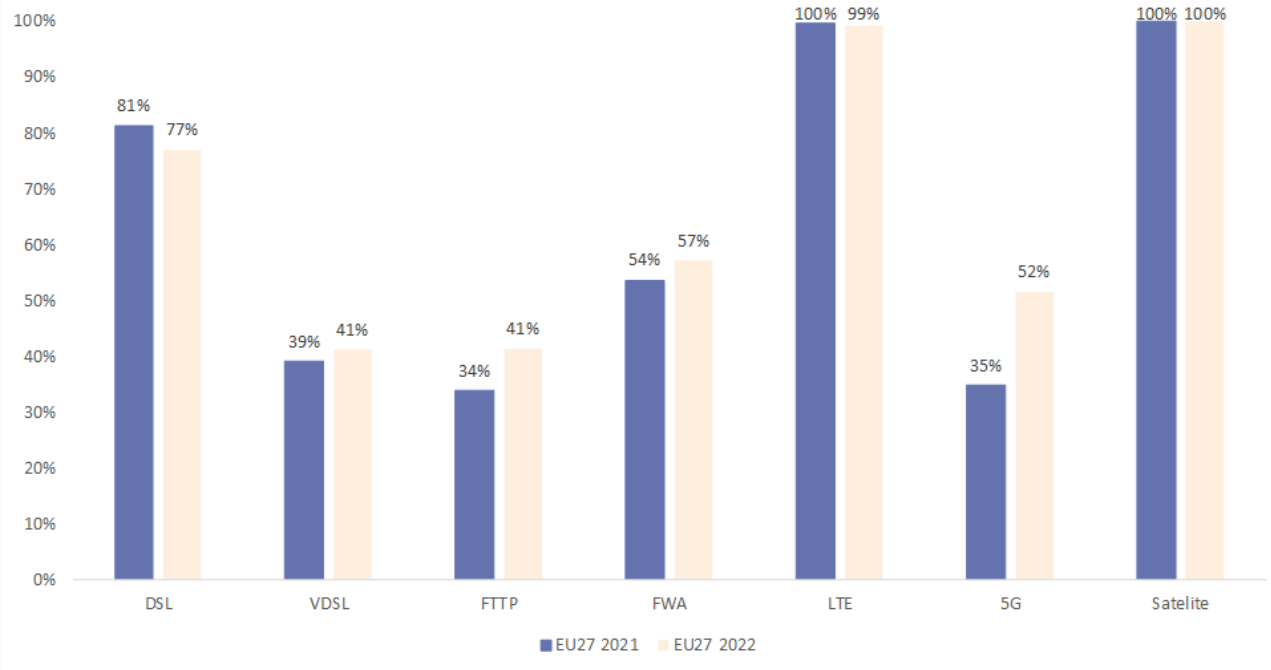
pervasive broadband technology, reaching 89.3% of EU households in mid-2021. On the other hand, fibre is a key source of fixed technology between 2023 to 2028, with an increasing number of operators opting to decommission legacy copper lines and upgrade to fibre.

Figure 7: EU27: Coverage by technology, % total, 2021 and 2022



Source: European Commission (2022)

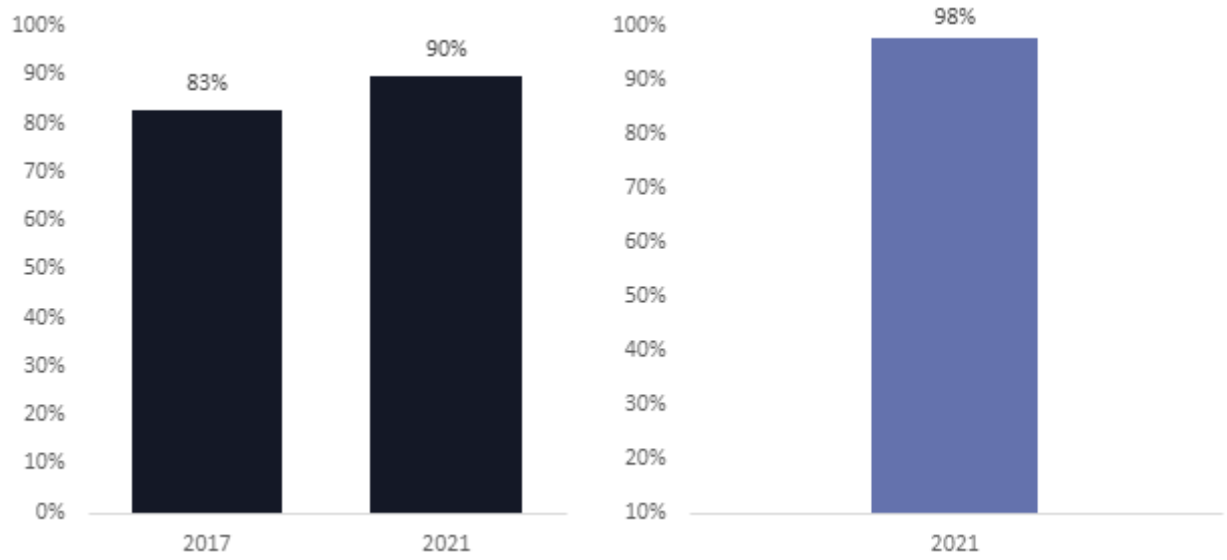
Figure 8: EU27: Coverage in rural areas, in %, 2021 & 2022



Source: European Commission (2022)

North America: Fixed wireless access has emerged as a critical technology for expanding broadband availability to rural and underserved areas, since FWA is perceived as a cost-effective way to deliver high-speed internet to areas. The US has allocated funds to support the expansion of FWA in rural areas through government-led programmes, such as Rural Digital Opportunity (RDOF) and Connect America Fund (CAF). Such developments in the FWA market have attracted interest from leading US operators. For example, Verizon plans to expand its mmWave 5G network with C-band spectrum, unlocking FWA services to up to 50 million households by 2024. On another front, in March 2021, AT&T started offering 5G fixed wireless for enterprise customers, citing FWA as a key pillar to 5G approach for businesses, together with mobile and edge computing.

Figure 9: % of North American households with broadband subscriptions (left) and % access to fixed technology at minimum 30 Mbps download speeds (right)[5]



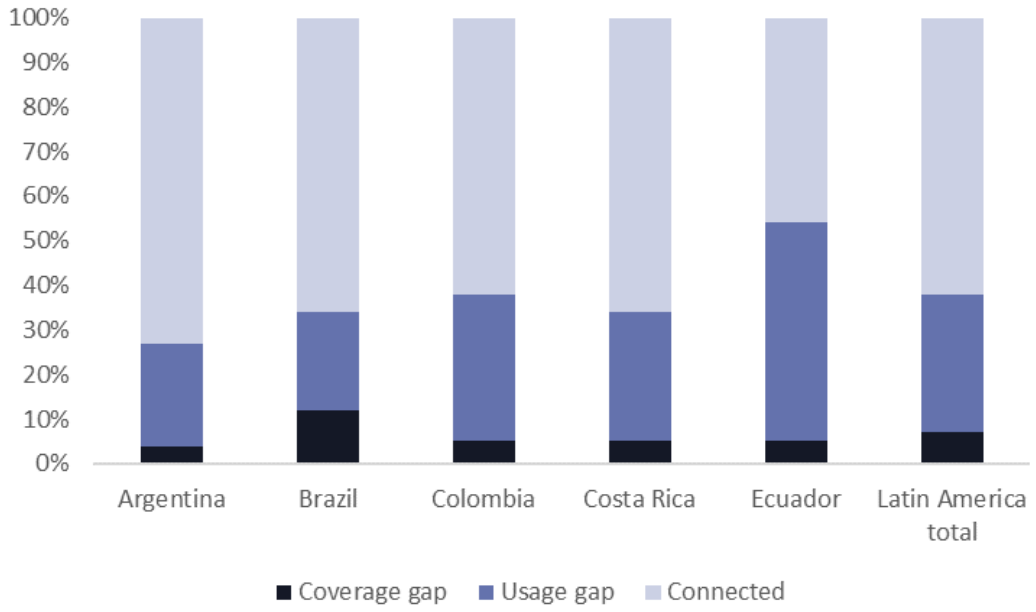
Latin America – In 2022, the LATAM region achieved a residential fixed broadband penetration of c.50%, with expectations that fixed broadband platforms will encompass c.53% of households by close of 2023. The expanding fibre optics technology is anticipated to capture a c.53% share of the residential fixed broadband market by the end of 2023. This surge is attributed to the growth of small internet service providers in Brazil and heightened demand across the region, prompting larger and incumbent players to expedite their deployment plans. Developments in the broadband market in LATAM are largely driven by the region's escalating need for high-speed internet connectivity, data transmission, and digitalisation spans various sectors.

Despite the growth in fixed broadband market, 230 million people in Latin America still have no access to the mobile internet. Two types of mobile internet connectivity gaps were identified: coverage gap and usage gap. The coverage gap is not wide relatively to other areas of the world, with an average of 7% of the population having no internet provision in the area

[5] The state of US broadband in 2022

they live. Meanwhile, the usage gap is largely driven by the lack of demand across Latin America. Of the 230 million unconnected, 190 million of them live in locations with mobile internet coverage but have no access to the internet. GSMA attributes this to a lack of affordability due to tax policies that artificially raise the cost of internet connectivity for the low-income households in Latin America.

Figure 10: Mobile internet connectivity as a % of population in Latin America[6]



[6] Connectivity gaps in Latin America

2. Iraq's vision for ICT industry development

2.1 Iraq 2030 vision

With periods of volatility behind it, Iraq is now in a critical stage of building and strengthening its development. The country is now forging ahead towards a prosperous and sustainable future guided by its visionary roadmap, Iraq Vision 2030. The vision seeks to achieve "Empowered Iraqis in a safe country, a unified society with diversified economy, sustainable environment, justice, and good governance"[7].

Amidst significant social, economic, security, and governance challenges, Iraq envisions a future that addresses these complexities with a comprehensive and forward-looking approach. The government's commitment to transformative policies and targeted reforms reflects a resolute dedication to correcting economic fundamentals and fostering an inclusive growth trajectory.

Figure 11: Iraq Vision 2030

Source: Iraq Vision 2030

As part of the Iraq Vision 2030, five national priorities were identified to address these challenges: man building, good governance, diversified economy, safe society, and sustainable environment.

These are described in more detail below:

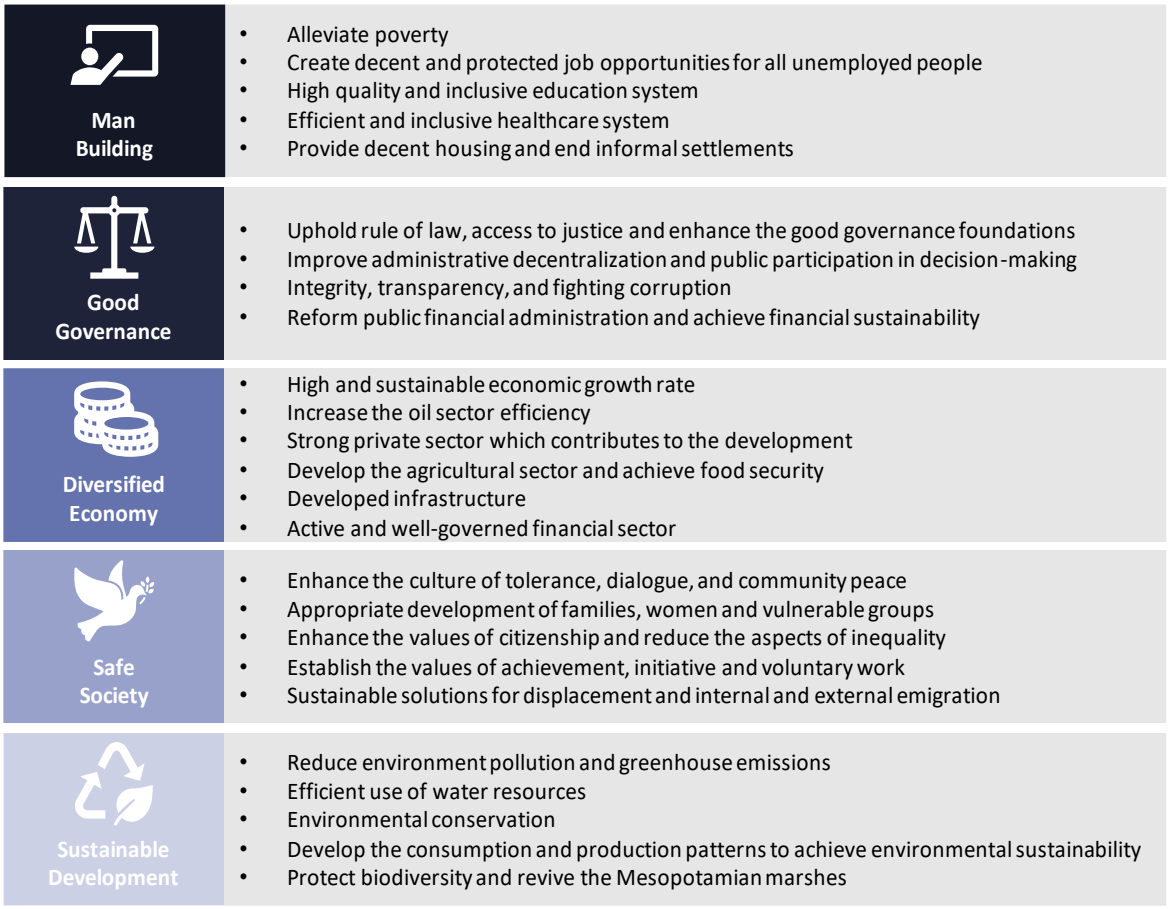
- **Man building:** Build spiritual, psychological and physical wellbeing to foster generations who are capable of innovation, creation and achievement by alleviating

[7] Iraq Vision 2030

poverty, creating job opportunities, providing access to well-functioning education and healthcare systems, as well as access to permanent housing.

- **Good governance:** Active administrative institutions which ensure the respect of political, civil and human rights, justice and equality of all citizens before the law.
- **Diversified economy:** Diversified social market economy which generates decent job opportunities and provides an economic welfare level a joint management of public and private sectors to enhance the Iraqi economy.
- **Safe society:** Ensuring a vibrant society whose members enjoy peace and in which the values of citizenship, solidarity and achievement are strengthened.
- **Sustainable development:** Create clean, safe and sustainable environment for the current and future generations through incorporating environment in the development plans and policies to achieve a sustainable improvement in the human life quality, ensure the sustainability of the production and consumption patterns and reduce the repercussions of environment pollution and climate changes.

Figure 12: Iraq Vision 2030 in detail



Source: Iraq Vision 2030

Digitising communications will support Iraq's aims in improving governance, by being able to allow for decentralisation without impacting productivity and allow greater participation in

decision-making through remote access. Additionally, it supports new digital use cases such as digital government and digital society, thereby facilitating the vision of good governance. This advancement aids in streamlining administrative processes, promoting transparency, and encouraging increased public engagement.

Critical telecommunications infrastructure plays an indispensable role in fostering economic development in Iraq by serving as the bedrock of modern connectivity and information exchange. In today's globalised and technologically driven world, robust telecommunications networks are essential for facilitating seamless communication, enabling the swift flow of data, and supporting the efficient operation of businesses and industries. Reliable telecommunications infrastructure and access to broadband enhances productivity, encourages innovation, and fosters entrepreneurship by providing a platform for the rapid dissemination of information and the development of digital technologies. Moreover, it promotes inclusivity by connecting remote or underserved areas, opening up new opportunities for education, healthcare, and commerce.

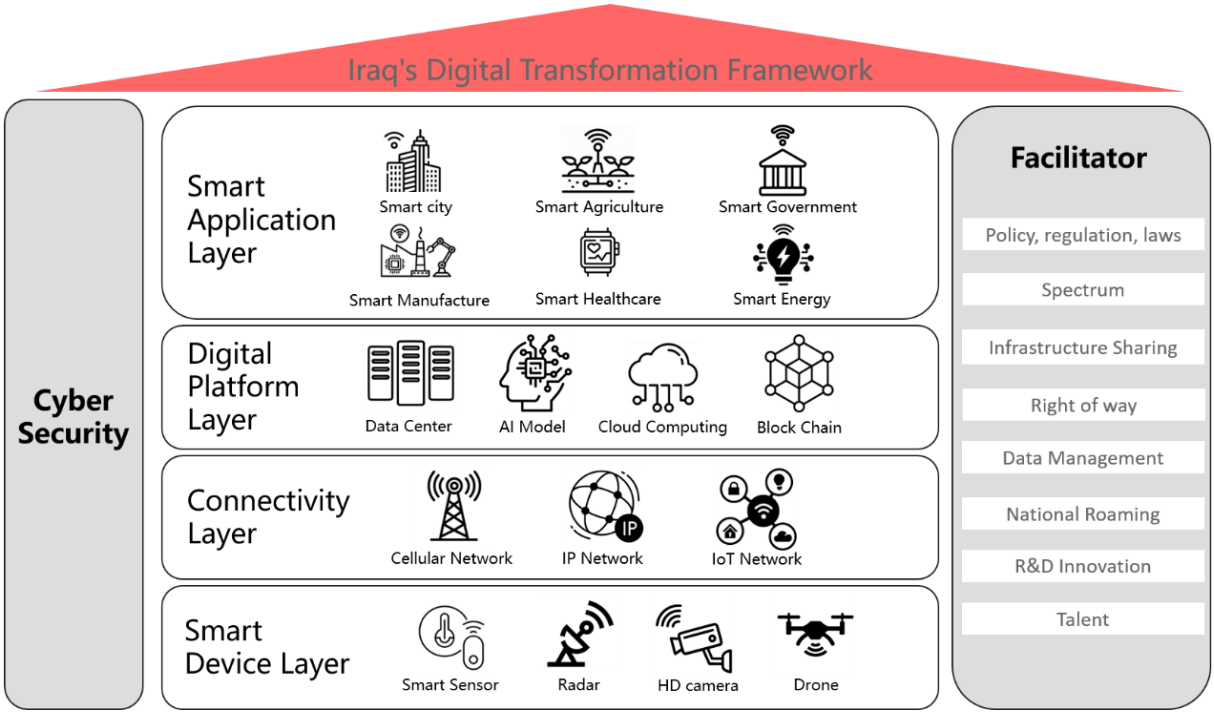
In essence, a well-developed and resilient telecommunications infrastructure is a cornerstone for economic growth, driving national competitiveness and ensuring that nations can fully participate in the digital economy. As more activities are expected to be carried out through the network, ensuring security of the connectivity becomes imperative. It is therefore essential to protect critical telecommunications infrastructure and improve the cybersecurity management mechanism to protect data and network security in the Iraq economy. This in turn facilitates Iraq’s vision to promote economic growth and build a safe society. More details on the importance and measures to safeguard the critical infrastructure and the network in Iraq are discussed in Section 3.6 of the document.

Communication technology plays a crucial role in shaping and strengthening various aspects of society, including social cohesion, stability, security, and civil society. Effective resource management, especially in the context of scarce resources like water, benefits significantly from communication technology. For instance, smart technologies encompassing sensors and data analytics, provide real-time monitoring and management capabilities. This not only optimises resource allocation but also minimises inefficiencies and waste, contributing to sustainability and responsible resource usage. In this context, the advancement of the ICT sector aligns seamlessly with the vision's commitment to creating an empowered and diversified society, fostering sustainable development, and laying the groundwork for transparent and efficient governance.

2.1.1 Iraq’s digital transformation framework

The Digital Iraq is based on a four-level framework of digital transformation. It integrates various applications, services, resources and physical infrastructure. As seen in the figure below, an integrated ICT framework will enable all participants to move in the same direction, avoiding duplication in investments and efforts in infrastructure planning. This is also designed to promote collaboration, coordination, and alignment across all stakeholders to better embrace the digital economy.

Figure 13: Iraq's digital transformation framework



Smart devices layer: A better-connected country has the potential to be a smarter nation and it is at the smart devices layer that many of the key connections take place. This layer is intertwined with the Internet of Things (IoT).

Connectivity layer: The connectivity layer represents various networks provided by telecommunication operators as well as networks provided by city stakeholders or enterprise private communication networks. This layer is crucial for transmitting data generated by the sensors and facilitating communication among various elements of the ICT infrastructure, including data centres, platforms, end-user devices and applications. It comprises both fixed and wireless components, each delivering data which underpins a digital Iraq.

Digital platform layer: The digital platform includes computing and storage infrastructure in data centres. The layer integrates cloud computing, intelligent computing, to provide high-efficiency computing power. New technologies, such as AI model and block-chain, are evolving to form infrastructure in the form of platforms.

Application layer: The capacity of ICT enables applications across six key public and private sectors.

Additionally, Iraq's national digital transformation enables the country to achieve long-term sustainable development, and the role of digital transformation in driving GDP growth and promoting the achievement of sustainable development goals will be significantly enhanced. Digital transformation will contribute to the implementation of all the 17 UN's Sustainable Development Goals (SDGs), extending social and economic progress to all the people in Iraq.

Figure 14: ICT goals for promoting SDG implementation

Leverage ICT to improve productivity among millions of people so they have better means of income and livelihood. Promote work and financial inclusion by providing services such as mobile banking and micro-crediting.

Leverage ICT-enabled solutions to make agricultural practices more data-driven and efficient, help farmers increase crop yields and reduce use of energy.

Deploy widespread e-health applications. Improve direct patient interaction, health informatics and telemedicine through better connectivity.

Equip millions of young people with job ready digital skills.

Improve women' s access to ICT, build relevant digital and other skills, and promote female leadership in digital transformation.

Leverage ICT to facilitate smart water and sanitation management.

Develop greener ICTs, and use green energy saving equipment to reduce energy consumption and carbon emissions.

Stimulate ICT-centric innovative entrepreneurship and vibrant micro, small and medium enterprises

Accelerate digital transformation with better infrastructure, investment, innovation, and inclusivity.

Reduce digital divide and inequality within and between communities and populations by enabling access to ICTs and knowledge for all.

Leverage ICT-enabled solutions to realize more effective and holistic city management and facilitate the transition to smart sustainable cities.

Leverage ICT innovations and applications to improve the use of the natural environment and resources, and promote sustainable lifestyles.

Leverage ICT to optimize value chains and reduce resource usage, waste, and emission, and facilitate all sectors to better respond to climate change.

Leverage ICT to conduct marine monitoring, plan mitigation and adaptation strategies, and achieve marine conservation and sustainability.

Leverage ICT to conduct land monitoring, plan mitigation and adaptation strategies, and achieve land conservation and sustainability.

Leverage ICT-enabled solutions to promote digital governance, increase transparency, empowers citizens, and improve public services.

Enhance public-private partnerships to provide better ICT infrastructure and digital services for all. Foster international cooperation to promote technology transfer and capacity building.

2.2 Current ecosystem: Key players and stakeholders

Regulatory bodies

The Communications and Media Commission (CMC) plays a pivotal role as the main independent regulator overseeing Iraq's telecom sector. The CMC is tasked with crucial responsibilities such as issuing and managing telecom licenses, strategically allocating spectrum resources, and regulating broadcasting, media, and information services.

As the central regulatory authority, the CMC is tasked with shaping the landscape of Iraq's Information and Communication Technology (ICT) sector. Its directives and decisions determine the licensing framework for telecom operators, playing an important role in the allocation of spectrum resources to ensure the efficient functioning of the industry.

Mobile broadband market

In the dynamic landscape of Iraq's mobile broadband sector, three major national service providers dominate the market: **Zain Iraq, Asiacell,** and **Korek Telecom**. Together, these three mobile network operators (MNOs) account for more than 90% of the mobile broadband market in Iraq in 2023.

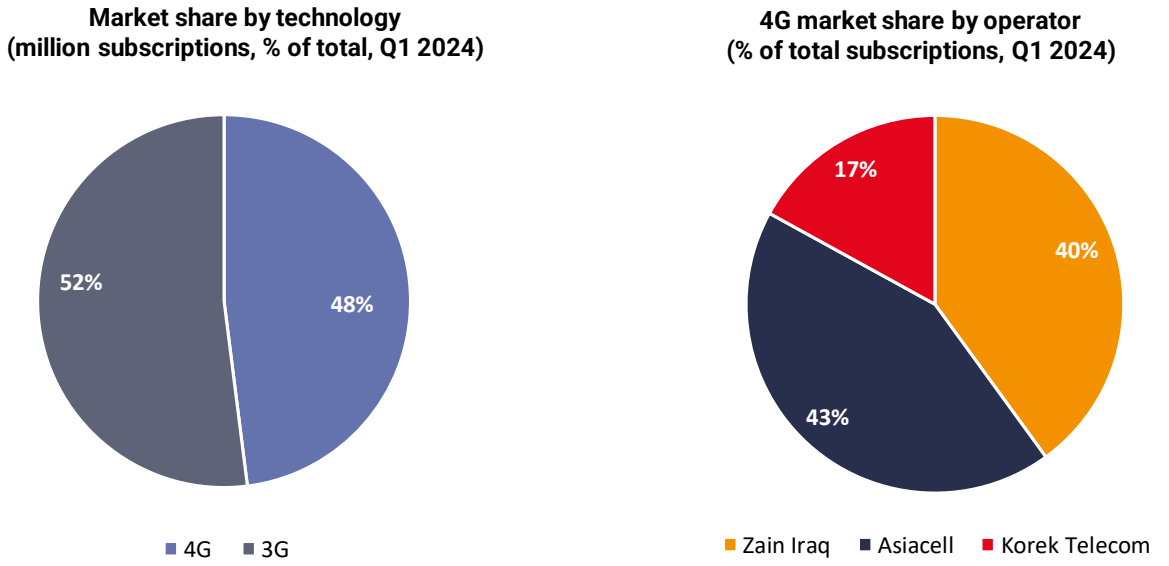
Zain Iraq, initially founded as Atheer Telecom, holds the market leader position with approximately 41.2%[8] of subscriptions as of June 2023. The company, awarded a 15-year concession in 2007, has continuously evolved. It launched 3G services in 2014 and subsequently introducing 4G in January 2021. Zain's strategic expansions, such as acquiring the Iraqna network in 2007, have also contributed to its substantial market presence.

Asiacell, a subsidiary of Qatar's Ooredoo, secured a 15-year national GSM-900/1800 license in 2007, marking a significant chapter in Iraq's telecommunications landscape. The company, granted 3G and 4G licenses in 2014 and 2020, respectively, has played a pivotal role in advancing mobile internet access in the country.

Korek Telecom, founded in 2000, initially faced challenges but emerged as a major player after winning a national cellular license in 2007. Majority-owned by Korek International Management, Korek successfully launched 3G in 2014 and 4G in 2021, expanding its coverage nationwide.

[8] TeleGeography: Iraq mobile broadband

Figure 15: Market share by technology and mobile operator



Source: GSMA Intelligence (Q1 2024)

The mobile broadband sector's growth is underscored by the issuance of 3G concessions in 2014 and the subsequent introduction of 4G services by all three major players from January 2021. The competition and technological advancements introduced by Zain Iraq, Asiacell, and Korek Telecom have collectively contributed to Iraq's mobile broadband landscape, fostering connectivity and data consumption in the nation.

Fixed broadband market

In Iraq, the fixed broadband market is characterised by a concentration of licensed Internet Service Providers (ISPs) alongside a few smaller operators providing fixed wireless access using the unlicenced spectrum. The licensed ISPs dominate the majority of the market, shaping the landscape and driving connectivity across the country.

The competitive landscape is complex due to the partly decentralised structure of service provision and the emergence of regional providers through the National Internet Project. The government's support for FTTH deployment and the involvement of various private companies indicate a dynamic and evolving fixed broadband sector in Iraq.

Other infrastructure providers

TASC Towers marks a large-scale cross border collaboration between telecommunication service providers in the Middle East and North Africa (MENA) region. This independent multinational tower company was founded following the proposed partnership between the regional telecom giants Ooredoo Group, Zain Group and TASC Tower Holding. A definitive agreement to combine the tower assets of the three Gulf Telco’s (Ooredoo, Zain, and TASC Towers) was signed in December 2023. This strategic collaboration, valued at USD2.2 billion, aims to facilitate the management of approximately 30,000 telecom towers in the MENA

region. Iraq is among one of the countries covered under this partnership, along with Qatar, Kuwait, Algeria, Tunisia and Jordan.

2.3 Current state of play: Broadband access, network status and development

With two decades of constrained development of its ICT sector, Iraq is lagging compared to its neighbouring countries in terms of technology deployments and infrastructure buildout. BuddeComm[9] has ranked the Middle Eastern countries based on their socioeconomic status and broadband market performance. Iraq was ranked in the 'Market Emergent' category with lower Telecom Maturity Index scores.

Figure 16: Middle East Telecoms Maturity Index (TMI)

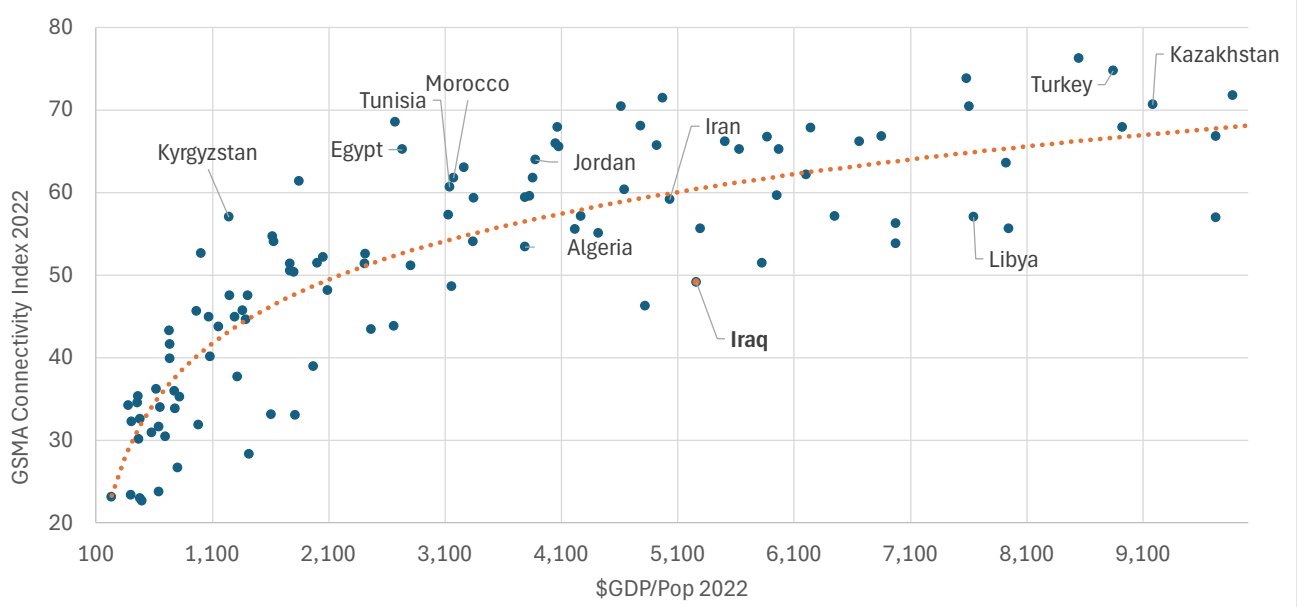
	Country	Global Ranking	TMI Score
Market Leader	UAE	14	84
	Saudi Arabia	41	67
Market Challenger	Qatar	55	55
	Oman	58	54
	Bahrain	65	50
	Turkey	67	49
	Kuwait	67	49
	Iran	73	46
Market Emergent	Jordan	99	32
	Lebanon	102	30
	Iraq	107	28
	Syria	133	13
	Yemen	153	3

Source: BuddeComm

Iraq also scored 49.1 in the GSMA Mobile Connectivity Index in 2022. Upon comparison of index scores relative to GDP per capita across different countries in Figure 17 below, there is a clear gap between the benchmark and where Iraq is currently placed. This indicates the need for greater progress to reach the benchmark highlighted. The CMC is therefore focused on driving and establishing clear priorities for Iraqi telecoms stakeholders to accelerate infrastructure development and create a strong foundation for future growth of its ICT sector.

[9] BuddeComm: Iraq - Telecoms, Mobile and Broadband Statistics and Analyses

Figure 17: Comparison of Iraq vs. others on the GSMA Mobile Connectivity Index



Source: GSMA Mobile Connectivity Index (2022)

2.3.1 Broadband access by technology type (# of users, spectrum, coverage)

The percentage of households with Internet access in Iraq has been increasing sharply in recent years, up from only 26.5% in 2014 to 88.7% at the end of 2022. It surpassed the world average in 2017 with 58.8% household coverage comparing to worldwide average of 53.9%[10].

Mobile broadband access

According to the International Telecommunication Union (ITU), the population coverage by mobile broadband technology in Iraq has been rising sharply in recent years. As of 2022, the 2G population coverage was reported to be at 100%. 3G coverage has reached 98.2% of the population, and 4G coverage stands at 96.6%[11].

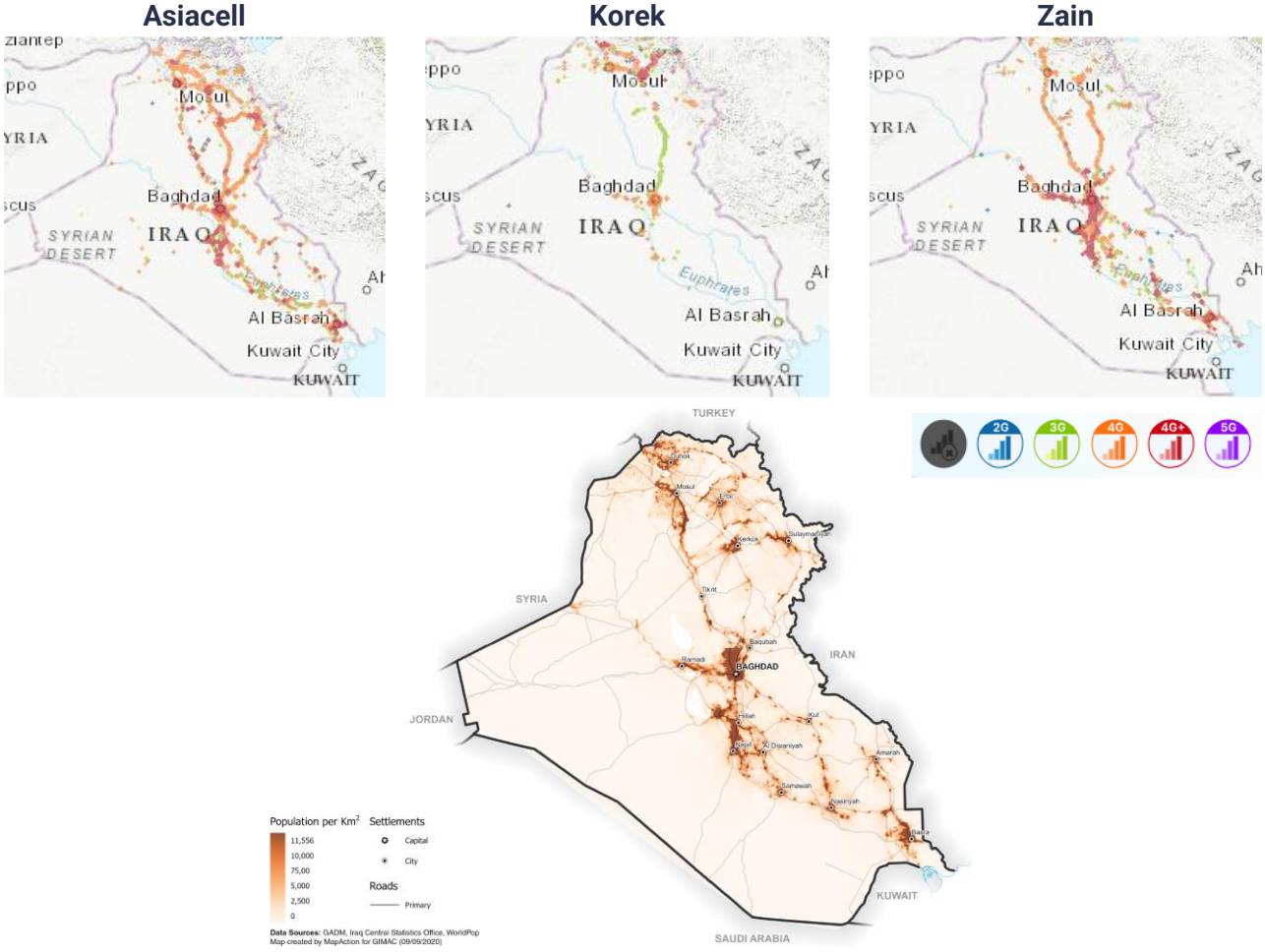
Figure 18: Population coverage by mobile technology, reported by the ITU in 2022

Country	At least 2G	At least 3G	At least LTE/WiMAX	At least 5G
Iraq	100%	98.2%	96.6%	–
Oman	100%	100%	97.9%	88%
Turkey	99.8%	99.8%	99.5%	–
Jordan	99.8%	99.8%	99%	–
Saudi Arabia	100%	100%	100%	53%
United Arab Emirates	100%	100%	93.8%	93.9%
Qatar	100%	100%	99.8%	98.3%

[10] ITU: Household with Internet access at home
[11] ITU: Iraq population coverage, by mobile network technology

However, analysis from other various independent sources reveals that coverage often falls short of commonly cited metrics, such as quality and availability. For example, OpenSignal[12] conducted research on the availability of the 4G network measured as the percentage of time users get access to 4G connection. The results show that 4G availability time differs between the three Iraqi mobile operators. Asiacell's 4G users are connected to the 4G network 87.4% of the time. Zain ranks second in 4G availability with the 4G network accessible for its subscribers 74.1%, and Korek Telecom, ranks third at 64.4%. Analysis of mobile cellular coverage by operator by nPerf[13] also shows gaps in 4G coverage where 3G is currently available (as indicated by the green dots in Figure 19). These disparities underscore how actual network availability can vary considerably from aggregate coverage statistics.

Figure 19: Mobile network coverage by operator as per nPerf analysis



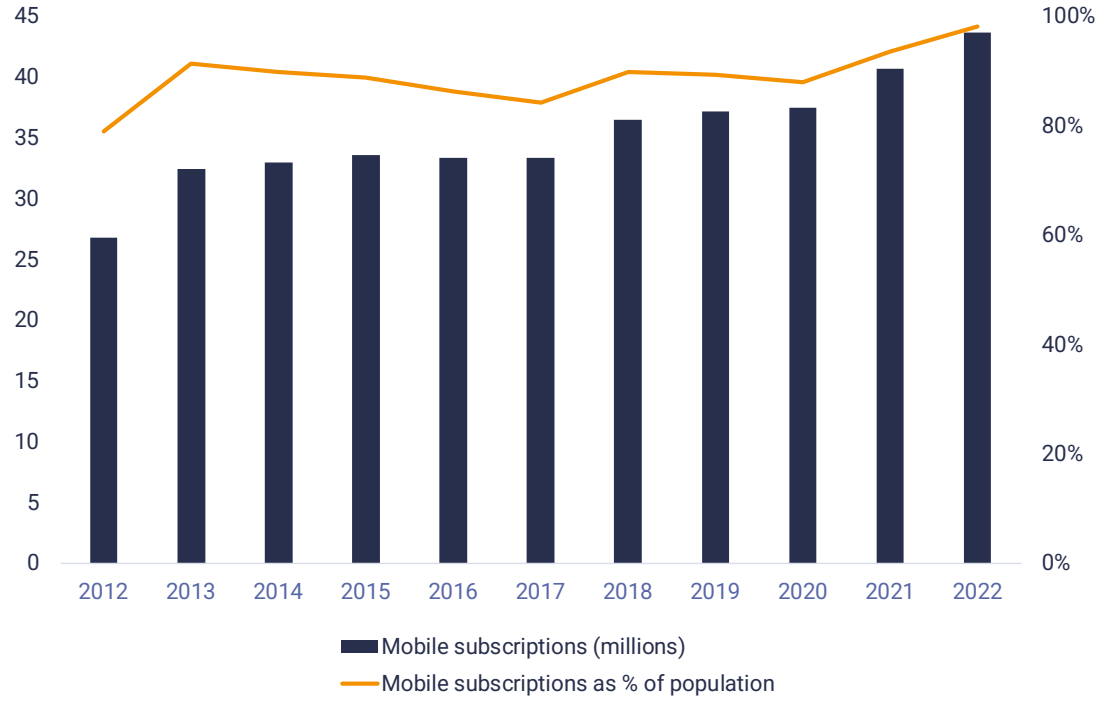
Source: nPerf (Mar 2023)

Despite the recent developments, the rate of mobile penetration is still lagging behind other Middle Eastern countries. The most recent subscription total in 2023 equals to an estimated 42.91 million mobile subscribers, with growth in the last few years largely driven by the launch

[12] Iraq: Mobile Network Experience Report January 2024
[13] nPerf 3G/4G/5G coverage map in Iraq

of 4G services in 2021. The overall trend has been moving upwards in recent years, increasing from 33.4 million in 2017[14]. However, the total number of subscriptions to the mobile network in Iraq (the estimated 42.91 million) marks a slight decline in the total subscriptions from 43.7 million at the end of 2022.

Figure 20: Mobile-cellular subscriptions

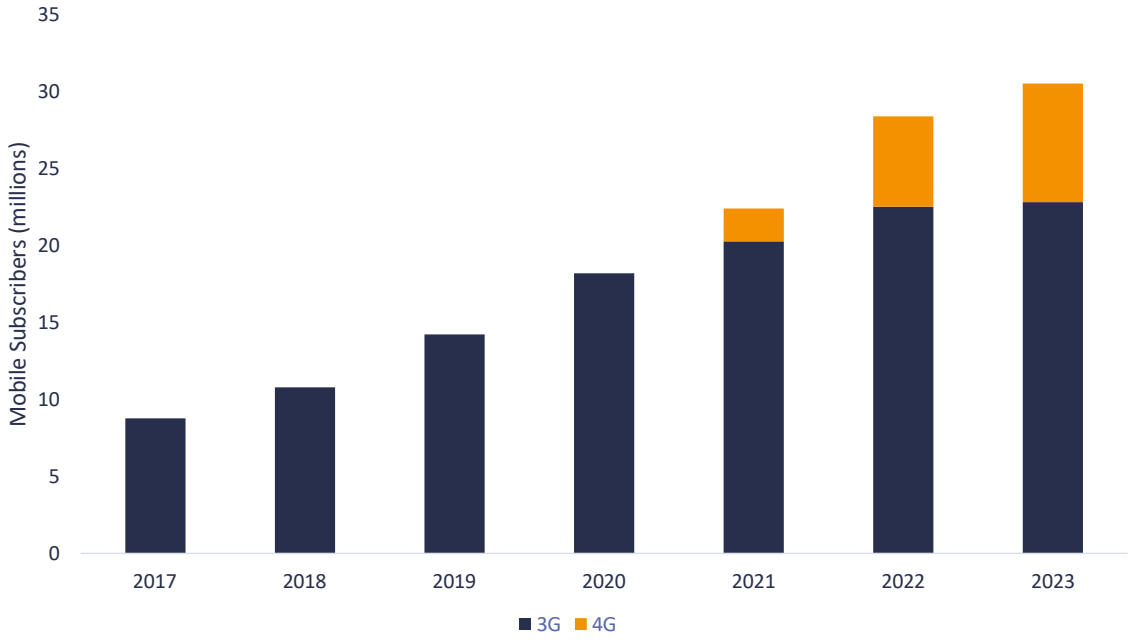


Source: ITU

As of June 2023, there are approximately 22.7 million 3G subscribers and 7.1 million 4G subscribers, showcasing the significant impact of mobile services on Iraq's telecommunication industry landscape.

[14] ITU: Iraq mobile-cellular subscriptions

Figure 21: Mobile data subscribers over time by technology (excludes 2G)



Source: Telegeography

Timeline of launch per mobile generation:

- In 2014, 2100MHz spectrum (W-CDMA type) was allocated to the three national operators, Zain Iraq, Asiacell and Korek Telecom, on an 8-year basis to facilitate the launch of the 3G technology. 900 and 1800MHz spectrum bands were initially awarded in 2007 on a 15-year term that were used for 2G connectivity. The licenses were renewed for another 8 years and became technology neutral in 2021.
- Following the change, all three MNOs launched 4G with the 1800MHz spectrum in January 2021. In comparison with other countries in the Middle East and North Africa, the 4G launch in 2021 was seen as relatively late, with stc in Saudi Arabia launching the region's first 4G network approximately 10 years prior in 2011[15].
- 5G services are yet to be provided. In October 2023, the CMC has been granted the ability to issue a three-year exclusive national license for 5G mobile technology to Al-Salam State Company[16] a subsidiary of the Ministry of Communications.

[15] stc launches 1st LTE 4G network in the Middle East and North Africa
[16] Iraq grants 5G mobile license

Figure 22: List of mobile operators and associated technology and spectrum

MNO	Market Share (Mobile)	4G Launch	Spectrum (MHz)	3G Launch	Spectrum (MHz)	2G Launch	Spectrum (MHz)
Zain Iraq	42%	2021	1800	2015	2100	2004	900/1800
Asiacell	40.6%	2021	1800	2015	2100	2004	900/1800
Korek Telecom	17.4%	2021	1800	2014	2100	2001	900/1800

Source: Telegeography

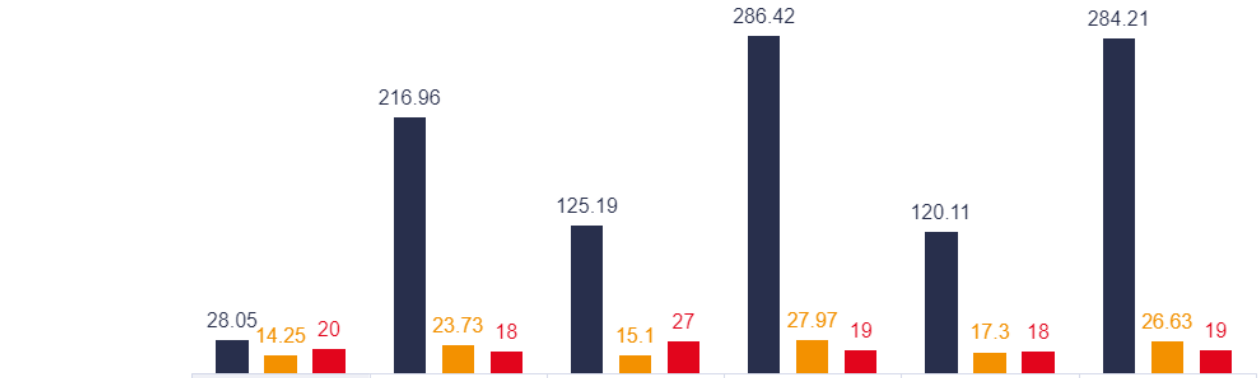
Fixed wireless access

Fixed wireless access is playing an increasingly important role in connecting Iraqi households. Data from the International Telecommunication Union (ITU) shows that in 2021 fixed wireless access was the main technology used to connect the Iraqi households. 5.13 million subscriptions were live at the end of that year, with the second highest fixed broadband subscription number coming from fibre optic connectivity with 1.21 million subscribers. DSL subscriptions was recorded to be 40,000 in 2021 and satellite broadband only had 2,010 subscribers.

2.3.2 State of broadband availability and performance (capacity, experience)

As of February 2024, the state of broadband performance in Iraq reflects a position behind the global average. According to the Speedtest Global Index, Iraq ranks the 89th for mobile broadband and 123rd for fixed broadband out of a total number of 142 economies listed. The global benchmarks for mobile broadband indicate a median download speed of 51.16Mbps, a median upload speed of 11.37Mbps, and a median latency of 27ms. Similarly, global fixed broadband medians surpass Iraq, with a median download speed of 92.26Mbps, an upload speed of 44.65Mbps, and a median latency of 9ms. As indicated in the analysis below, Iraq is significantly behind when comparing download speeds with leading GCC countries.

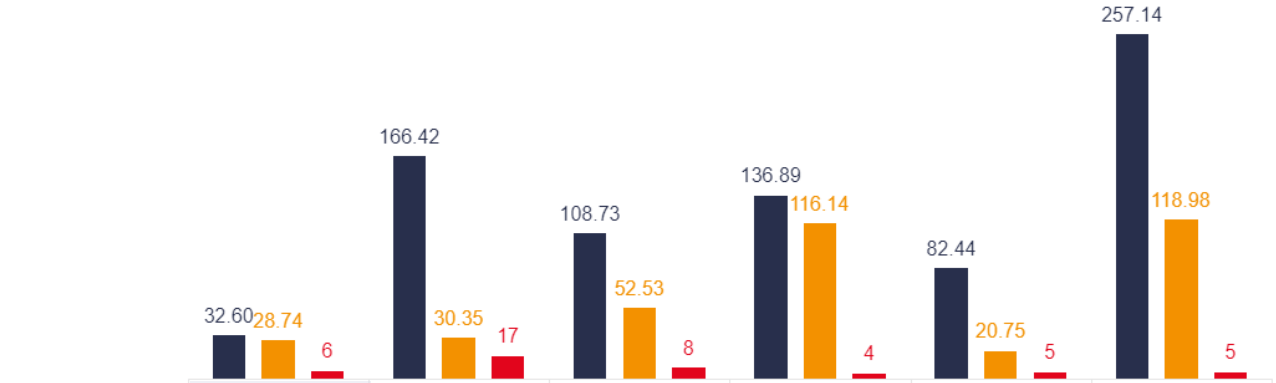
Figure 23: Median mobile broadband speeds across a sample of leading GCC countries



	Iraq	Kuwait	Saudi Arabia	Qatar	Bahrain	UAE
Download (Mbps)	28.05	216.96	125.19	286.42	120.11	284.21
Upload (Mbps)	14.25	23.73	15.1	27.97	17.3	26.63
Latency (ms)	20	18	27	19	18	19

Source: Speedtest Global Index (Feb 2024)

Figure 24: Median fixed broadband speeds across a sample of leading GCC countries



	Iraq	Kuwait	Saudi Arabia	Qatar	Bahrain	UAE
Download (Mbps)	32.60	166.42	108.73	136.89	82.44	257.14
Upload (Mbps)	28.74	30.35	52.53	116.14	20.75	118.98
Latency (ms)	6	17	8	4	5	5

Source: Speedtest Global Index (Feb 2024)

While both mobile and fixed broadband performances in Iraq lag behind the global benchmarks, the gap is more pronounced in the fixed broadband sector. The median download and upload speeds for mobile broadband in Iraq stands at 28.05Mbps and 14.25Mbps respectively. The fixed broadband, on the other hand, still falls far below the global average, with median download and upload speeds of 33.60Mbps and 28.74Mbps. Additionally, the reported latency for both mobile and fixed broadband ranks below the global medians at 20ms and 6ms respectively.

The coverage and performance of mobile and fixed broadband in Iraq varies significantly depending on geographical location. The following illustration depicts the median upload and download speeds for both mobile and fixed broadband across different governorates in Iraq.

In provinces such as Karbala and Kirkuk, mobile broadband outperforms fixed broadband significantly. Conversely, in other governorates like Sulaymaniyah, fixed broadband connections exhibit speeds notably faster than the national averages.

Figure 25: Median download and upload speeds (Mbps) in Iraq by governate

Governate	Major city	Median download speeds (Mbps)	
		Mobile broadband	Fixed broadband
Global	-	**51.16**	**92.26**
Iraq	**Country rank: #84**	**28.05**	**32.60**
Al Anbar	Ramadi	23.62	31.18
An-Najaf	Najaf	31.19	31.52
Babil	Hillah	22.32	26.42
Baghdad	Baghdad	29.47	36.26
Basrah	Basrah	24.73	20.68
Diyala	Baqubah	27.11	12.82
Duhok	Duhok	38.76	29.69
Erbil	Erbil	35.19	29.37
Karbala	Karbala	31.92	10.64
Kirkuk	Kirkuk	34.07	27.13
Ninawa	Mosul	28.62	25.64
Salah Al-Din	-	29.98	26.57
Sulaymaniyah	Sulaymaniyah	28.50	61.07

Source: Speedtest Global Index (Feb 2024, Iraq and Global)

The speed for fixed broadband by tier[17] at the end of 2022 provides some detailed insights into the fixed broadband user experience in Iraq. It counts the number of fixed broadband subscribers in Iraq within each speed threshold. The data is collected for subscribers with access to public Internet at downstream speeds equal to or greater than 256 Kbit/s.

Figure 26: Fixed broadband connection speed by tier

Country	256 kbit/s to 2 Mbit/s	2 Mbit/s to 10 Mbit/s	Equal to or > 10 Mbit/s
Iraq	**59.9%**	**30.1%**	**10.0%**
Syria	93.1%	6.8%	0.1%
Iran	10.9%	44.8%	44.3%
Kuwait	4.3%	30.3%	65.4%
Saudi Arabia	0.5%	1.9%	97.6%
Jordan	0.1%	29.2%	70.7%
Turkey	0.1%	4.7%	95.3%
Morocco	0.0%	41.7%	58.3%

Source: ITU (2022)

[17] ITU: Iraq fixed broadband subscriptions speed tier

The majority of subscriptions fell within the 256 kbit/s to less than 2 Mbit/s threshold, constituting approximately 60% of the total subscriptions considered. Within the speed range of 2 Mbit/s to 10 Mbit/s, there were 1.92 million fixed broadband connections, while only 639,000 subscriptions provided connectivity speeds equal to or above 10 Mbit/s. Minimal changes in the user distribution across different speed tiers have been observed since 2020. The data indicates that a greater proportion of fixed broadband users in Iraq are connected at lower speeds compared to other countries in the region. For instance, in Morocco, the majority (1.41 million) of fixed broadband subscriptions operate at speeds equal to or above 10 Mbit/s. Connections with lower speeds, ranging from 2 Mbit/s to 10 Mbit/s, have a lower number of subscriptions at 1.01 million.

2.3.3 Existing initiatives and buildout plans

Early developments

Under the authority of Coalition Provisional Authority's (CPA) Order 65 of 2004, the CMC takes on the responsibility of overseeing Iraq's telecom sector developments. At the time there was no existing set of legislations regulating the Iraqi telecommunications sector. In the early 2000s, two sets of regulations were introduced by the CMC to provide better guidance for the ICT sector.

The first regulation established an updated licencing framework for ISPs. The adjustments targeted three areas: the legal and technical requirements for applicants, obligations of licensees and rules regarding use of spectrum.

The second regulation specified the requirements, conditions, and procedures for licensing in the telecom sector depending on the service coverage of the ISPs. Three types of operational and service provision purpose were identified: nationwide network operators, regional network operators, and end-user service providers (utilising network capacity leased from the previous two groups).

National Internet Project

Fibre-optic became the major trend in the fixed broadband market in recent years. In March 2015, the Iraqi government initiated the National Internet Project, aiming to create a secure nationwide fibre-optic broadband network. The project is also known as the Iraq National Backbone project.

This project facilitates the development of e-government services and provides high-quality, low-cost broadband access to the public. The project involves regional private operators and subcontractors through revenue-sharing agreements.

Construction began in March 2018, with activation in February 2021 and plans for further expansion. The network spans over 4,000km, connecting with neighbouring countries, and includes both backbone and access infrastructure. The government's aim was to reach 2.5 million homes by the end of 2023. Up-to-date information on progress is not available.

4G network developments

All three MNOs in Iraq launched 4G network services in January 2021. Upgrades to the 4G connectivity was carried out by Asiacell and Zain Iraq in the following year.

Zain Iraq announced its upgrade of 4G network to the "4.5G+" (LTE-A) technology in February 2022[18], stating that 4.5+ was the most advanced network technology in Iraq at the time. The latest development on 4G aimed at providing the customers with better experience in terms of network coverage, speed and latency. Targeted solutions for enterprises and special offers with unlimited access to social media apps for customers backed by the 4.5G+ network were introduced by the operator in August and December 2022 respectively[19] [20]. Asiacell also launched its 4G+ network with the aim to enhance speed and resilience of its network through segmented routing in the transport network. The operator's customer base increased by 10% as a result of this upgrade in its 4G network.

Although the number of 4G subscriptions is still growing on a quarter-by-quarter basis, the majority of mobile network subscriptions are still 3G-based, making up approximately 53% of total subscriptions. Quarterly growth in 4G subscriptions in 2023 is also growing at a slower pace in comparison to 2022.

Figure 27: Quarterly growth in 3G and 4G mobile subscriptions in Iraq

Period	Total	Growth (%)	3G	3G growth (%)	4G	4G Growth (%)
Jun 2021	39,078,710	-0.8	19,030,000	2.3	1,155,000	32.0
Sep 2021	40,155,911	2.8	19,625,000	3.1	1,500,000	29.9
Dec 2021	40,872,857	1.8	20,260,000	3.2	2,110,000	40.7
Mar 2022	42,123,252	3.1	20,900,000	3.2	3,150,000	49.3
Jun 2022	42,615,725	1.2	21,800,000	4.3	3,995,000	26.8
Sep 2022	43,713,279	2.6	22,250,000	2.1	5,020,000	25.7
Dec 2022	43,701,372	0.0	22,540,000	1.3	5,837,000	16.3
Mar 2023	43,469,372	-0.5	22,770,000	1.0	6,468,000	10.8
Jun 2023	42,913,080	-1.3	22,690,000	-0.4	7,060,000	9.2
Sep 2023	43,202,360	0.7	22,820,000	0.6	7,664,000	8.6
Dec 2023	43,733,516	1.2	22,805,000	-0.1	8,605,000	12.3

Source: Telegeography (Dec 2023)

[18] Zain Iraq upgrades its fourth-generation network to the 4.5G+ technology
[19] Zain Business caters to the needs of enterprises and projects of all sizes
[20] Zain Iraq launches special offers for its 4.5G+ bundles

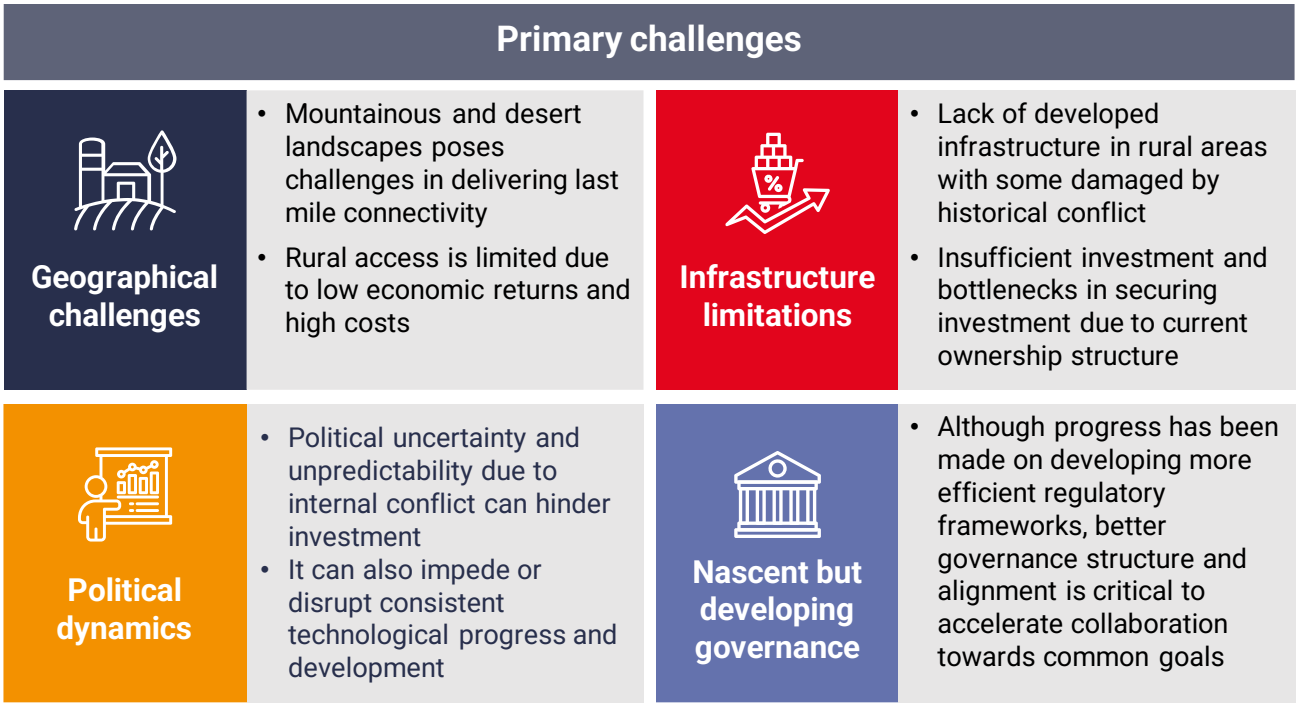
2.4 Primary challenges faced by the telecoms sector and key considerations

Iraq's geographic positioning places the nation as a key transit hub for communication and data traffic. Located near the Gulf countries, the Levant, and being in close proximity to Europe brings a host of benefits to Iraq including enhanced international cooperation. This strategic location facilitates the exchange of best practices for enhanced coordination, which can be used to provision last-mile and cross-border connectivity. The benefits extend to reduced latency with shorter communication and data loops, enabling faster connectivity.

To unlock these benefits, Iraq must advance its ICT sector to build a robust and strong communication network that fuels further technological innovation. However, Iraq is faced by a number of primary challenges which impedes its ability to strategically leverage these geopolitical benefits. This section explores the intricacies of these challenges in greater detail, delving into the following four areas:

- Geographical challenges
- Political dynamics
- Infrastructure limitations
- Governance and regulatory frameworks

Figure 28: Primary challenges faced by the Iraqi telecoms sector



Challenging physical geography

Iraq faces challenging physical geography characterised by a diverse and often harsh environment. Approximately 40% of the country consists of rocky deserts with an additional

30% consisting of mountainous areas[21]. Iraq's physical geography therefore presents significant obstacles for infrastructure development and resource management, contributing to the nation's complex socio-economic and environmental challenges.

In terms of implications for broadband development in the country, the arid and semi-arid landscape, coupled with extreme temperatures pose obstacles for the deployment and maintenance of the necessary broadband infrastructure. Harsh environmental conditions can affect the reliability of equipment, leading to increased maintenance costs and potential service disruptions.

Additionally, the presence of vast deserts and difficult terrains complicates the task of laying fibre-optic cables or establishing other broadband infrastructure, making it a resource-intensive and challenging endeavour. These geographical constraints contribute to the difficulties Iraq faces in expanding and enhancing its broadband infrastructure, limiting the accessibility of high-speed internet services and hindering the country's ability to fully leverage the benefits of advanced digital connectivity.

Infrastructure limitations

Iraq has historically faced significant challenges in developing and maintaining general infrastructure, including broadband infrastructure. Many areas across Iraq have inadequate or outdated infrastructure, posing as a challenge to the availability and reliability of broadband services, particularly across many rural landscapes. The lack of reliable electricity and frequent power outages further exacerbate the challenges, as a stable power supply is crucial for sustaining modern telecommunication networks.

The country’s economic and political history has hindered consistent investment and planning for robust infrastructure. The impact of past conflicts has left much of Iraq's infrastructure in disrepair, requiring substantial reconstruction efforts. Furthermore, the current infrastructure ownership and management structure hinders infrastructure investments, presenting a bottleneck in progressing the availability and quality of infrastructure. Addressing these infrastructure limitations requires a concerted effort in rebuilding and upgrading infrastructure, coupled with stable governance and strategic investments to propel Iraq into a more digitally connected and resilient future.

Nascent but developing governance model and regulatory frameworks

Iraq's telecom regulatory framework is in its early stages but is committed to the adoption of global best practices to promote wider broadband development and deployment. The country has been making efforts to establish a more structured and transparent regulatory environment for the telecommunications sector. Initiatives include clear structure and responsibilities of an independent regulatory body (e.g. the CMC) and the formulation of policies to encourage fair competition, attract investment, and ensure the efficient allocation of resources. However, progress is still required to ensure that efficient regulatory

[21] Iraq Country Profile: National Geography

frameworks are in place across all aspects related to broadband development, from rights of way and other operational measures to network security and assurance for example.

Having an independent regulatory body is critical in driving better governance structure and alignment across different stakeholders in the telecoms and wider ICT sector to accelerate collaboration towards the same outcomes for the country. This body is responsible for fostering a more conducive environment for the growth and modernisation of the telecommunications industry in Iraq.

2.5 Assessing the longer term viability of different broadband technologies

The expanding broadband landscape needs a nuanced approach to recognise the unique strengths and limitations of each option and how that applies to regions with different socioeconomic and geographical characteristics.

Mobile broadband technologies, such as 4G, 5G and beyond, are generally characterised by widespread accessibility and user convenience, serving as a diverse solution across regions and consumers. Fibre technology emerges as a high-performing internet solution, primarily limited in suitability for metropolitan areas, such as Baghdad. However, it takes time and significant levels of up-front investment to deploy FTTx. Fixed wireless access (FWA) presents an alternative solution that is mostly focused on rural and less populated areas, providing connectivity in places where traditional infrastructure may be impractical and not economically feasible to deploy. Meanwhile, DSL suffers from faces degradation and is often associated with high deployment and maintenance costs, hence, indicating the importance of decommissioning outdated, older technologies.

As broadband technologies advance, a strategic shift towards high-performance technologies becomes imperative, emphasising the need to phase out legacy networks such as copper, 2G and 3G, while acknowledging the distinct advantages more modern broadband options bring to the table. It is therefore crucial for Iraq to assess the viability of available broadband options to facilitate its digitalisation. The paper also dives into the various actions and priorities to accelerate the development of very high speed broadband networks in **Section 3.3** and to expand coverage and quality for universal access in **Section 3.4.**

3. National priorities for Iraq and how to measure success

This chapter details the specific priorities and objectives that the CMC has identified as key requirements to successfully promote broadband deployment and development, in line with Iraq's priorities and 2030 vision. It outlines key implications and impact of these priorities on the development of the Iraqi ICT sector and looks at methods to measure success.

The following priorities are as follows:

- **Establishing the right market conditions for broadband development:** The legislative priorities and measures required to facilitate and stimulate broadband development, with the aim of fair access to high quality broadband
- **Selecting appropriate approaches for efficient spectrum allocation and use:** The need for efficient and appropriate spectrum allocation in optimising network performance, encouraging innovation, promoting competition and supporting emerging use cases
- **Accelerating high speed broadband infrastructure development:** The role of broadband infrastructure deployment in providing high speed (gigabit) broadband connectivity in key municipal areas to drive digital and industrial transformation
- **Expanding coverage and quality for universal access:** Ensure widespread deployment and implementation of higher capacity networks for peripheral and rural areas
- **Bridging the digital divide and enabling new digital use cases:** Promoting awareness and demand for high speed broadband access and demonstrating the different types of use cases it unlocks for government, enterprise and consumer
- **Ensuring security and assurance for critical infrastructure:** The need for network and data security, privacy, and network assurance as part of overall critical infrastructure protection and resilience

The following sub-sections elaborates on each of the six priorities above in more detail.

3.1 Establishing the right market conditions for broadband development

As countries across the world enter an era of increased digitalisation, creating an environment that encourages digital readiness is paramount. Fostering the right market conditions will be critical for Iraq in enabling broadband transformation to a more digital economy, both at national and local market levels. This requires efforts from all levels of stakeholders – including the government and regulatory bodies, operators, and consumers.

State authorities and policymakers must facilitate the design and implementation of an environment conducive to efficient, competitive service offerings from operators. This entails the following:

1. Reducing friction to obtain access for **rights of way**
2. **Investment-friendly framework** that encourages effective collaboration, innovation, and deployment of infrastructure
3. Fair input **pricing controls** and appropriate fee structures

At the level of end-users, this involves promoting digital literacy and eliminating barriers that impede consumers and businesses from fully leveraging digital tools at their disposal. These methods combined will establish the right market conditions for broadband development.

3.1.1 Role of frameworks addressing rights of way processes

Efficient management, maintenance, and upgrading of Iraq's underlying broadband infrastructure are all essential to longer term broadband development and the delivery of reliable network services. This includes constructing, operating, and maintaining facilities to support fibre rollout to the mast or mobile tower to support mobile networks.

Critical to this is the access to public rights of way (RoW) in Iraq. This refers to the permissions and pathways for the installation and maintenance of network infrastructure across public spaces such as roads, pavements, and utility corridors. The RoW concept defines the legal foundations which grants entities to build, operate, and maintain infrastructure on land owned by other parties. The problem is that planned work can affect existing infrastructure, so telecoms operators typically have to negotiate rights of way with affected parties. This process can be time-consuming and complex.

The implementation of an effective RoW framework necessitates a top-down approach, starting at the national level where changes in public policies, practices, and regulatory measures are required to improve the process for telecoms operators to obtain RoW for any work required on network infrastructure. The regulatory and government policies for RoW should then be cascaded down to specific municipalities to ensure a coordinated, standardised, and transparent process for operators.

An efficient RoW framework needs to cover the following main aspects:

- **A transparent and uniform (ideally digitised) application process:** Clear standardised step-by-step process implemented on a national basis on how to obtain access to rights of way from various entities (e.g. municipality or local authority)
- **A standardised fee structure:** For clarity and predictability for both telecoms operators and regulatory authorities, granting RoW in financial planning to promote fair and consistent practices
- **Clearly specified timelines and deadlines for response:** Establish deadlines and expectations on when to expect responses to simplify the permitting process

Below are some key reasons why this is important in the context of broadband development and ensuring speed in providing universal access to high-speed connectivity services in Iraq:

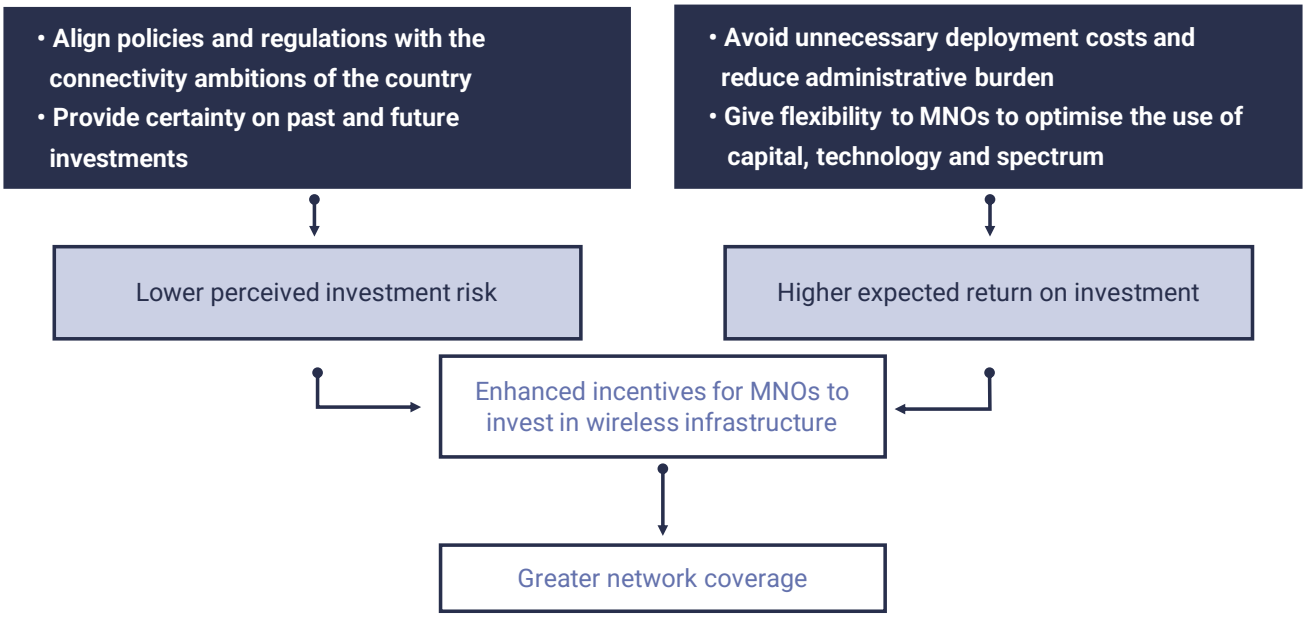
- **Predictability and transparency:** A standardised process fee structure provides clarity and predictability for all parties involved. This transparency helps in budgeting and financial planning for broadband deployment projects, reducing uncertainty and promoting fair and consistent practices.
- **Cost reduction:** Standardising fees helps to minimise negotiation efforts and costs associated with determining and agreeing on individual compensation amounts for accessing different RoW. This reduction in transaction costs can make broadband infrastructure deployment more economically viable, encouraging more investments in network expansion.
- **Promotion of competition**: A uniform fee structure fosters a level playing field by ensuring that all providers pay the same fees for accessing RoW. This promotes healthy competition among telecommunication companies, preventing any undue advantages for specific players and encouraging market diversity.
- **Avoidance of disputes:** Standardisation can help prevent disputes and conflicts between telecommunication companies and landowners or regulatory authorities. Clear and consistent fee structures reduce the likelihood of disagreements over compensation amounts, expediting the approval process for RoW access.
- **Speed of infrastructure deployment and development:** By simplifying the overall process to obtaining RoW, this contributes to the efficiency and timeliness of broadband deployment. Telecommunication companies can navigate the RoW approval process more smoothly when fees are well-defined, leading to quicker project implementation and network expansion.
- **Facilitation of investment:** Investors, whether private or public entities, are more likely to support broadband development projects when there is a clear and standardised fee structure. This promotes a favourable investment climate, attracting the necessary funds for expanding broadband infrastructure and services.

By establishing clear guidelines and expectations for obtaining permissions, the system promotes efficiency in the overall broadband development process by reducing bottlenecks, delays, and administrative burdens faced by the telecoms operators, and providing a comprehensive understanding of the process from the outset.

3.1.2 Investment-friendly regulatory framework for broadband development

An investment-friendly regulatory framework is crucial for fostering broadband development and synergies in Iraq. Within mobile broadband, the GSMA identifies such a framework to be one that not only adheres to laws, secondary legislation, and regulatory guidelines, but also ensures effective enforcement by an independent authority. This authority should collaborate seamlessly with other relevant entities that may have jurisdiction in overlapping areas. In particular, the framework should support investment in rural areas for universal access and high-speed service deployment (e.g. 5G).

Figure 29: Elements of regulatory framework supporting investment in rural areas



Source: GSMA

The regulatory framework should be clearly defined around policy objectives that promote a competitive environment, encourage infrastructure investment and innovation, and uphold consumers' and operators' interests. Unnecessary bureaucracy can significantly affect willingness to invest in infrastructure by increasing costs of innovation and reducing the expected return on investment. Reducing this will be imperative to lower network deployment costs. An investment-friendly regulatory framework should therefore enable the following:

1. **Facilitate voluntary cooperative agreements** such as passive infrastructure sharing to encourage telcos to explore synergies in broadband infrastructure development.
2. **Streamline rights of way processes** to grant access to land.
3. **Maintain technology neutrality** to allow MNOs flexibility in optimising the use of existing capital, technology, and spectrum usage as well as developing next-generation access technologies.

Mandating a framework that establishes these characteristics can future proof the market for new innovations by instilling confidence among private investors and encouraging them to develop plans for network expansion and broadband upgrades with confidence. In spite of this, periodic audits of policies every 3-5 years are essential. Regulatory authorities should demonstrate flexibility by making appropriate legislative changes that align with technological and market evolution, better reflecting prevailing market conditions. This oversight can be achieved by collecting and evaluating data in line with the costs and benefits associated with key market stakeholders.

3.1.3 Importance of competition, fair pricing controls and open innovation

The telecommunications industry is characterised by high-fixed costs with rapid technological advancements. In order to keep up with the pace of development and assure an environment that promotes better outcomes for broadband access and quality for end users, a combination of competition, fair pricing controls, and open innovation is essential for broadband development in Iraq. The key reasons for this are outlined below:

Competition: Competition is crucial for driving broadband development as it incentivises companies to innovate, invest in infrastructure and provide better services that customers want. In a competitive market, multiple providers strive to outperform each other, leading to improved technologies, increased network coverage, and enhanced service quality. This competition not only expands consumer choices but also fuels the expansion of broadband access, ultimately benefiting communities through faster, more reliable, and affordable internet connectivity. This shapes better market outcomes for all stakeholders with lower prices and enhanced services for customers.

Fair pricing: Given Iraq is still in the process of developing its broadband market, price regulation could be counterproductive to the long-term development and effectiveness of the market. However, some fair pricing controls are a necessary tool in select situations to ensure basic broadband services are accessible and universally affordable. In its absence, operators with significant market power engaging in predatory pricing and price discrimination will affect the affordability and accessibility of services. For example, fair pricing controls should apply in the wholesale market for access to passive infrastructure (e.g. ducts, poles, and conduits), to ensure equitable use of essential resources and encourage services providers to access and utilise existing infrastructure. While price intervention is necessary in addressing potential market failures and protecting consumers, it should be approached cautiously without running the risk of limiting investment and innovation and market distortion.

Open innovation: Open innovation supports collaboration among ecosystem players, including communication service providers, technology companies, and public authorities. This collaborative environment supports the development of new solutions, technologies, and infrastructure, accelerating broadband expansion and improving the quality of service.

The interplay of competition, fair pricing controls, and open innovation is essential for sustainable broadband development. The dynamic interaction between the three aforementioned aspects fosters a healthy dynamic environment that contributes to universal access and a more efficient market. State authorities play a crucial role in creating a framework that balances industry interests and end customer protection, ensuring the overall health of the broader telecoms ecosystem.

3.2 Assessing key requirements for efficient spectrum allocation and use

Regulatory bodies play an influential role in propelling key spectrum considerations and in the management of spectrum. According to the ITU, spectrum management functional responsibilities are as follows:

Figure 30: ITU Spectrum management functional responsibilities

Source: ITU Handbook on National Spectrum Management

Efficient spectrum allocation and management is critical in optimising the use of scarce spectrum and valuable resources. The availability of appropriate frequency bands also facilitates the rapid expansion of emerging technologies and use cases that foster innovation and economic growth. Furthermore, flexibility in spectrum allocation and management is essential to the industry's ability to adapt to the dynamic needs of evolving technologies and user demands, enabling a more agile response to market changes and optimisation of wireless communication services in Iraq.

Assessing spectrum allocation regularly and refining policies will be essential to stay ahead in this dynamic landscape. Its management plays a pivotal role in ensuring resources are managed efficiently to meet network capacity requirements and drive innovation.

3.2.1 Role of efficient and appropriate spectrum allocation

Flexible spectrum usage policies and adaptability in spectrum management are both crucial elements that foster innovation in the Iraqi ICT sector. They not only ensure the efficient utilisation of radio frequency spectrum resources but also accommodate and allow the rapid deployment of emerging technologies using the appropriate spectrum for various needs.

Flexible spectrum usage policies:

Spectrum usage policies that enable dynamic and efficient deployment of diverse services include **flexible use rules**.

Flexible-use technical and service rules in spectrum regulation enable diverse applications and services within a frequency band, promoting innovation, investment, and efficient spectrum use. Technical rules pertain to the specific technical parameters governing the use of a particular frequency band while service rules relate to the services provided within a given frequency band. This can refer to the use of spectrum for both 4G and 5G. This flexible-use approach to spectrum allows rapid deployment of mobile services, fostering adaptability in a dynamic technological landscape. For example, in Saudi Arabia, licenses for low-band spectrum (700MHz and 800MHz bands) are technology neutral so although it was intended for 4G, operators are able to also use it for 5G[22].

Technology and service neutrality for spectrum collectively support wider innovation by eliminating bottlenecks with the number of licenses that an operator needs to acquire while broadening the scope of services they can deliver.

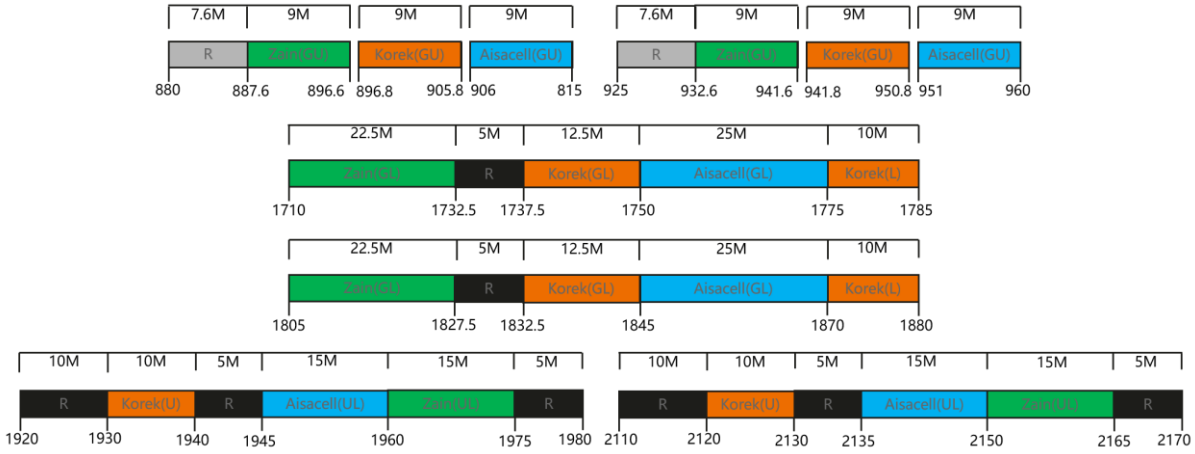
3.2.2 Analysis of spectrum frequency bands to unlock different outcomes

Mobile operators need timely and affordable access to a sufficient amount of spectrum in order to support high speed, mobile broadband services with good coverage. When operators are spectrum-constrained, they are likely to have to invest more on densifying their network in urban areas than they would otherwise. This in turn can constrain their ability to invest in the rest of the network and, especially, improve coverage.

The GSMA Mobile Connectivity Index shows that countries that have allocated more spectrum for mobile are more likely to have higher levels of mobile broadband coverage. Research by the GSMA[23] has shown that 4G mobile coverage increases by 11-16 percentage points, and 3G coverage increases by 20 percentage points, when operators are assigned spectrum 2 years earlier. The same study showed an additional 20MHz of spectrum per operator increases 4G coverage by 2-4 percentage points. Besides, to get ready for 5G launch, a significant amount of new harmonized mobile spectrum is needed.

[23] GSMA: The impact of spectrum prices on consumers

Figure 31: Current mobile spectrum allocation in Iraq



Currently, cellular mobile telephony frequency spectrum in 900MHz, 1800MHz, and 2100MHz were made available in Iraq. Iraq has allocated 274MHz mobile spectrum to three operators in total but currently lags behind other Middle Eastern countries based on allocation of spectrum resources, such as UAE 338MHz without considering the spectrum of 5G, Bahrain 306.4MHz without considering the spectrum of 5G and so on.

In Iraq, MBB services develop rapidly since 2021. More and more Iraqis enjoy the convenience brought by MBB services and expected to see exponential growth of data traffic over the next coming years. However, limited spectrum resources will restrict the future development of MBB services. The availability of spectrum is therefore a critical aspect to support the development of broadband services in Iraq.

Telecoms operators should have a diverse range of spectrum frequency bands to enable them to offer different types of high-quality services to their customers across both urban and rural areas. Given the suitability of spectrum for different purposes, operators should have a mix of higher and lower frequency spectrum to address specific situations, associated challenges and requirements. For example:

- **Low frequency bands (less than 1GHz)** are best suited to providing coverage in sparsely populated areas. They each have a higher cell radius and therefore requires fewer cell sites to reach the same level of performance and coverage where user densities are lower. This can significantly improve the business case for telecoms operators in expanding coverage in rural areas with fewer cell sites needed to reach a certain level of performance. They can also be used to complement and expand existing coverage because they can penetrate better inside buildings24. However, they have lower capacity capabilities (per square km) given limited supply.
- **High frequency bands (above 6GHz)** are better suited to providing capacity necessary for high bandwidth demands and hence, better serves more dense areas (higher concentration of users, e.g. in urban areas). There is also a larger supply of this

[24] Introducing radio spectrum

spectrum to enable high volumes of data traffic to be supported. However, compared to lower frequency bands, its weakness is in its shorter range resulting in issues with coverage and providing signal penetration in indoor areas such as buildings.

- **Mid band spectrum (1GHz to 6GHz)** is the balance of the two and brings the best of both low and high frequency bands. It has the ability to carry significant volumes of data at high-data rates to meet growing requirements while still being able to travel significant distances and achieve decent coverage and penetration.

The use of low to mid band spectrum can also lead to cost savings in the number of cell sites required to reach a certain level of coverage, particularly in vast rural areas. Wider channel bandwidths can also lead to a reduced environmental footprint with lower power usage.

For 5G, the 700MHz band has been allocated as the preferred low band frequency for 5G. Most leading countries (including almost all European Union member states) have made spectrum available in the 700MHz band to address coverage needs. Most EU member states have allocated 2 blocks of minimum 10MHz (not contiguous blocks but organised as paired spectrum) with technology neutral licenses. Further analysis of other countries as shown below indicates consistency with the EU spectrum allocation of 700MHz.

Figure 32: Sample of other countries and 700MHz spectrum allocation

Countries	700MHz band allocation	Purpose
Japan	2x10MHz for Rakuten Mobile	Technology neutral, used for 4G/5G
	2x10MHz for KDDI	
	2x10MHz for NTT DOCOMO	
	2x10MHz for Softbank	
Australia	2x10MHz for Optus	Technology neutral but used for 5G
	2x20MHz for Telstra	
	2x15MHz for Vodafone	
Philippines	2x10MHz jointly purchased by Globe telecom and PLDT	Technology neutral but used for 5G

Countries	700MHz band allocation	Purpose
Hong Kong	2x10MHz for CMHK	Technology neutral but used for 5G
	2x10 for HKT	
	2x10 for Hutchinson	
	2x5MHz for SmarTone	
India	2x20MHz for Jio	Technology neutral, Used for 5G
Thailand	2x10MHz for DTAC	Technology neutral, Used for 5G
	2x10MHz to True Corp	
	2x10MHz to AIS	
	2x10MHz to NT	
Oman	2x10MHz for Vodafone Oman	Used for 5G

Source: Telegeography

In terms of the impact on the overall economy, mid-band spectrum in particular has been identified as a critical element to unlock the benefits of 5G and its associated impact on GDP. The GSMA estimates[25]:

- Of the total additional GDP value that 5G will add to the global economy, mid-band 5G contributes 63%.
- More specifically in the MENA region, the benefits of mid-band spectrum for 5G is projected to reach an estimated economic sector contribution (impact on GDP) of

[25] Socio-economic benefits of mid-band spectrum

US$16 billion by 2030. This is through enhancing and enabling use cases that drive digital transformation across multiple industries.

Mid-band spectrum does this by being able to address three broad use cases for 5G:

- **Enhanced mobile broadband (eMBB):** For higher speeds, capacity and mobility use cases such as high-definition video streaming on the go, augmented or virtual reality (AR/VR), immersive collaboration
- **Ultra-reliable low latency communications (URLLC):** Providing high reliability and low latencies required for mission critical applications such as autonomous cars and remotely operated equipment in the industrial sectors
- **Massive machine type communications (mMTC):** To connect a large volume of IoT devices across vast areas and enable real-time data collection and response, including use cases in smart agriculture, asset tracking and delivery fleet management in logistics

The below sections analyse the need for specific frequency bands within this category:

2.6GHz (Band 41)

The 2.6GHz band is seen as the best suited option to augment any available sub-1GHz spectrum as they both provide arguably the most cost-effective means of providing nationwide coverage, including in both rural and urban areas. This band can be used to support both 4G LTE and 5G networks. Its range and coverage capabilities make it particularly suited to meet objectives around universal access.

Figure 33: Sample of countries and 2.6GHz spectrum allocation

Countries	2.6GHz band allocation	Purpose
Saudi Arabia	100MHz is allocated to Mobily	5G
	90MHz is allocated to Zain	
UAE	100MHz is allocated to Du	5G
	94MHz is allocated to Etisalat	
Bahrain	50MHz to Batelco	Technology neutral
	40MHz to Viva (stc Bahrain)	
	50MHz to Zain	
Uzbekistan	50MHz to Ucell	4G
	50MHz to UMS	
Lebanon	50MHz to OGERO	Technology neutral
Yemen	194MHz to PTC	5G

Countries	2.6GHz band allocation	Purpose
Seychelles	160MHz to Cable and Wireless Seychelles	5G
Maldives	90MHz to Dhiraagu	Technology neutral
	90MHz to Ooredoo	
Bangladesh	60MHz to Grameenphone	5G
	60MHz to Robi	
	40MHz to Ollo *(for FBB only)*	
Thailand	100MHz to AIS	Technology neutral
	90MHz to True	
Philippines	110MHz to Globe Telecom	Technology neutral
	55MHz to Smart	
Fiji	85MHz to Digicel	5G

Source: Telegeography

Based on the analysis in Figure 33: Sample of countries and 2.6GHz spectrum allocationFigure 33, many markets that have issued licenses in the 2.6GHz frequency band have allocated contiguous blocks of 40MHz to 100MHz per 5G license holder. Countries that have allocated 40MHz to 60MHz blocks to operators (e.g. 40MHz to Ollo in Bangladesh) have done so to operators that are using for fixed wireless broadband. Many of those who

allocated smaller blocks have also allocated or plan to allocate additional spectrum to operators.

3.5GHz (also known as C-band)

The 3.5GHz frequency band has been deemed as the 'principal 5G launch band[26]' given many countries globally have already designated it for 5G. It underpins many of the first implementations of 5G globally, including across Europe and the US. The availability of wider channels in the 3.5GHz range has been encouraged by the ITU and regional groups to lower network density and infrastructure costs for CSPs to support increased traffic and capacity requirements. This in turn has a direct impact on the cost of 5G services for consumers.

3.5GHz spectrum has also been allocated in many leading Middle Eastern countries to support 5G development. Most countries analysed below have provided 100MHz contiguous blocks for license holders, with the UAE regulator even providing 200MHz contiguous blocks to mobile operators du and Etisalat.

Figure 34: Sample of Middle Eastern countries and C-Band allocation

Countries	3.5GHz band allocation	Purpose
Saudi Arabia	50MHz to GO Telecom	Technology neutral
	50MHz to ITC	
	100MHz to Mobily	
	100MHz to stc	
	100MHz to Zain	
Kuwait	100MHz to Mada	Technology neutral
	100MHz to Kuwait Telecom	
	100MHz to Ooredoo	

Countries	3.5GHz band allocation	Purpose
Qatar	100MHz to Ooredoo	Technology neutral
	100MHz to Vodafone	
Bahrain	100MHz to Batelco	Technology neutral
	100MHz to stc	
	100MHz to Zain	
Oman	100MHz to Omantel	5G
	100MHz to Ooredoo	
	100MHz to Vodafone	
UAE	200MHz to du	Technology neutral but used for 5G
	200MHz to Etisalat	

Source: Telegeography

[26] The 3.5GHz range in the 5G era

Figure 35: Specific 3.5GHz band allocation for sample countries

Countries	3.5GHz band allocation				
	3300MHz – 3400MHz	3400MHz – 3500MHz	3500MHz – 3600MHz	3600MHz – 3700MHz	3700MHz – 3800MHz
Saudi Arabia		50MHz, 50MHz	100MHz	100MHz	100MHz
Kuwait		100MHz	100MHz	100MHz	100MHz
Qatar		100MHz	100MHz		
Bahrain		100MHz	100MHz	100MHz	
Oman		100MHz	100MHz	100MHz	
UAE		200MHz		200MHz	

Source: Telegeography

4.9GHz and 6GHz

The importance of the 4.9GHz and 6GHz bands, compared to 2.6GHz and 3.5GHz, lies in its ability to address the growing demand and future requirements for high-speed, low-latency wireless connectivity, supporting emerging technologies and alleviating demands on existing frequency bands.

Some countries have already started deploying 4.9GHz and 6GHz for 5G use:

Figure 36: Early deployments using 4.9GHz and 6GHz spectrum

China

4.9GHz

- China Mobile was awarded spectrum in the 2515MHz-2675MHz and 4800MHz-4900MHz bands for the trial of 5G services in December 2018
- The operator went on to launch full 5G services in 50 cities on 31 October 2018
- 5G voice users totalled 91.9 million by the end of 2022

6GHz

- China's industry regulator has approved the 6GHz frequency band for cellular networks
- The country granted its first private 5G spectrum allocation of 100MHz under 6GHz band to the Commercial Aircraft Corporation of China (COMAC) in 2022

Japan

4.9GHz

- In April 2019 an advisory panel to the communications minister approved the allocation of frequency bands for 5G advanced mobile communications services to three operators in Japan
- NTT DOCOMO was issued with spectrum in the 3.6GHz-3.7GHz, 4.5GHz-4.6GHz and 27.4GHz-27.8GHz bands, it is now targeting >90% coverage by March 2024
- KDDI issued with spectrum in the 3.7GHz-3.8GHz, 4.0GHz-4.1GHz and 27.8GHz-28.2GHz bands, with estimated >90% coverage by June 2023
- SoftBank was authorised to use spectrum in the 3.9GHz-4.0GHz and 29.1GHz-29.5GHz bands, the operator has reached 90% coverage in June 2022

Russia

4.9GHz

- At the end of January 2024, the government added the 4.4GHz-4.99GHz range for mobile services to the national frequency table, thereby making this an official 5G band
- National 5G plans are contained in the 'Strategy for the Development of the Communications Industry of the Russian Federation until 2035', approved by the Cabinet of Ministers in December 2023
- The plans state that 5G should cover 10%-25% of the population by 2030 and should be deployed across all cities with 100,000-plus populations in 2031-2035 using 4400MHz-4990MHz as the main 5G frequency band alongside additional 694MHz-790MHz spectrum

Source: Telegeography

There was a pivotal agreement made at the 2023 World Radiocommunication Conference (WRC-23) to open up a portion of the 6GHz band for 5G, specifically setting aside 6.425-

7.125GHz for licensed mobile operations[27]. Below are some key reasons why this decision on 6GHz spectrum is critical:

- Insufficient mid-band spectrum can lead to network densification, which in turn reduces the quality of service experienced by the end user.
- To support growing capacity requirements without the 6GHz band, telecoms operators would have to install additional base stations which will generate an estimated carbon footprint 1.8-2.9x higher[28].
- The associated cost of deploying more base stations will fall to the consumer via higher prices for their services.

As a result, this particular band in addition to 4.9GHz play an essential role in longer term development of accessible high speed broadband services.

3.2.3 Need for spectrum refarming (2G/3G)

Spectrum refarming of 2G and 3G frequencies is critical for spectrum efficiency and allows operators to allocate valuable frequency bands for more efficient use given spectrum is a finite resource. The lower frequency bands from 2G and 3G offer better propagation characteristics, enabling signals to travel over longer distances and penetrate indoor areas more effectively. By refarming this spectrum for 4G and 5G, which are naturally more efficient networks, operators can improve coverage and capacity in both urban and rural areas.

In Iraq, the current spectrum that the mobile network operators have for 2G and 3G are:

- 900 and 1800MHz for 2G: Asiacell, Korek Telecom and Zain Iraq as license holders
- 2100MHz for 3G: Asiacell, Korek Telecom and Zain Iraq as license holders

As mentioned earlier in the document, these licenses upon renewal were made technology neutral and therefore can be used for future generations of mobile networks. The process of spectrum refarming is typically coupled with decommissioning of legacy 2G and 3G networks, which we will discuss in Section 3.4.4.

3.2.4 Allocation of reserved spectrum and reallocation of underused spectrum

As demand for high-speed internet access increases, allocating additional specific bands for broadband technologies like 4G and 5G is important to meet growing connectivity needs of citizens and businesses. As a result, to ensure the ability to address growing traffic demands and requirements, it is important for state authorities to reserve spectrum to support the growth of wireless broadband services, should additional spectrum be required.

[27] 6GHz, satellites and 6G addressed at WRC-23
[28] 6GHZ in the 5G era

As conditions and market demands in Iraq change, the reallocation of spectrum should be enabled where required. For example, the strategic reallocation of underused spectrum from military to civilian applications holds immense promise for bolstering technological innovation and meeting the escalating demands of modern communication systems. By repurposing spectrum traditionally designated for military use, governments can address the burgeoning need for expanded bandwidth in the civilian sector.

3.3 Accelerating high speed broadband infrastructure development

As discussed in earlier sections (see 3.1 and 3.2), the continual assessment of spectrum allocation and adaptation of policy frameworks regarding RoW are crucial components in effectively addressing the advent of new technologies. This dynamic approach not only fosters an environment conducive to innovation and economic growth through enhanced collaboration across key market players, but also helps establish widespread access to high-speed broadband – a critical determinant for optimising the expansion of the digital economy and augmenting data transfer capabilities, speed, and latency in Iraq.

It is therefore imperative for state authorities to cultivate conditions that encourages operators to further innovate. This necessitates the construction of robust and secure infrastructure (e.g. towers, fibre, etc.), the strategic deployment of suitable technologies to ensure high-speed access (e.g. very high-capacity networks or VHCN) in both urban and rural landscapes, and the establishment of distribution networks to cater the needs of the underserved areas. These technologies will likely differ significantly across geographical regions. Rural communities, for instance, are often underserved with weaker infrastructure compared to their urban counterparts and the expected revenues are insufficient to compensate for the operating costs incurred by operators and ISPs.

Consequently, the terms and conditions set out in regulatory frameworks must create a competitive environment, providing operators in Iraq with incentives to stimulate investment in VHCN infrastructure deployment and strengthen quality of connectivity for all citizens and businesses whilst protecting the private interests of operators.

3.3.1 5G rollout and development plan

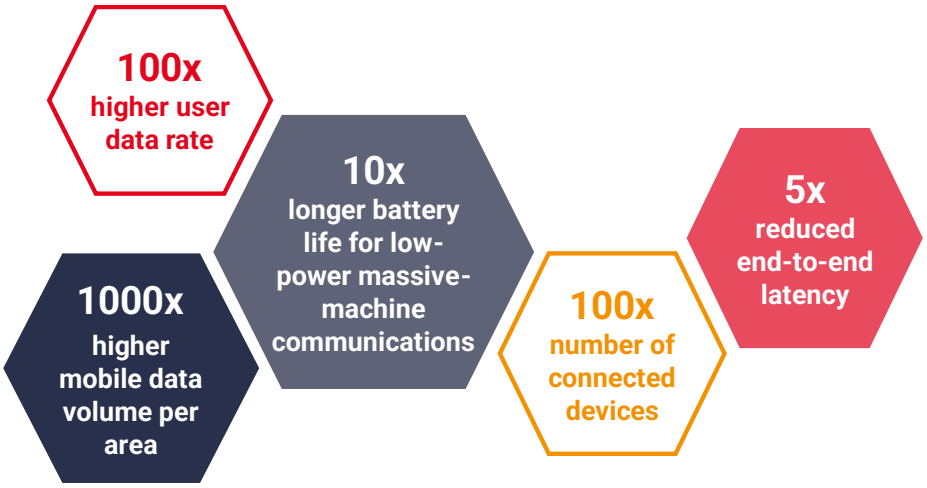
The provision of advanced connectivity solutions will remain as the core service area for communication service providers in Iraq, despite the industry wide move towards provisioning the fourth industrial revolution. 5G's full economic impact is expected to be realised across the globe by 2035[29]. 5G will eventually underpin society's connection fabric, connecting a multitude of devices, machines, and systems across Iraq. It is imperative to recognise this when developing national broadband plans.

[29] Overview of 5G

The rollout of 5G promises great potential in enhancing cellular capabilities and new value add use cases which ensures IoT and ultra-reliable, low-latency communications (URLLC) are more accessible through society. For instance, 5G-enabled use cases such as smart cities, remote patient monitoring and autonomous vehicles allow various consumer groups (e.g. businesses and households) to experience more reliable and effective communication. Additionally, 5G rollout guarantees Iraq with more seamless deployment of FWA as much of the infrastructure will be readily available for fixed alternatives.

Figure 37 outlines the potential network benefits to be achieved by implementing 5G. These benefits lend itself to the convergence of 5G and IoT. The increasing presence of IoT is expected to digitally transform many industry verticals, unlocking the capacity for the effective management of more than 100 billion[30] connected devices to efficiently transfer user data whilst demanding very low power.

Figure 37: Potential 5G network benefits



Source: ITU

To build next-generation access networks, policymakers in Iraq must adopt a forward-looking approach and create the right conditions for efficient spectrum use. 5G demands low- and mid-bands below 6GHz and new spectrum bands like mmWave, previously reserved for satellite communication, for high-speed terrestrial connectivity. Furthermore, strengthening infrastructure implementation models and ownership are pre-requisites for driving infrastructure growth and developing broadband connectivity. As for the long-run, the government needs to consider how to best serve rural communities. Private players need incentives to deploy the required infrastructure to grant these excluded areas with access to high-speed broadband networks.

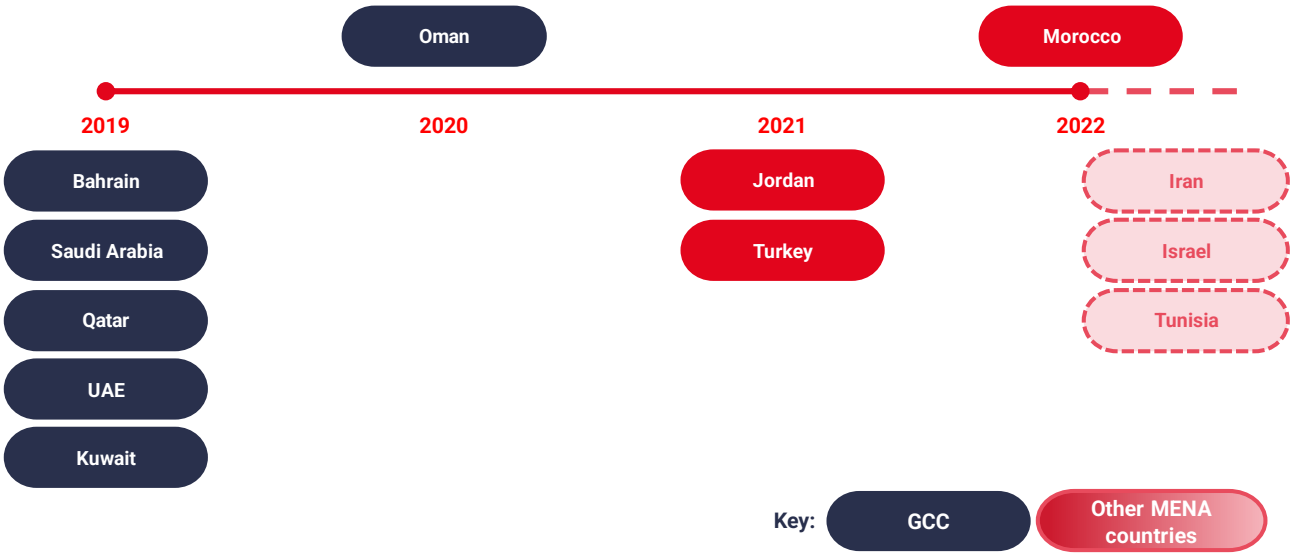
Omantel's launch of the 5G networks was part of their pioneering efforts to supporting digital transformation. The Omani Telecommunications Regulatory Authority (TRA) approved Omantel's roadmap to commercially launch 5G services in 2,226 locations in the Sultanate

[30] Huawei ICT Insights – 5G for IoT and Mobile

by 2024[31]. Building out FWA of the back of the 5G wireless technology allowed Omantel to extend its services to a wider spectrum of the Sultanate population, particularly the markets with limited access to wired technology and fixed broadband solutions.

Several operators across the GCC Arab states have started to make similar strides, demonstrating the move from trial phases to early 5G deployments and commercialisation, many of which have chosen to adopt the non-standalone (NSA) model. Under an NSA model, operators leverage existing 4G LTE macro sites and spectrum alongside a 5G RAN to achieve higher speeds. The drive for this comes from the mobile industry's vested interest in growth and development as well as governments and state authorities. The GSMA anticipate 16% 5G adoption as a fraction of total mobile connections across the GCC by 2025[32].

Figure 38: Commercial launch of 5G mobile services across MENA countries



Source: GSMA

3.3.2 Need for a fully developed and modernised backbone network

The provision of communication services in Iraq relies on a combination of network infrastructure, with domestic backbone networks that serve as a highway for network traffic. The lack of a modernised backbone networks supporting high capacity requirements can significantly impede national broadband development. As traffic volumes grow, network traffic can be non-uniformly distributed with some links suffering from congestion with others having much lighter loads. These congested links then become bottlenecks.

A modernised and fully developed backbone network should be resilient, fibre-based and able to support all types of services. It also requires the ability to dynamically share network resources and select the optimal path to support efficient traffic transmission and improve

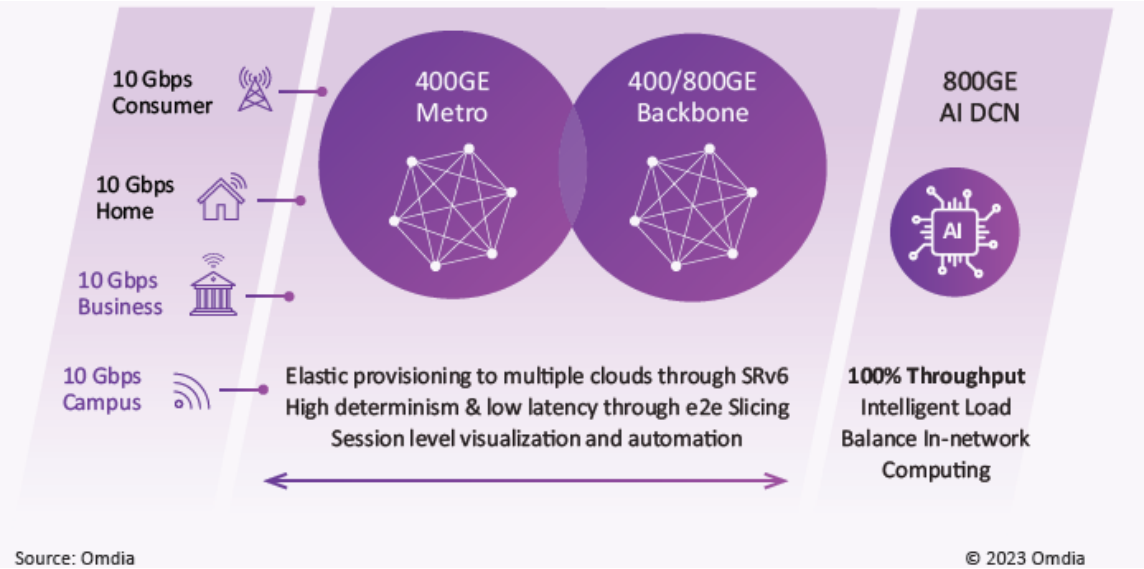
[31] First 5G Network in Oman Witnesses High Turnout
[32] 5G in MENA: GCC operators set for global leadership

the overall service quality, latency and availability. The increasing adoption of AI applications also places additional strain on networks today. It is therefore important for Iraq to modernise its domestic backbone infrastructure to address these potential challenges arising from the growing network traffic.

At the access level, this entails providing Gigabit per second (Gbps) or even 10Gbps connections to consumers, homes, businesses, and enterprises. Such high-speed connections are essential for facilitating fast data transmission and enabling seamless access to AI-driven services and applications as shown in Figure 39.

Moreover, to support the increasing demands generated by these high-speed access connections, the capacity of the backbone network needs to be upgraded to meet the rising demand for both mobile and fixed subscribers increase in the next 5 to 10 years, with the move to 400GE or even 800GE converged backbone networks. High reliability (99.9999% or also known as '6 9's') and cut-resistant fibre (or associated prevention measures) across the various access networks is also critical to facilitate the reliable and efficient transfer of data between different locations, forming a resilient foundation to enable digitalisation in Iraq.

Figure 39: Role of backbone network development



The inherent challenge lies in the high fixed costs associated with modernising the existing backbone infrastructure. Policymakers face difficulties in providing operators with incentives to participate in competitive markets for developing the required backbone infrastructure. Additionally, offering financial and fiscal support to develop high-capacity networks becomes crucial. Policy measures discussed in earlier sections such as removing regulatory hurdles for investment, passive infrastructure sharing, and awarding subsidies can create an environment that reduces financial and operational burdens, stimulating private investment.

3.3.3 Strategic fibre deployments and decommissioning legacy (copper)

The strategic deployment of fibre and switching of copper have emerged as primary focal points for many global incumbents, particularly through Europe. A parallel trend is beginning to emerge across the GCC, notably in countries like Bahrain where the telecommunications industry is being shaped by these advancements. In Bahrain, 68% of households have active fibre connections and 100% accessibility to ultra-fast broadband services[33] where most of the population is concentrated around its capital Manama. Understanding the rationale behind this global emerging trend is important for Iraq to plan its decommissioning of legacy technologies and accelerate its digitalisation journey.

The transition from copper cables to fibre optic and fixed wireless access is a commonly observed trend driven not only by fibre and FWA's role in offering higher speeds and bandwidth, but also by the substantial operational and maintenance costs associated with legacy copper networks. This introduces an opportunity for operators to reallocate capital and resources towards the delivery of next-generation technologies that are designed to be future-proof, more economically viable, and energy efficient (and thus less detrimental to the environment). Critically, while phasing out legacy connectivity, deploying fibre infrastructure and advanced wireless connectivity such as 4G, 5G and FWA are next-generation solutions that will be instrumental in extending high-speed internet access.

A significant aspect of strategically deploying fibre and FWA services involves proactively supporting customer migration away from legacy services. In Bahrain, the Telecommunications Regulations Authority played a pivotal role in advancing the fibre agenda and supporting the transition to fibre with new routers and speed upgrades via targeted migration programmes[34]. Although these initiatives are distinctively smaller in scale, extending such equipment will ensure that households and businesses are equipped with the necessary tools to harness the benefits of high-speed infrastructure deployment and minimise the churn rate.

Fibre deployments should also be focused on supporting mobile networks to meet the rapidly growing bandwidth demands. This includes fibre to the mast, towers and other cell sites to ensure that mobile networks have a robust means of meeting these growing needs.

3.3.4 Transitioning to more effective backhaul solutions

Globally, microwave is the mainstream in wireless backhaul. Despite fibre being the first choice for MNOs for 4G and 5G backhaul, operators rely heavily on microwave backhaul solutions. This is especially the case for the Iraqi MNOs, for the following reasons:

1. Logistical difficulties in deploying optical fibre
2. High CAPEX investment required

[33] Bahrain tops GCC countries with most affordable fibre broadband
[34] Qatar and UAE are global leaders in fibre deployment

3. High rate of fibre breakage
4. High requirements on network construction speed

Currently, more than 90% of base stations in Iraq use microwave for backhaul. However, operators should consider different forms of backhaul solutions that suit various current and future requirements.

The table below assesses the advantages and disadvantages of different backhaul solutions for 4G and 5G:

Figure 40: Comparison of trade-offs for 4G and 5G mobile backhaul, wireless vs. fibre

Characteristics	K-Band (7 - 40GHz)	V-Band (60GHz)	E-Band (70/80GHz)	Fibre-optic
Future-Proof Available Bandwidth	Medium	High	High	High
Deployment Cost	Low	Low	Low	Medium
Suitability for Heterogeneous Networks	Outdoor Cell Site/Access Network	Outdoor Cell Site/Access Network	Outdoor Cell Site/Access Network	Outdoor Cell Site/Access Network
Support for Mesh/ Ring Topology	Yes	Yes	Yes	Yes, where available
Interference Immunity	Medium	High	High	Very High
Range (Km)	5~30, ++	~1	~3	<80

Note: Shading in blue indicates key advantages

Source: ABI Research

In the era of 5G, the requirements for wireless backhaul capacity are increasing sharply, from 100M/1G in the 4G era to 1G/10G in the 5G era. The use of microwave spectrum has also shifted from traditional frequency bands to E-band.

Figure 41: Microwave spectrum requirement along with wireless development

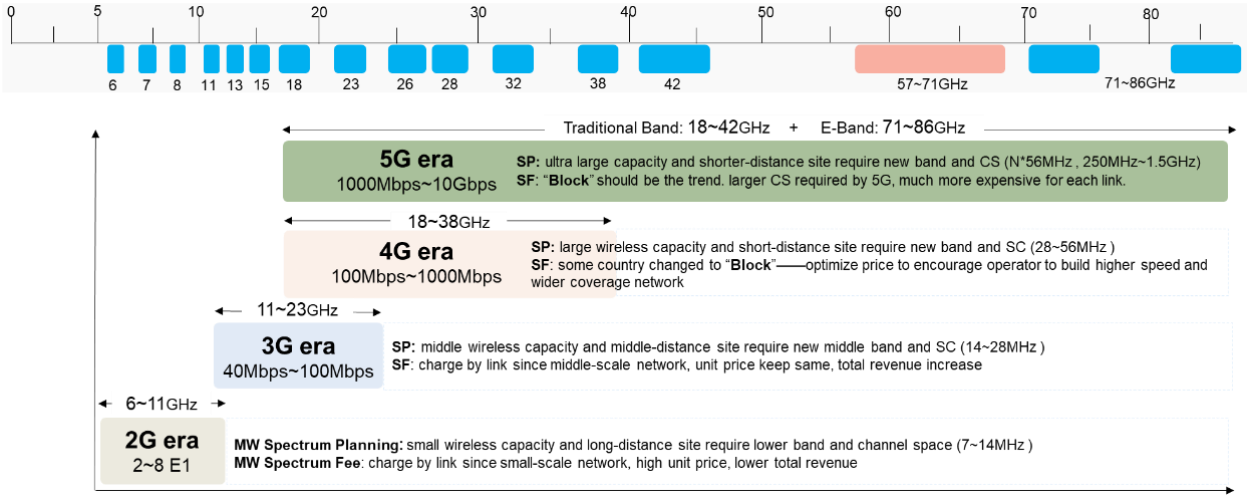
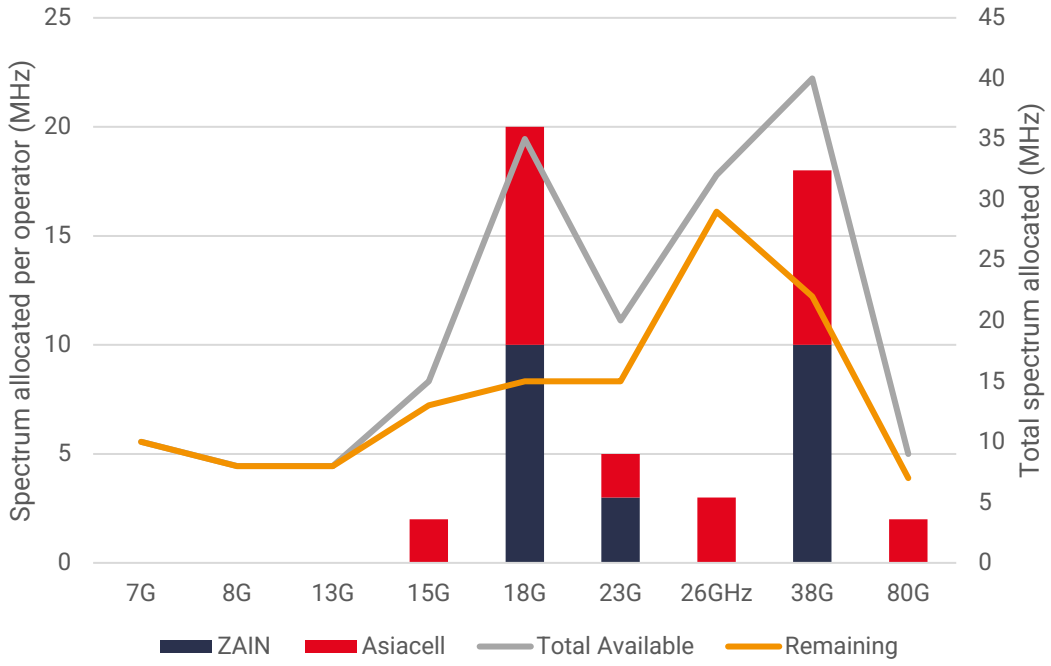


Figure 42: Current microwave spectrum allocation in Iraq



With the rapid development of 4G networks and future evolution requirements, the microwave spectrum allocation in Iraq is facing challenges with the need for microwave spectrum charging mode to be introduced. Currently, the OPEX of microwave spectrum accounts for a high proportion. For 7~13G and 80G scenarios, carriers charge by hop and acquire block more spectrum. Especially, E-band is the key for MNOs to meet 5G backhaul requirements. Operators will have a strong demand for network construction in the future. Each operator should block frequencies above 2G bandwidth.

3.4 Expanding coverage and quality for universal access

Several countries have achieved near-one hundred percent broadband coverage, including Oman and Jordan[35]. Both these countries serve as great case studies, showcasing parallels with Iraq in their primary utilisation of 3G and 4G technologies. They are also making notable progress in accelerating broader internet access and coverage through a combination of FWA and fibre roll out. Many other countries, often frontier markets that are constrained by geographical factors like being landlocked or a small-island country, face challenges in achieving widespread broadband access. These countries at large strive to extend universal broadband access as a means of bridging the digital divide through policy reforms and interventions. Some examples of these strategic efforts include:

- **Government subsidy** such as Universal Service Funds can help connect areas that that are more expensive serve.
- **Government financial support or grants** for infrastructure development to bring broadband coverage with predefined speed targets for urban and rural regions.
- **Public-private partnerships** that involve outsourcing network deployment to private organisations, with incentives for further investment to expedite broadband access.
- **Pricing controls** to regulate pricing in a way that it does not adversely affect or discourage investment from operators in these regions.

It is imperative policy makers and state authorities recognise the economic benefits that stem from broadband deployment. These methods will pave the way for extending coverage and granting rural communities with access to broadband. A combination of policies will be critical in effectively overcoming the geographical disparities in high-speed internet access.

3.4.1 Examining the key considerations in providing rural access

Reaching rural areas and providing access to quality broadband services has been a challenge in many markets, and Iraq is no exception. They are typically more expensive to serve given the need to build out the associated infrastructure with fewer returns given the number of users, and therefore, telecoms operators find little incentive to invest in these markets. To address this, state funding becomes a crucial intervention, motivating operators to develop these markets by facilitating the construction of high-capacity communication networks for broader coverage and build infrastructure in a more efficient and cost-effective way. This is a necessary step in maximising the economic and social benefits of digital connectivity (i.e. reduce the inequality gap by driving digital and social inclusivity across all stretches of society and ensure marginalised communities can partake in the digital economy). However, before taking measures to extend government support for rural access, regional operators and policy makers must take into account some key considerations on the demand and supply side.

[35] ITU: DataHub, World Population Coverage, by mobile network technology

On the **demand side**, operators should assess the current and future needs for higher-speed internet and specific bandwidth requirements. Analysing this in conjunction with their per capita income in these localities provides insight into their limited purchasing power. This is critical factor at play as the market size is substantially reduced, rendering any business case challenging to justify. Consequently, it is imperative that public and private organisations identify optimal strategies for fostering growth in rural broadband and mitigate tendencies to isolate these communities - be it through individual initiatives, collaborative partnerships, or with the aid of subsidies.

It is also important to identify key industry hotspots. Iraq is rich in natural resources with oil and gas serving as the largest source of income. The oil fields of Iraq are situated in the sparse localities, including across Kirkuk, Irbil and Basrah[36]. Providing B2B communication services to these rural areas can facilitate operational processes. Increased availability of high speed connectivity solutions can equip the oil and gas sector with better connected digital infrastructure and tools, which critically optimises costs when used for routine management and monitoring of oil rigs. This can consequently accelerate the advancement of exploration phases to large-scale operations in the oil industry, leading to economic growth and development.

On the **supply side**, key stakeholders must examine the feasibility of establishing presence in rural communities. This involves evaluate more economically feasible broadband technology solutions and spectrum options that are best suited for providing rural coverage. Such considerations allow operators and policymakers to build a viable business case, determining whether the expected revenue (both social and monetary returns on investment) outweigh the cost associated with investment, operations, and maintenance. As mentioned, certain broadband technologies such as mobile and FWA can be more economically viable than fibre rollout in rural areas. Coupled with low- and mid-band spectrum availability, this can significantly improve the business case and investment needed for rural coverage.

Furthermore, the provision of connectivity must align with regulatory standards. For example, operators should ensure the availability of a target minimum megabit internet speed for downloading and uploading data. Policy initiatives including South Africa Connect set out national target of 90% penetration at 5 Mbps and 50% at 100 Mbps by 2020 and 100% penetration at 10 Mbps and 80% at 100 Mbps by 2030[37]. Similarly, India has set targets of universal broadband provision of 50 Mbps by 2022[38].

[36] Iraq oil reserves map
[37] South Africa Connect: Creating opportunities, ensuring inclusion, South Africa's Broadband Policy
[38] South Africa Fixed Broadband speeds up as fibre takes off

3.4.2 Addressing the need for reliable mobile network coverage indoors

Statistics show that approximately 80% of services on mobile networks occur indoors[39]. Therefore, users today expect more and more quality indoor coverage. Whether in transport, shopping centres or other areas, they can no longer tolerate the lack of regular and seamless 4G coverage, including in large cities such as Baghdad. The need for better indoor coverage is not only due to the increasing number of consumer devices (e.g. smart phones) but also the increased mobility of devices and volume of IoT sensors (e.g. smart metering in utilities). As a result, digitalisation and adoption of digital services needs to be underpinned by the implementation and availability of reliable, seamless network coverage.

As 5G penetrates into all walks of life, services such as augmented reality (AR), virtual reality (VR), smart home, wireless healthcare, remote education, new social networks, personal AI assistance, industrial manufacturing, and IoT will mean that the need for indoor coverage will only become increasingly acute.

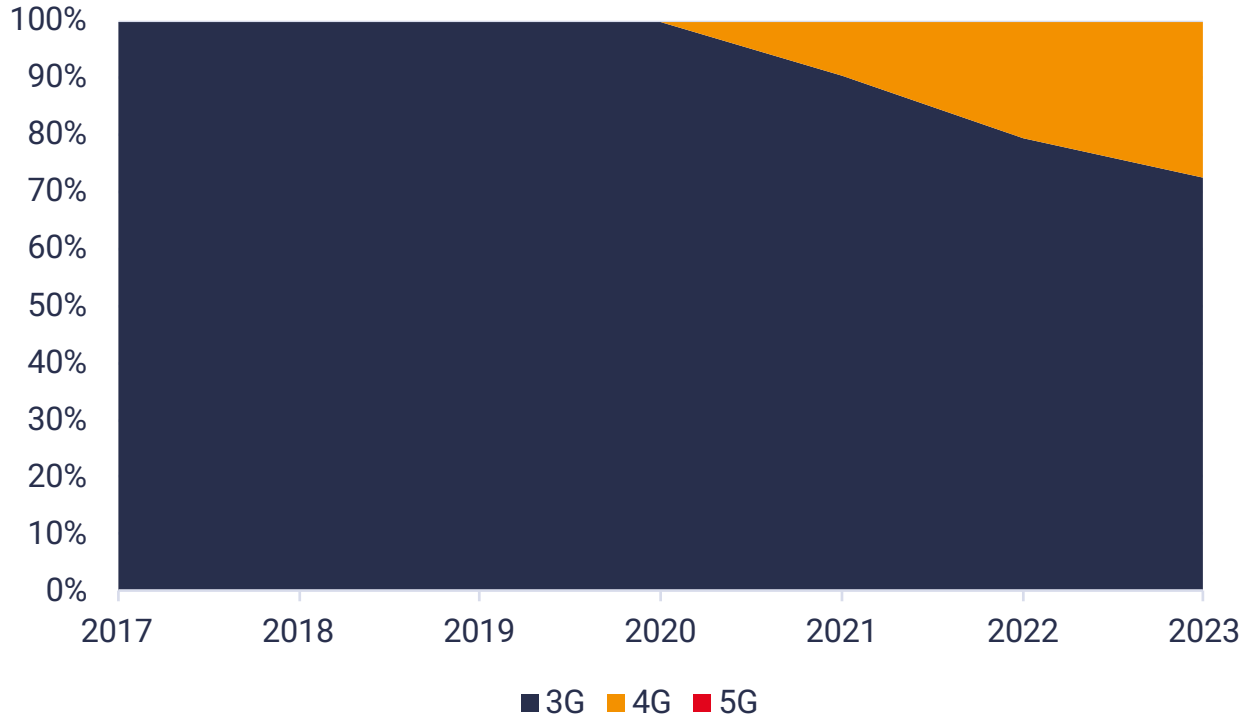
To address this, some governments have issued policies and white papers to standardize indoor QoS and promote indoor network construction. For example, Qatar CRA released the mobile site sharing policy to support indoor network deployment. In addition, many governments have called for better ease of opening indoor property rights in public areas to mobile network operators, creating conditions for operators to build indoor networks.

3.4.3 Role of mobile broadband

Iraq's mobile technology landscape has evolved through recent years. As reflected in Figure 43, the share of 3G mobile subscriptions has seen a gradual decline, while the share of 4G mobile subscriptions shows consistent annual growth.

[39] Analysys Mason: Rethink the approach to 5G indoor coverage

Figure 43: Share of annual subscriptions by mobile technology in Iraq, 2017 - 2023



Source: Telegeography

Mobile broadband critically eliminates the dependency on conventional wired infrastructure and physical cables. It is therefore regarded as a quicker and more cost-effective method of deploying connectivity compared to fixed-line networks, particularly across more remote regions where the installation of cables proves less economically viable. The reduced infrastructure deployment and installation costs can be passed onto end-users, ensuring internet access becomes a more accessible and affordable service. Combined with advances in mobile technology, such as the evolution of 4G and 5G networks, the synergy significantly improves MBB speeds and network capacity, enhancing user experience. This enables a large number of use cases that demands greater bandwidth and reduced latency, such as streaming, video conferencing, and online gaming.

Mobile technology and broadband also plays a crucial role in poverty reduction. The extension of broadband coverage can critically address the usage gap (and the inequality gap that follows) observed across various socioeconomic groups. It ensures the benefits of digital technologies reach all communities and can support the participation of these groups in the wider economy (e.g. through engagement in more skilled labour force, improved productivity and remote learning). Hence, the strategic integration of MBB technologies in complementarity with wired broadband solutions holds the potential to optimise coverage and propel Iraq towards comprehensive connectivity.

3.4.4 Role of fixed wireless access

Fixed wireless access (FWA) is a competitive solution for stationary internet connections in localised areas with limited access to fibre or cable, hence proving to be a great tool for connecting Iraq's rural areas with low population density. However, the limited availability of 4G and 5G infrastructure across Iraq reduces the viability of FWA as a broadband solution as the nation necessitates a greater level of upfront investment in advanced mobile infrastructure. Granted operators have access to and are able to leverage existing base stations, towers, and other critical network infrastructure, FWA is easily deployable. The reduced need for installation of aerial, underground cabling or ducting as well as the acquisition of RoW permissions positions FWA as a more cost-effective solution for addressing markets that are deemed economically unviable.

Adding to the cost-savings, FWA's capabilities in delivering a fibre-like connection has been a primary driver for the widespread adoption of 4G FWA, and, notably, the growing prominence of 5G FWA globally, as shown in Figure 44. As successive generations of technology enhances network performance, FWA develops an increasingly versatile role across various use cases. The growing potential for FWA has prompted local governments and regulatory bodies to taking the steps to include FWA in their national broadband plans. FWA adoption has increased from 100 to 224 out of the 311 CSPs across more than 100 countries, indicative of its growing presence in providing communication solutions[40].

[40] The state of broadband: People-centred approaches for universal broadband

Figure 44: Live and planned 5G FWA deployments, as of Q3 2021

Source: GSMA

3.4.5 Decommissioning legacy networks (2G, 3G)

Mobile operators have prioritised the expansion of their 4G and 5G footprints to facilitate the provision of high-speed mobile broadband services. This undertaking necessitates the need for timely and affordable access to spectrum, a finite and scarce resource. To address this, decommissioning legacy mobile networks (2G and 3G) to free up and refarm spectrum has become a viable and pragmatic solution for Iraqi mobile operators.

The impetus behind this stems from a confluence of factors, including the obsolescence of legacy technologies and increasing operational and maintenance costs. The shift in this paradigm necessitates a reallocation of spectrum resource to more efficient wireless connectivity solutions, hence the need for decommissioning of legacy networks. This has become a noticeable global trend as a means to free up valuable spectrum resources and refarming for 4G and 5G deployments.

Decommissioning legacy mobile networks (2G, 3G) is highly encouraged for several key reasons, outlined below:

- **Technological obsolescence:** 2G and 3G technologies are becoming outdated, offering lower data speeds and limited capabilities compared to more advanced technologies like 4G LTE and 5G. Decommissioning older networks allows for the deployment of technologies that provide higher data rates, lower latency, and better support for emerging applications and services.
- **Spectrum refarming:** Advanced technologies utilise spectrum more efficiently than 2G and 3G networks. Decommissioning older networks frees up valuable radio

frequency spectrum that can be reallocated for more efficient and advanced technologies, enhancing overall network capacity and performance.

- **Cost optimisation:** Maintaining and operating multiple generations of networks, each with its own infrastructure and maintenance requirements, can be financially burdensome. Decommissioning 2G and 3G networks allows operators to optimise resources, reduce operational costs, and redirect investments towards more advanced technologies.
- **Opportunity for innovation and enabling of new use cases:** 4G LTE and 5G networks support a wide range of advanced services, including high-definition video streaming, augmented reality, and Internet of Things (IoT) applications. Decommissioning older networks enables the delivery of these services, which may not be efficiently supported by 2G and 3G technologies.

Between 2015 and mid-2023, the GSMA reports that a total of 91 mobile networks had been shut down. This comprised of 43 2G network shutdowns and 48 3G network shutdowns. This trend is expected to continue with further planned shutdowns disclosed by operators with almost 150 network sunsets planned between Q4 2023 and 2030[41]. The decommissioning of 2G lags behind that of 3G because of its fundamental role in supporting voice messages and the functionalities of IoT and machine-to-machine (M2M) technologies.

The shutting down of legacy networks not only facilitates the adoption of more advanced technologies among end-users, but also carries ancillary benefits. Mobile operators are cognisant of the need for enhancing efficiency and fiscal prudence within the broader context of environmental, social and governance strategies. The phase-out of legacy networks has been a key enabler to reducing operators' energy consumption.

3.5 Bridging the digital divide and enabling new digital use cases

The expansion and effectiveness of broadband network and services are largely driven by supply and demand forces. However, ensuring the optimal realisation of broadband's potential in Iraq involves more than just these factors. Broadband customers (i.e. government, consumers, and enterprises) should also have the capacity to comprehend and apply the lessons learned about broadband's benefits and capabilities to broader society. Absorptive capacity, in this context, denotes an organisation's capacity to recognise the value of new, external information, to assimilate it and then apply it to its advantage. Therefore, Iraq's ability to absorb broadband depends on three key aspects:

1. Government and public institutions' capability to introduce and integrate broadband-enabled services, thereby enhancing the efficiency and transparency of public service delivery to the citizens

[41] GSMA Technology Neutrality and Legacy Network Sunsets

2. Consumers' capacity to create and utilise broadband-enabled services and applications for the betterment of their well-being
3. Enterprises' capacity to generate broadband-enabled services and applications, utilising them to enhance their business processes' productivity and efficiency

Figure 45: Services and applications by network speed[42]

Services enabled by capacity today	Use cases and applications unlocked
500 kbit/s to 10Mbit/s	**10Mbit/s and above**
Web browsing (basic and complex sites)	Telemedicine
Email services (basic and large attachments)	Educational services
SMS	Broadcast video, HD
Streaming music	Full IPTV channel support
VoIP	Telecommuting (high-quality video)
File sharing (small, medium)	High-quality telepresence
Video streaming (2-3 channels)	Surveillance, HD
Video downloading, HD	Smart, intelligent building control
Telecommuting	Video on demand, HD
Digital broadcast video	Remote supercomputing
IPTV, SD (multiple channels)	Live event digital cinema streaming
Remote diagnosis	Interactive remote visualisation and virtual reality
Video on demand, SD	Movement of terabyte data sets
Switched digital video	Research applications
Remote surveillance	Remote server services for telecommuting
Low -definition telepresence	Multiple educational services
Remote education	Remote control of equipment and cranes
Building control and management	
Gaming	

In today's dynamic society, broadband plays a catalyst role, not only as a means of connectivity, but also as a bedrock for digital transformation, fostering government and corporate innovation and bolstering national economic growth and development. Availability of high upstream and downstream speeds unlocks a variety of services and applications, enabling innovation in digital government, digital enterprise and society, and digital consumer and smart home use cases.

3.5.1 Digital government

Digital government comprises a variety of applications and services that can revolutionise government procedures and interactions with corporates and citizens. This digital shift nurtures citizen involvement in the community and improves the overall effectiveness of government initiatives and operations. The role of broadband in digital government is seen

[42] World Bank Broadband strategies handbook

as critical, serving as the necessary infrastructure for public networks and therefore ensuring smooth and streamlined processes for enterprises and citizens. This is particularly relevant for Iraq as it lays the foundation for advancing government services, fostering citizen engagement, and enhancing overall administrative efficiency in the country.

Globally, governments are broadening their availability of online services, including essential services provision, employing multimedia technology for interactive communication, and utilising technology to engage citizens in public policy consultations. Mobile phones usage for e-government-related services, such as alert messages, fee payments, or applications, is also becoming more and more prevalent both in developed and in developing countries.

Broadband availability can contribute to digital government success through a number of outcomes as outlined in Figure 46.

Figure 46: Digital government success outcomes

Outcomes	Rationale
Accessibility and inclusivity	Ensures that citizens, regardless of their location, can access government services online, promoting inclusion and access to the broader population
Efficient service delivery	Enables data transfer, allowing government agencies to deliver data-heavy services, such as permits, licenses, and other official documents more efficiently
Real-time interactions	Enables real-time interactions between citizens and government agencies to facilitate services, such as online consultations, virtual meetings, and customer support
Data sharing and collaboration	Facilitates seamless communication and data sharing between different government departments and levels of government, promoting a more integrated and efficient public administration

Broadband expansion also unlocks various digital government applications and use cases:

Figure 47: Digital government use cases and applications unlocked by broadband

Selected use cases & applications	Rationale
E-government applications	Supports the functionality of various e-government applications, including online forms, data submission, and document uploads
Video conferencing & telecommuting	Supports the use of video conferencing tools, enabling government employees to work remotely and participate in virtual meetings
Smart government infrastructure	Enables the development and operation of smart city initiatives and other advanced government infrastructure, typically involving the use of IoT devices, sensors, and real-time data analytics, all of which depend on robust broadband connectivity
Public safety and emergency services	Supports the implementation of emergency response and public safety services that may require real-time communication, data sharing, and coordination between multiple agencies
Education and training	Enhances the quality of online educational resources and training programs, enabling citizens to access educational content, participate in online courses, and advance their skills toolkit

Figure 48 outlines the types of digital government use cases unlocked at different speeds:

Figure 48: Services and use cases unlocked by broadband speed

Services enabled by capacity today	Use cases and applications unlocked
500 kbit/s to 10Mbit/s	**10Mbit/s and above**
Access information online	Telecommuting (high-quality video)
Email communication	Digital transformation projects
Telecommuting (basic tasks)	Online education and training (advanced multimedia)
Online submission form	Telemedicine
Basic online transactions	Virtual meetings
Interactive consultations and surveys	Smart city infrastructure
E-government applications	High definition video conferencing
Government online portal	Emergency communication services
Government training programs	Smart city sensor data collection
Online education and training (text-based)	Remote health consultation
Emergency services communication (basic)	Government cloud services
	National cybersecurity infrastructure
	Smart city infrastructure management
**E-government applications: E.g. tax filing systems, permit applications* ***Government training programmes: E.g. multimedia content and/or interactive features)*	

3.5.2 Digital business and society

The evolution of digital enterprises and society is largely driven by:

- **Connectivity and communication:** enables seamless communication within digital enterprises so that teams can collaborate in real-time, share large files, and use advanced communication tools. Individuals within a society can easily connect with others, fostering communication, collaboration, and social interaction
- **Business operations:** facilitates data transfers, cloud-based applications, and online services access, empowering productivity and competitiveness. All rely heavily on broadband connectivity to streamline their operations and reach a wider audience
- **E-commerce and online services:** supports online services, and ensures a smooth user experience for customers. Access to digital services, and the ability to engage with various online platforms contribute to customers' daily life convenience
- **Innovation and technology adoption:** accelerates innovation by supporting the adoption of emerging technologies such as artificial intelligence, IoT, and big data
- **Supporting skills development**: supports online training, webinars, and remote learning programs for employees, promoting continuous skill development
- **Improving workforce flexibility**: allows employees to work remotely from different locations, contributing to a more flexible and distributed workforce, reducing commuting time, and potentially improving work-life balance

Broadly speaking, different broadband speeds enable different types of horizontal use cases:

Figure 49: Services and use cases unlocked by broadband speed

Services enabled by capacity today	Use cases and applications unlocked
500 kbit/s to 10Mbit/s	**10Mbit/s and above**
Email communication and simple online tasks	High-quality video conferencing
Remote work (low bandwidth tasks)	Cloud-based applications
E-commerce transactions	IoT data collections
Basic communication	Advanced AI and Big Data analytics
	High-performance computing

Besides the aforementioned horizontal use cases, advanced networks can also unlock value-adding vertical use cases that can drive digital transformation across key industries and fundamentally transform the way that companies within these industries operate.

The table below explores how broadband expansion and digital transformation can benefit and unlock efficiency for the oil and gas and agricultural industry verticals:

Figure 50: Benefits captured in the oil and gas and agriculture industries

Oil and gas	Agriculture
Remote monitoring and control – allows for real-time monitoring of equipment and facilities in remote locations **Data analytics and predictive maintenance –** facilitates the collection and transmission of vast amounts of data **Automation and robotics –** enables the deployment of automation and robotics in operational activities (i.e. automated drilling systems, robotics inspection) **Enhanced safety and security –** supports the implementation of advanced safety and security measures **Efficient resource management –** allows for management of resources, such as energy, water and other materials	**Precision agriculture** – enables the use of advanced tech, such as sensors and drones for real-time data on soil conditions, weather patterns, or crop health **Remote monitoring of assets** – allows farmers to remotely monitor various assets, such as machinery and storage facilities **Market access and e-commerce** – facilitates access to online markets and e-commerce platforms so that farmers can sell directly to consumers or businesses, reducing reliance on traditional distribution channels **Farm management** - enables the use of farm management software that helps in planning, monitoring, and analysing agricultural activities

3.5.3 Smart consumer and home

Smart home technologies have become increasingly prevalent through the world, driven partly due to evolving consumer behaviour and dynamics. Broadband availability can unlock a variety of use cases for consumers:

- **Customer support and communication** facilitates real-time communication with customer support through chat, video calls, and other interactive channels
- **Video streaming and content delivery** allows for high-definition video streaming without buffering, ensuring a superior entertainment experience for digital customers using platforms like Netflix, Hulu, or YouTube
- **Smart home automation** supports the communication of various connected smart devices within a home, including smart thermostats, lights, and security cameras
- **Gaming and virtual reality** enhances gaming experiences on smart devices and gaming consoles within the home
- **Smart speakers and voice assistants** enables fast and accurate responses from voice-activated smart assistants
- **Remote access and monitoring** allows users to remotely manage and control various aspects of their smart home systems, such as adjusting thermostats, checking security cameras, and controlling smart locks

- **Security and surveillance systems** enables high-quality video streaming and real-time monitoring of security cameras.

The table below outlines how different broadband speeds are tied to specific use cases:

Figure 51: Services and use cases unlocked by broadband speeds

Services enabled by capacity today	Use cases and applications unlocked
500 kbit/s to 10Mbit/s	**10Mbit/s and above**
Basic communication	High-quality video conferencing
Email communication and simple online tasks	Cloud-based applications
Remote work (low bandwidth tasks)	Gaming (console and smart devices)
E-commerce transactions	Voice assistant interactions
	Smart home security
	Smart TV streaming
	Smart appliance connectivity
	VR experience
	Voice assistant interaction
	Remote home management

3.6 Ensuring security and assurance for critical infrastructure

The rollout of advanced broadband technology in Iraq, and its increasingly critical role in society and the economy, poses new security challenges for the country. As the cyber security environment today constantly evolves, it is essential to address any relevant security concerns. This section identifies four key aspects below related to network security and explores potential strategies to address these challenges:

- Improving network assurance capabilities
- Enhancing and ensuring network and data security
- Strengthening critical infrastructure resilience and protection
- Improving the overall cybersecurity management mechanism

Ensuring security and assurance for critical infrastructure in Iraq is critical for several reasons. Firstly, the telecoms sector processes huge volumes of data and supports mission critical use cases such as communications for emergency services. Cyberattacks targeting the critical infrastructure will cause disruptions to the public, such as the compromising of personal data privacy, network instability and outages, and financial losses. Clear requirements would help enhance data security and facilitate regulatory compliance.

3.6.1 Improving network assurance capabilities

In the digital era, enhancing data security and network assurance is crucial to providing reliable connectivity, ensuring quality customer experience and building public trust over the networks they use. As networks become increasingly complex and dynamic in nature, Iraqi telecoms operators need to adapt to stay efficient in managing complex infrastructures and ensuring overall network quality and reliability. Operators' ability to deliver cutting-edge services also becomes increasingly important. Network assurance is therefore a linchpin for sustaining operational efficiency and customer satisfaction for operators across Iraq.

To guarantee the end-to-end network experience in the 5G and AI era, it is important to realise the deployment of high-quality campus networks with Wi-Fi 7, 400GE bearer networks with IPv6 Enhanced, hyper-converged 400GE data centre networks, building an intelligent network infrastructure that connects the physical and digital spaces as expected to be ready by 2030.

Network assurance (including of infrastructure) involves the following activities:

- Deployment of IPv6 and IPv6 enhanced technologies deployment such as SRv6, network slicing and network digital map, together with hyper-converged 400GE bearer networks
- Adoption of high-quality Wi-Fi, particularly the latest standards such as Wi-Fi 7, for public key areas and enterprises
- Increase the adoption of FTTS (Fiber-to-the-site) to improve the speed and quality of 5G networks
- Enhancement of data centre networks. The server network scale increases from 100,000 nodes to millions of nodes. The maximum interface rate of data centre switches is upgraded to 400GE, reducing the latency from microseconds to nanoseconds
- Network discovery to have a dynamic and comprehensive view of network assets
- Identification of network faults, including root-cause analysis, impact assessment and associated triaging and prioritising of issues
- Timely notification of customers precisely what and where the problem is occurring
- Automated or autonomous resolution of faults

Telecoms operators need to ensure that their assurance capabilities are able to keep up with the speed of change. Telecoms operators need to ensure that their assurance capabilities are able to keep up with the speed of change. The table below summarises the key technical features of the network infrastructure to assure the end-to-end experience.

Application Scenario	Key features
WAN network	**Ultra-high bandwidth:** The MAN aggregation and backbone network's transmission speed is upgraded from 100GE to 400GE
	High utilisation of resources**:** The network resource utilisation rate increases from 40% to 60%
	Efficient cloud migration: Multiple hops to the cloud to one hop to multiple clouds based on SRv6
	Ultimate experience: Tenant-level network slices are upgraded up to 100K-level
DCN	**Ultra-high bandwidth:** The maximum interface rate of data centre switches is upgraded from 100 GE to 400GE
	High throughput: The network throughput needs to be increased to be able to serve 95% of the centre compute power available
Campus network	**Large bandwidth:** Wi-Fi 7 and other technologies are supported, having a maximum rate of 23 Gbit/s or higher
	Ultimate experience: Differentiated granted SLA
Intelligent O&M	**Upgradable Autonomous Network level:** Upgrade from L3 (conditionally autonomous) to L4 (highly autonomous) networks and later to L4.5 to achieve almost fully autonomous

Automation, analytics, artificial intelligence and machine learning (AI/ML) is also critical in the assurance of networks for the following reasons:

- Automation for example plays a role in streamlining routine tasks, reducing human error and increasing the speed at which the operator can respond to network issues.
- Analytics can help operators better monitor network performance, identify patterns, and predict potential issues before they escalate. This proactive approach allows operators to optimise resource allocation, improve network capacity planning, and enhance the overall performance of their networks.
- AI technologies, including machine learning and predictive analytics, contribute significantly to network assurance. Machine learning algorithms can analyse historical data to identify anomalies and predict potential network failures. AI-powered systems can dynamically adapt to changing network conditions, optimise performance, and even predict and prevent service disruptions.

These capabilities combined empower telecoms operators to move from reactive to proactive network management, improving overall service reliability and quality to ultimately deliver better experience for customers. The TM Forum Autonomous Networks[43;44] maturity

[43] TM Forum Autonomous networks: exploring the evolution from level 0 to level 5
[44] TM Forum Autonomous Networks Project (ANP)

model is a useful widely-adopted industry framework to utilise, which supports the move to self-configuring, self-healing, self-optimising and self-evolving telecoms network infrastructure to ensure operators are able to offer the best possible user experience efficiently. As such, the aim should be to achieve Levels 4 (highly autonomous) and higher in the network and to eventually target L4.5 (almost fully autonomous). This involves the move to highly intelligent network orchestration and management systems, which are critical to effectively operate highly dynamic networks (and services) that customers will demand.

3.6.2 Managing and ensuring data and network security

In terms of data security, the government plays a key role in building a consistent security framework to set standards that promote overall privacy in Iraq. To protect sensitive information and ensure data security, the Iraqi government needs to implement strong security measures and regular risk assessments.

In 2020, the ITU released its 5th edition of Global Cybersecurity index (GSI)[45]. The GSI is a reference index that ranks countries base on their cybersecurity commitment at a global level. Five pillars were defined to assess the status of cybersecurity developments: legal measures, technical measures, organisational measures, capacity development and cooperation. Each country evaluated is then given a score and ranked based on their relative performance. Out of the 184 countries surveyed, Iraq ranked 129th globally with an overall score of 20.71. Iraq also ranked the 17th among the 22 Arab State countries.

Figure 52: Global Cybersecurity Index: Arab States region

Country Name	Overall Score	Global Rank	Regional Rank
Saudi Arabia	99.54	2	1
United Arab Emirates	98.06	5	2
Oman	96.04	21	3
Egypt	95.48	23	4
Qatar	94.5	27	5
Tunisia	86.23	45	6
Morocco	82.41	50	7
Bahrain	77.86	60	8
Kuwait	75.05	65	9
Jordan	70.96	71	10
Sudan	35.03	102	11
Algeria	33.95	104	12
Lebanon**	30.44	109	13
Libya	28.78	113	14
State of Palestine	25.18	122	15
Syria Arab Republic**	22.14	126	16
Iraq**	20.71	129	17
Mauritania	18.94	133	18
Somalia	17.25	137	19
Comoros**	3.72	175	20
Djibouti	1.73	179	21
Yemen*	0	182	22

* No data collected
** no response to the questionnaire/data collected by GCI Team

Source: ITU Global Cybersecurity Index

[45] ITU: Global Cybersecurity Index

The Iraqi Cybersecurity Strategy (ICS) was published in 2017 by the National Security Advisor office to address deficiencies in Iraq's cyber policy. The ICS outlined a roadmap to build robust cyber infrastructure and identified the structural weakness in Iraq's cyber domain. Despite being the first of its kind, the ICS lacked a concrete analysis on the proposed objectives and was criticised for its theoretical nature[46]. As a result, the ICS was ineffectively implemented. In 2020, the Iraqi government initiated a new strategy, incorporating the implementation of new laws and the establishment of a dedicated cybersecurity agency[47].

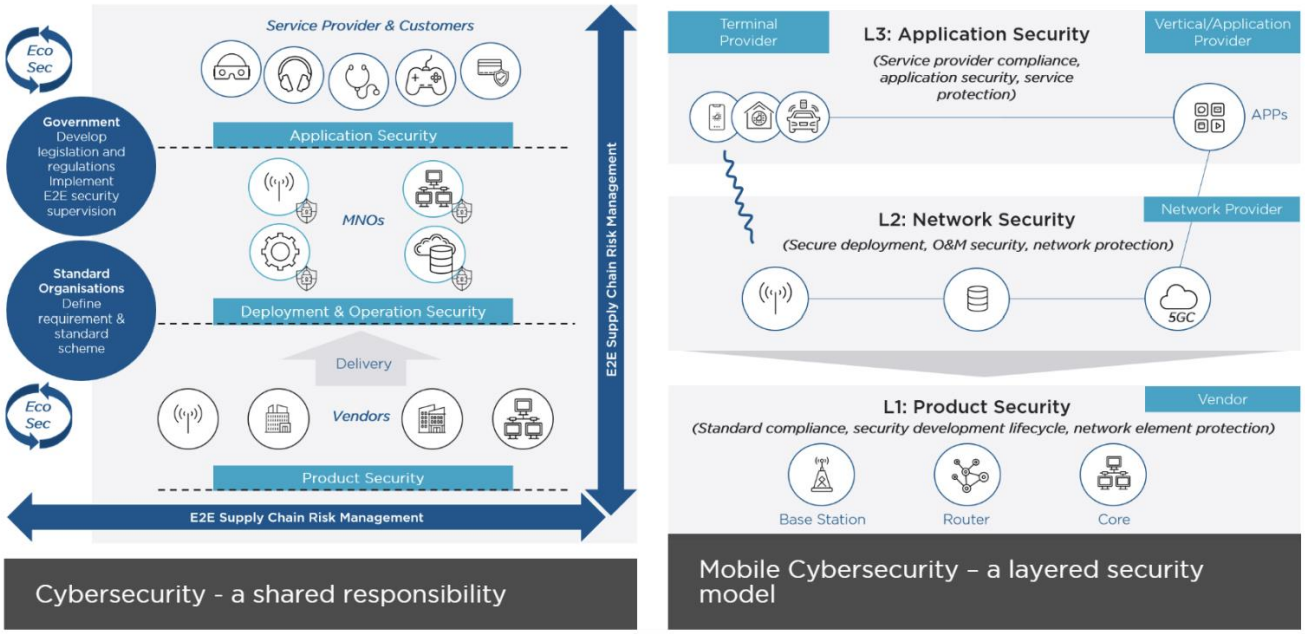
As the ICT sector in Iraq develops, the critical infrastructure could become a top target of cyberattacks. Ensuring public trust in the security of the network is critical as the public's trust, cooperation and associated demand is crucial to broader successful digital transformation. Effective cybersecurity management mechanisms need to be established to protect the network from external threats.

The global mobile standards body (3GPP) addresses these concerns by improving security protocols and standards within its specifications on a regular basis. The organisation's emphasis on developing reliable and secure communication networks ensures data integrity, confidentiality, availability, and overall resilience of mobile ecosystems. Amid a changing network security landscape brought on by technology evolution, the industry calls for trust built on global security assurance standards to provide all stakeholders a greater level of confidence. The GSMA and 3GPP have collectively defined the Network Equipment Security Assurance Scheme (NESAS) and Security Assurance Specifications (SCAS) [48] as global frameworks to ensure the products offered by network equipment vendors are up to the security standards.

The GSMA also conducts comprehensive threat analyses with inputs across the ecosystem and public sources such as the 3GPP, European Union Agency for Cybersecurity (ENISA) and National Institute of Standards and Technology (NIST). It maps potential threats to appropriate and effective security controls and collates this analysis into the Mobile Cybersecurity Knowledge Base (CKB). The Mobile CKB is designed to help key stakeholders understand security threats that mobile networks face in a systematic and objective fashion with guidance and best practice on risk management strategy and risk mitigation measures.

[46] Constructing an Interinstitutional and interministerial effort on Cyber Security in Iraq
[47] The Challenges of Combating Cybercrime in Iraq
[48] GSMA Network Equipment Security Assurance Scheme (NESAS)

Figure 53: Different elements of cybersecurity to consider in mobile networks



Source: GSMA Mobile Cybersecurity Knowledge Base

Besides global initiatives, two types of national data privacy initiatives are being widely adopted[49] across the globe and could be a reference point for Iraq's data privacy measures. The first type is informed consent where individuals sign an agreement on their consent to share personal information with a third party. For example, when opening a website, users are asked to set their cookies preferences which define the level of personal information they are willing to share with the website owners. This kind of informed consent mechanism allows Internet users to make informed decisions on sharing their personal data. The second widely-adopted initiative is enhancing network and data security is through mandating privacy protection measures into company practices.

In summary, adapting to technological advancements requires a collaborative approach involving international standards (e.g. 3GPP), global frameworks, and national initiatives. This collective effort is crucial to strengthen data security, improve network assurance, and maintain public trust in the digital economy and services provided.

3.6.3 Strengthening critical infrastructure resilience and protection

As digital technologies advance, the interconnectivity of sites and facilities hosting critical infrastructure is on the rise. Industries like telecommunications, energy, and healthcare rely heavily on information technology (IT) and operational technology (OT) systems. Although this trend improves the monitoring and management of critical infrastructure, also increases the possibility of cyberattacks these connections. Implementing security measures to

[49] The World Bank Broadband Strategies Handbook

safeguard these systems against potential threats is therefore crucial for enhancing the resilience of national infrastructure in Iraq.

Efficient access control methods can be used to determine who can access specific areas of a site. The implementation of automated access control systems can also improve the precision and effectiveness of managing access, contributing to the overall security of critical infrastructure. Another form of critical infrastructure protection is robust perimeter security. This includes screening entry points, blocking unauthorised vehicles, and constant monitoring to detect and respond to any breaches promptly. Such measures can fortify the outer layer of defence, preventing unauthorised access to critical sites.

Apart from protecting the critical infrastructure, resilience is also a key aspect of safeguarding critical infrastructure in Iraq. This entails the establishment of comprehensive plans, procedures, and backups to swiftly respond to damages. From access control mechanisms to securing OT and IT systems, resilience measures encompass a range of strategies, including the implementation of cloud-based off-site backups.

To achieve the goal of enhancing critical infrastructure resilience and protection, operators should allocate sufficient resources to adopt and implement cyber-tools and internationally recognised security standards. The availability of domestic Critical Infrastructure Protection (CIIP) policy and legal frameworks is equally essential. Governments, through coordinating authorities, must allocate resources to implement and monitor CIIP policy and regulatory frameworks, ensuring clear legal mandates and responsibilities for safeguarding critical information infrastructure.

Over the years, international organisations such as the OECD have adapted their frameworks to address the evolving nature of digital security[50]. Shifting from the concept of “Critical Information Infrastructure” to "Critical Activities”, these frameworks aim to ensure consistency with the contemporary understanding of digital security. However, adoption of these frameworks varies among countries, with only a few incorporating concepts like "digital security" into their national strategies. Both natural and man-made incidents pose potential threats to critical infrastructure. Rather than focusing on specific threats individually, states should identify and address all potential risks. Understanding the interdependencies between infrastructure elements and sectors is crucial for assessing vulnerabilities and enhancing security and resilience.

In conclusion, strengthening critical infrastructure resilience and protection demands a comprehensive approach. From access control and perimeter security to resilience measures and international collaboration, a well-coordinated effort is essential to mitigate risks and ensure the continued functionality of critical activities.

[50] ITU: Trust and safety

3.7 Leveraging cloud infrastructure

In the ever-evolving landscape of Iraq's ICT sector, carriers and ISPs need to move more quickly towards a future defined by digital excellence and connectivity ubiquity. As stewards of technological progress, it is imperative for carriers and ISPs to recognise the indispensable role of cloud infrastructure in driving digital transformation and securing the nation's position on the global ICT stage.

Navigating the digital frontier: The role of cloud infrastructure

At the heart of the digital revolution lies the transformative power of cloud technology. Unlike traditional infrastructure models, cloud-based solutions offer unparalleled scalability, agility, and cost-efficiency, empowering carriers and ISPs to meet the escalating demands of a digitally-driven society. By transitioning to cloud infrastructure, these stakeholders can transcend the constraints of legacy systems, fostering innovation and accelerating the deployment of next-generation services and applications. Given the sensitivity of data, it is crucial to focus on private cloud solutions to ensure data security and compliance with regulatory standards.

Unleashing innovation: The promise of cloud adoption

The adoption of cloud infrastructure heralds a new era of innovation and opportunity for carriers and ISPs. Through cloud-native architectures and services, providers gain the agility to experiment, iterate, and deploy services at unprecedented speed and scale. From IoT-enabled solutions to AI-driven analytics, the cloud ecosystem catalyses the development of transformative technologies, positioning carriers and ISPs at the forefront of digital innovation. Utilising private cloud environments further enhances data control and security, essential for protecting sensitive information.

Catalysing economic growth: Monetising cloud capabilities

Crucially, cloud infrastructure serves as a catalyst for economic growth and revenue diversification within the telecom and ISP landscape. By monetising cloud capabilities, carriers and ISPs can unlock new revenue streams, capitalise on emerging market trends, and differentiate themselves in a competitive marketplace. Whether through value-added services, subscription models, or strategic partnerships, the cloud presents a myriad of opportunities for revenue enhancement and business expansion. Emphasising private cloud solutions ensures that these new services adhere to the highest standards of data protection.

4. Actions and measures to promote broadband development

This section addresses the short-, medium-, and long-term actions and policy measures to foster broadband development and adoption. It outlines key focus areas for the Iraqi telecoms industry and indicative timelines. Each area included in this section contributes in its own way to achieving the overarching goal for the Iraqi ICT sector.

The CMC has set the following targets for key stakeholders to aim for:

Figure 54: Key mobile broadband targets for the Iraqi telecoms sector

Target goals for mobile broadband	Definition	2024	2025	2026	2027	2028	2029	2030
4G availability	Proportion of time users with 4G device and subscription had an active 4G connection	81%	86%	90%	94%	97%	98%	99%
5G coverage	Geographical extent over which 5G network signal is available across Iraq	0%	10%	25%	34%	43%	51%	60%
5G user penetration	The number of 5G-specific SIM cards as a ratio to the total population	0%	5%	13%	19%	26%	33%	40%
Average download speeds *(Mbps)*	Typical download speeds a user experiences on the mobile network	24	38	53	80	103	161	235
Average upload speeds *(Mbps)*	Typical upload speeds a user experiences on the mobile network	8	12	16	25	32	50	78

Based on these areas, these sub-sections also include the following:

- Key priorities for the next 12 months
- High level plans set out by the CMC, informed by global best practice
- Proposed timelines for specific activities

As a result, these form an indication of where key players and stakeholders in the telecoms industry should focus in order to meet the targets mentioned above.

4.1 Short-term actions: Next 12 months

4.1.1 Supportive spectrum policy

Spectrum plays a crucial role in wider national broadband development, influencing the economic feasibility of providing universal access and bridging the digital divide. As spectrum is a limited and valuable resource, its efficient allocation and management is critical in driving Iraqi broadband development. Optimising the use of spectrum can enable telecoms operators to provide broader coverage and higher data speeds in a more cost-effective manner, whilst reducing the overall cost per user.

Sufficient spectrum allocation for coverage and capacity needs

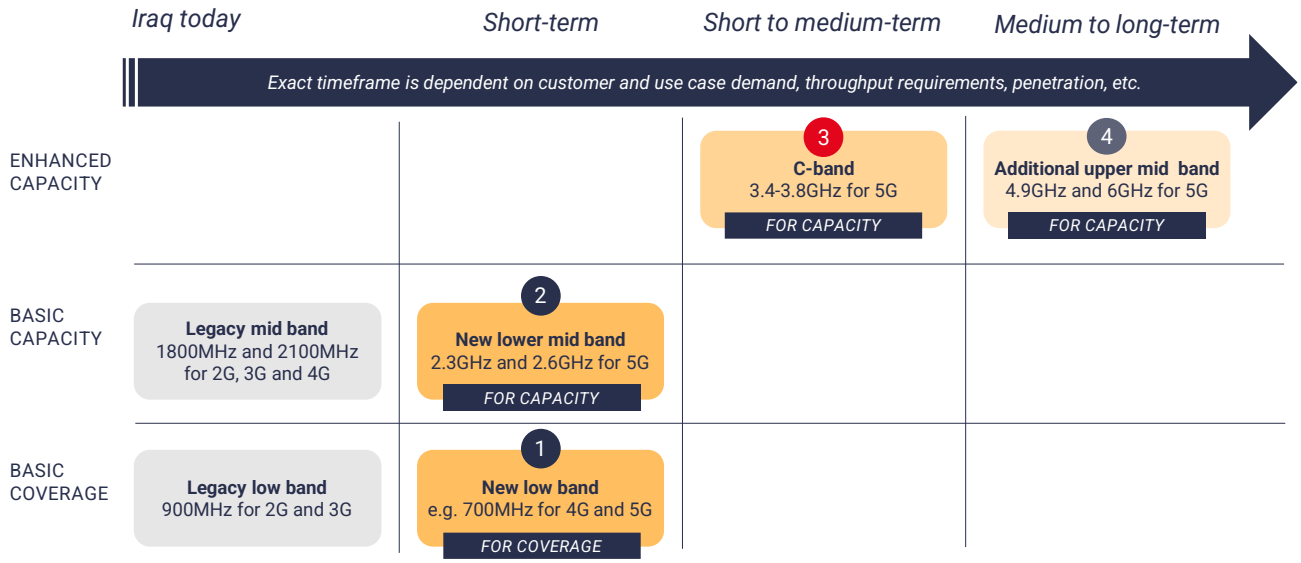
As described in the **section 3.2.2 Analysis of spectrum frequency bands to unlock different outcomes**, different spectrum frequency bands are suited for different purposes and

therefore should be allocated accordingly and sufficiently to support broader policy goals on universal access, rural coverage and higher speed connectivity for Iraqi citizens. Lower bands (sub-1GHz) are better suited to provide broader coverage while higher bands can better meet capacity improvement objectives.

Figure 55 below outlines the proposed approach to 5G spectrum allocation in the shorter to longer term and maps this to key goals:

- **Basic coverage:** To support rural coverage and reduce the digital divide
- **Basic capacity:** To promote digital inclusion and digital use cases
- **Enhanced capacity:** To drive innovation and advanced digital services for economic growth

Figure 55: Overview plan for spectrum allocation for 5G



In terms of existing spectrum allocated for basic coverage and capacity needs, the 900MHz, 2100MHz and 1800MHz bands have been allocated for 2G, 3G and 4G respectively. The spectrum frequency bands cited in Figure 56 will be considered for 5G, to augment the existing spectrum used to meet growing needs of the Iraqi citizens in the short-term. This will form a basis the first 5G coverage and capacity layers, on top of which can be built on in the medium to long term.

Figure 56: Short-term spectrum allocation priorities for 5G

Purpose	Frequency bands	Description
Basic coverage	700MHz for 5G	Enables ability to address rural coverage requirements more cost-effectively for providers Offers improvement on indoor coverage for in-building 5G services

		Supports mobility use cases and use cases that require wide area coverage Encourages and supports growth of IoT
Basic capacity	2.6GHz for 5G (Band 41)	Balances (urban) coverage and capacity requirements Offers relatively high data rates making it suitable for eMBB use cases Provides broader coverage than higher-frequency bands, hence suitable for urban and sub-urban deployments Allocated in several other countries in the MENA region
	2.3GHz	Similar advantages to 2.6GHz and complementary, may be made available should additional spectrum be required

To augment the 700MHz and 2.6GHz/2.3GHz bands, C-Band (3.4-3.8GHz) will be considered as the key capacity band for 5G in the short to medium-term. This will provide capability for many use cases with higher throughput requirements. In the longer term, additional spectrum in the upper mid bands such as 6GHz will also be considered to support future enhanced capacity requirements and speeds that customers need. This is supported by the ITU's decision to announce this spectrum band for mobile broadband use (5G and 6G).

Regardless of the characteristics of different bands, sufficient bandwidth should be allocated to each spectrum license holder to enable them to optimise the use of the allocated frequency range. This ensures each provider is able to accommodate a larger number of users, avoid the risk of congestion (even during peak usage periods) and provide an overall better experience for end users.

Based on the analysis and benchmarks in Section **3.2.2 Analysis of spectrum frequency bands to unlock different outcomes**, the CMC will evaluate the viability of following options for the allocation of the spectrum frequency bands discussed above:

- To follow global best practices, the CMC will look to allocate **2 blocks of minimum 10MHz** (organised as paired spectrum, not contiguous blocks) to each license holder to meet coverage objectives.
- The CMC will explore allocating **minimum 50MHz blocks per license holder** in the 2.6GHz band.
- **Additional spectrum will be made available where required in 2.3GHz** to support deployment of 5G fixed wireless access and to ensure all operators can address rural coverage, universal access and capacity demands in an economically viable way.
- The CMC will also evaluate the allocation of **contiguous 100MHz blocks per license holder in the 3.5GHz band**, based on global best practices

- For spectrum in the 4.9GHz and 6GHz bands, the CMC will devise a plan and timeline for its exploration of these bands for 5G use to support future capacity demands.

By taking a layered approach to spectrum allocation across various bands, stakeholders in the Iraqi telecoms industry will have the necessary spectrum capacity to drive and support 5G innovation and growth for the benefit of the Iraqi ICT sector.

Spectrum licenses should also adhere to flexible-use technical and service rules. This means that a license holder can use the allocated spectrum for different generations of mobile networks. This ensures flexibility in spectrum management to embrace technological and market developments.

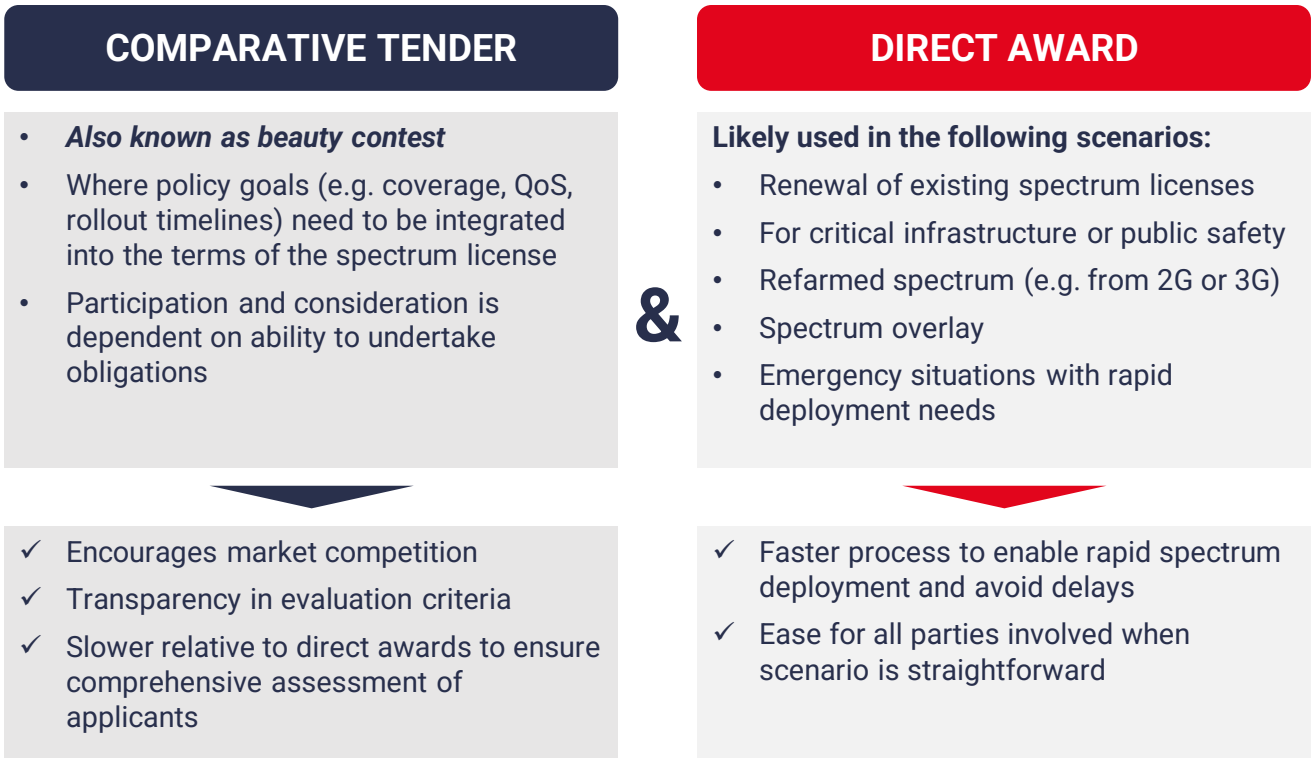
Clear and transparent spectrum allocation processes

In terms of the method of spectrum license award, the CMC will adopt different models based on the type of scenario. The main two methods of immediate consideration are comparative tenders (beauty contest) and direct awards:

- The **comparative tender** (also known as the beauty contest) method for spectrum licenses involves a process whereby responsible authorities evaluate competing applicants based on predetermined criteria. This process is considered in certain situations that align with specific policy goals.
- **Direct award** methods for spectrum licenses is the process whereby where licenses are assigned to specific providers without a competitive process. Compared to beauty contests, this method is considered in other situations where there is a clear and compelling reason to allocate spectrum to a particular entity.

Figure 57 below provides an overview of each method:

Figure 57: Indicative spectrum license award methods



Seamless processes for spectrum license renewal

Streamlined renewal processes for spectrum licenses allow communications service providers to avoid uncertainty and reduce administrative burdens and delays, enabling them to focus on improving service quality and uninterrupted services. Given the level of financial commitment made by providers through spectrum licenses and associated services, adopting best practices around license renewals is important to avoid the risk of deterring investments in improving networks and deploying new services to compete more effectively in the market. The key to best practice is predictability, timeliness and transparency in the renewal process.

In most cases, a strong presumption of renewal is expected where current spectrum license holders have abided by the associated terms and conditions e.g. providing sufficient services to the respective service area. In the unlikely case of serious breaches of license conditions or spectrum being poorly utilised, the CMC will consider alternative approaches.

4.1.2 Strengthening financial and fiscal support

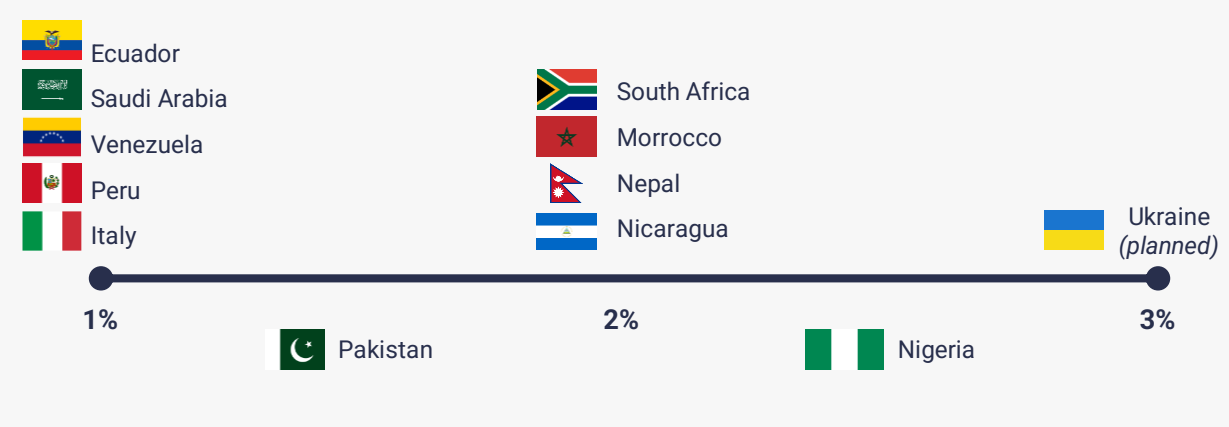
Establishing optimal market conditions for operators to further investment is crucial for national broadband development in Iraq, particularly in remote and economically unviable geographies as discussed in previous sections. This challenge, coupled with economic and political uncertainty, introduces a critical need for policymakers to strengthen financial and fiscal support. Implementing direct and indirect financial assistance in tandem will be an

essential tool in encouraging MNOs to dampen any current and future concerns that may deter infrastructure deployment and yield a positive investment environment.

Direct financial and fiscal support encompasses subsidies, tax rebates, and universal service funds allocated by state authorities.

- **Subsidies and tax rebates** are policies to be implemented more modestly, targeting specific areas. A notable example is the 2014 Malaysian corporate tax rebate system, which reimburses up to 70% on capital investment in rural areas[51]. This is favourable for operators as they benefit from exemptions on import duties for last mile connectivity equipment, providing direct incentive for operators to increase the investments for rural coverage.
- **Universal Service Funds (USFs)** should serve the primary purpose of extending universal access, encouraging additional investment from mobile operators in infrastructure and connectivity where there is no business case for development. Financial incentives can also be used to enhance digital literacy and awareness of all stakeholders in the ICT value chain. These funds can be collected by charging levies on operators. As illustrated in Figure 58, it is common that policymakers impose a 1-2% levy on operators' annual revenue. Emulating this approach, the CMC and the Comprehensive Service Department's decision to enforce an obligatory contribution of 1.5% of total operator revenue[52] will ensure the investment decisions of Iraqi operators remain unimpeded whilst encouraging their active participation in the Universal Service program fund.

Figure 58: USF levies incurred by operators on annual revenue between 2013 and 2016

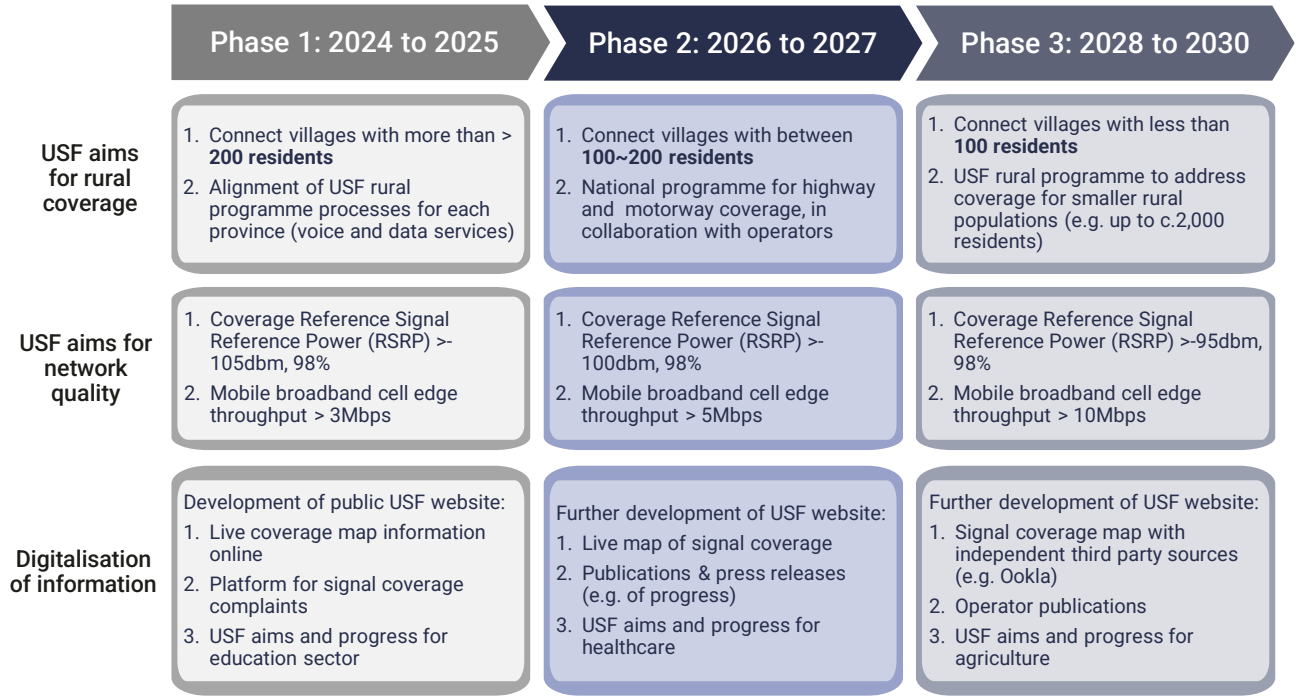


Source: GSMA, National Integrated ICT Policy whitepaper of South Africa

Below shows an indicative multi-phase USF programme whereby Phase 1 outlines the short-term actions focused on providing basic coverage and service experience for unconnected villages:

[51] GSMA: Enabling Rural Coverage
[52] The CMC: Universal Service Policy

Figure 59: Indicative phased USF plan



Indirect financial and fiscal support refers to measures where easing any financial burden on operators appears as a secondary effect. This can minimise the risk of distorting investment incentives and thus broadband market development. Simplifying and streamlining regulatory processes around broadband development removes a significant barrier for operators.

- Policies that encourage **passive infrastructure sharing**, such as co-ownership of key infrastructure, reduces the need for installing and setting up new equipment, towers, and antennas, thereby lowering the initial costs of infrastructure investment.
- Administrative processes and costs associated with **RoW** also critically influence operators' decision to invest in underserved areas and expand rural coverage.

The success of financial and fiscal support will, however, depend on the following conditions:

1. **Beneficiaries' needs are regularly assessed:** Ensures the scope of funds are relevant, serving the needs of operators and warranting appropriate disbursement of funds.
2. **Transparency of administrators:** Clear information is available on fund acquisition and distribution, including information on the available financial support measures, the application conditions and process, and reporting procedures. This will help maintain accountability and meet defined and measurable goals, all of which necessitates a well-established underlying governance structure for efficient and effective fund management.
3. **Independently assessed service requirements or key performance indicators (KPIs):** Timebound and measurable KPIs on coverage targets and QoS will ensure operators address market failures (e.g. access gaps and the digital divide). The establishment of a dedicated, unified, and independent account under the Comprehensive Service

Department arm illustrates a constructive move towards maintaining a well-regulated mechanism across Iraq.

4.1.3 Establishing operational facilitation measures

Measures facilitating the ease of infrastructure development, operations, maintenance and upgrades are critical components in the successful expansion of network infrastructure within the telecommunications sector. For example, establishing clear and efficient RoW is fundamental to streamlining the deployment of network infrastructure. Regulators play a pivotal role in facilitating this process by implementing standardised procedures for obtaining RoW permissions, minimising bureaucratic delays, and ensuring transparency. Clear guidelines on RoW not only accelerates network development but also reduce the administrative burden on operators, fostering a more agile and responsive industry.

Incorporating incumbent equal access obligations is another key operational facilitation measure that promotes fair competition and efficient use of existing infrastructure. By imposing obligations that mandate incumbent operators to provide equal access to their facilities and resources, regulatory authorities encourage a level playing field for both established and new market entrants. This approach minimises the need for redundant infrastructure investments and promotes resource-sharing practices, ultimately contributing to a more cost-effective and competitive telecommunications landscape. Incumbent equal access obligations stimulate innovation, as multiple operators can leverage shared infrastructure to deliver diverse services to end-users.

Furthermore, implementing regulated pricing for RoW is a strategic operational facilitation measure to ensure fair and transparent cost structures associated with deploying network infrastructure. Regulatory bodies can set guidelines for pricing RoW that balance the interests of both operators and public authorities. By regulating pricing, monopolistic practices can be prevented to promote healthy competition and create an environment where operators can invest confidently in expanding their networks. This measure contributes to the overall economic efficiency of the telecommunications sector, fostering sustained growth and enhancing connectivity for a broader segment of the population.

4.1.4 Standardising network evaluation and performance measures

Network evaluation and performance measures helps gauge an understanding of the progress and the growth of national broadband access, ultimately supporting the adoption of data-driven policymaking. Recognising the significance of this, standardising network evaluation procedures becomes a necessary step. Establishing a continuous and standardised process for monitoring the impact of public broadband policies becomes imperative to uphold the efficacy and the widespread influence of public intervention.

By adhering to standardised methods, regulatory authorities can identifying connectivity gaps and make informed decisions around provisioning high-quality broadband access for all. The quality of the service, availability of communication networks, demand, and pricing are all core principles underpinning the successful implementation of universal service access, whereby the entire population can access telecommunication services at affordable prices and superior quality. To capture the true extent of network reach across the entire population, particular in rural areas where access remains limited and underserved, the CMC recommends the use of multiple third-party data sources for the evaluation of network performance.

The following discussion delves deeper into the fundamentals for achieving robust network performance.

Quality:

Quality of service is an instrumental factor affecting the level of customer experience. The QoS offered by telecommunication operators should be of good technical quality and acceptable standards. These standards must be clearly defined and consider scenarios such as indoor, outdoor, large buildings and important roads (e.g. highways, motorways) to align with guidelines set out in the ITU's QoS Regulation Manual[53] to guarantee all users with adequate QoS. This can be achieved by:

- **Adopting competitive policy framework** to incentivise operators to invest in extending high quality mobile networks (e.g. VHCN, eMBB, URLLC, etc.)
- **Specifying a standard level of technical quality** such as meeting a minimum target upload and download speeds, latency requirements and service continuity to avoid call drop rates, down time and faulty networks. Compared to other countries in the region, Iraq's download and upload speeds are below average for both mobile and fixed technologies. Iraq should aim to multiply its MBB network download speeds to meet 80 megabits per second by 2027.
- **Defining service-level agreements (SLAs)** to formally offer customers a minimum level of network performance and establish accountability in addressing these performance commitments.
- **Establishing an effective mechanism** for users to raise network issues and track operators to fault repair time and complaint handling duration. This should be publicised to inform service users of the baseline standard frameworks and the mechanisms in place to raise poor quality of services and claim compensation.
- **Setting regular review timelines** to assess applicability and appropriateness of QoS requirements in line with technological advancements, adjusting the standards upwards where necessary to continuously provision better quality of services.

[53] ITU: Quality of Service Regulation Manual

Measuring operators' performance in delivering good QoS against these parameters and auditing their compliance will encourage operators to maintain user experience.

Network availability:

Ensuring the uninterrupted availability of broadband infrastructure and service coverage for all communities stands as another fundamental attribute in national broadband development. Acquiring comprehensive statistics on the availability and accessibility of broadband infrastructure and services becomes imperative. Such data will equip relevant authorities with the means to identify where there are universal service gaps. These gaps signify areas where broadband development lags, whether on a socioeconomic or regional scale. The CMC recommends the use of network availability as a key indicator versus network coverage. Network coverage is about the reach of a network signal across a geographical area, while network availability focuses on its reliability and uptime. Having broad coverage doesn't guarantee reliability; frequent outages can occur. Therefore, network availability provides a more comprehensive measure of a network's dependability and accessibility, crucial for assessing overall performance and user experience.

Collecting and synthesising up-to-date information on network availability spanning across the North, South, West, East, and mid-regions of Iraq becomes a catalyst for more informed decision-making. It paves the way for continuous improvements in strategies and policy making by helping decision makers foster a deeper understanding of the disparities in broadband access across the Iraqi landscape. This level of understanding will allow relevant authorities to proactively implement targeted measures to enhance broadband access, prioritising investment and development in regions that remain underserved by adequate connectivity, and overcome the digital divide across regions and communities.

As illustrated in Figure 60, the percentage availability of 4G in time has improved with a steady uptick year-on-year for each operator. However, improvement should still be made to reach optimal 4G availability levels (c. 99%). In the interim, all operators should aim to reach 86% availability by 2025 with the aim of 99% by 2030. The same applies over time for more advanced generations of technologies once deployed.

Figure 60: 4G availability by operator

Year*	2021	2022	2023
4G availability (% of time)			
Asiacell	73.4	86.9	87.4
Korek	61.7	62.1	64.4
Zain	62.6	69.8	74.1

*Data from Sep-Nov each year

Source: Open Signal

Demand and 4G/5G network penetration:

Measuring the demand for broadband services holds paramount importance as it reflects the growth in broadband sector. This must be measured to ensure demands for affordable, accessible and high-quality broadband and internet services are met, both in public and private market segments (e.g. public places or places of residence or work). This holds particular importance to ensure there is no regional discrimination in broadband coverage.

The success in using USF to expand coverage to rural areas, an untapped market, hinges on the demand for broadband (and cost of operators and ISPs serving) in these areas. It is therefore imperative that state authorities ensure the demand for broadband services are matched by the available infrastructure and communication networks, and where demand is not satiated, that authorities take active steps to plug the connectivity gaps.

In particular, 4G and 5G network penetration serves as a key indicator for authorities. Its reflects the widespread adoption and usage of network services within a population or region can help gauge the extent to which technology is integrated into society with implications for economic growth, education, emergency preparedness and technological innovation.

Pricing of broadband services:

The cost of access to networks, devices, and mobile and internet services is critical factor at play in households' and business' broadband purchasing decisions. Iraq is characterised by low income per capita of $12,050 USD[54]. Given the low purchasing power across the country, particularly in more sparsely located rural areas, it is imperative that mobile and internet services are affordable for all users. This may involve pricing interventions and control, which will inevitably lead to service access for all citizens as their ability and willingness to pay for these services increases.

In spite of that, the price of service is tied to the quality and must therefore internalise the value for money. This is dependent on QoS and the costs of operations and service delivery. Assessing the two and integrating it in operators' pricing plans will ensure that the price of service is not a factor that hinders mobile communication and internet access, maintaining fair and affordable pricing.

[54] https://www.imf.org/external/datamapper/profile/IRQ

Good practice case study: Cambodia

The efforts of the Cambodian telecoms regulator in introducing a price floor for mobile data packages which ensures they are not sold below cost base to address QoS and network coverage is key case study example illustrating the significance of policy intervention in generating fair competitive environment and favourable market outcomes in terms of fair prices and service quality for all stakeholders, including operators and consumers.

Source: GSMA and ITU

4.1.5 Driving greater digital awareness

ICT plays a pivotal role as an enabler, contributing to wider economic benefits including accelerated data transmission, enhanced intelligence and digital skills development, which in turn enhances employment and economic growth opportunities. A significant part of national broadband development lies in adopting demand side policies to encourage demand for and tap into the value enabled by broadband services.

Iraq's evolution in digital skills and general awareness of what tools are available and their benefits constrains both households and businesses, impeding their understanding of the mobile internet and their ability to effectively leverage the intricacies of digital tools. Progressing towards enhanced and more efficient nationwide connectivity lacks justification if the Iraqi population is unable to fully harness the technology's potential and derive maximum benefits from the available digital tools as well the opportunities it offers. Establishing greater digital awareness is a key component of this strategy and, therefore, a fundamental pillar for transforming Iraq's broadband penetration.

Efforts to advance connectivity must go hand in hand with initiatives to equip citizens with the necessary skills and awareness to achieve the following:

- Encourage uptake of more advanced digital tools at their disposal by highlighting their efficiency, reliability and, up-to-date features
- Promote awareness of cybersecurity risks such as phishing and identity fraud to safeguard digital advancements and ensure that Iraqi citizens have the knowledge to safely and securely access digital content and services
- Promote digital equality and a more inclusive digital society

To drive greater digital awareness and usage, the CMC recommends employing a host of measures, including:

- **Implementing gigabit technology** to facilitate innovative teaching and learning methods that can equip citizens with the necessary e-skills, tools, and techniques to use mobile internet. Based on the UNESCO's Sustainable Development Goals (SDGs), the CMC will work together with partners to develop special programs (e.g. Digital Village/Smart Classroom etc.) to leverage technology to create a better digital Iraq.

- **Provision mobile infrastructure and technologies** (e.g. appropriate handsets and tools) to harness the available digital resources and connectivity. The state authority can encourage mobile operators to support customer migration from legacy handsets to next-generation access tools, accelerating the transition of the Iraqi population to using advanced digital tools.
- **Development and provision of computing programs, ICT courses and country-level ICT certification programmes** through collaboration with public and private institutions that can offer citizens formal training to upskill. This can be integrated from early stages of schooling (i.e. primary school) through to secondary and tertiary education levels to improve the national competitiveness of local talent.
- **Awareness campaigns and content creation**, including programs on internet security mechanisms, educating the general population on practices that can help protect their identities from cyber risks, and promoting the benefits of mobile internet usage can encourage active participation in a more digitalised society. These initiatives can also be used as a mechanism to provide continuous access to the right information, tools, and technologies as well as informal training, thereby enhancing digital literacy.

By addressing the challenges posed by the general lack of skills and awareness through the implementation of these measures, the CMC will foster a more digitally aware and engaged society. This, in turn, narrows the digital divide, integrating the socioeconomically isolated communities into a single digital market and promoting digital equality by ensuring equal access to mobile services, all of which contributes to the overall success of national broadband development.

Good practice case study: Laos

As part of Laos' 20-year Vision for Digital Economy Development (2021-2040), the Ministry of Technology and Communications is driving greater awareness for digital transformation by visiting each province and educating on its benefits.

Source: GSMA

4.2 Mid-term actions: 2025 to 2027

4.2.1 Drive synergies through infrastructure sharing

The mobile sector has a paramount influence on Criteria 9 of the United Nations' Sustainability Development Goals[55], focusing on Industry, Innovation and Infrastructure. This influence is driven by the growing adoption of mobile and fixed mobile and internet services, which come with substantial investments in new technologies to extend the coverage of mobile networks. Introducing policies that support infrastructure sharing is a potential route

[55] THE 17 GOALS | Sustainable Development (un.org)

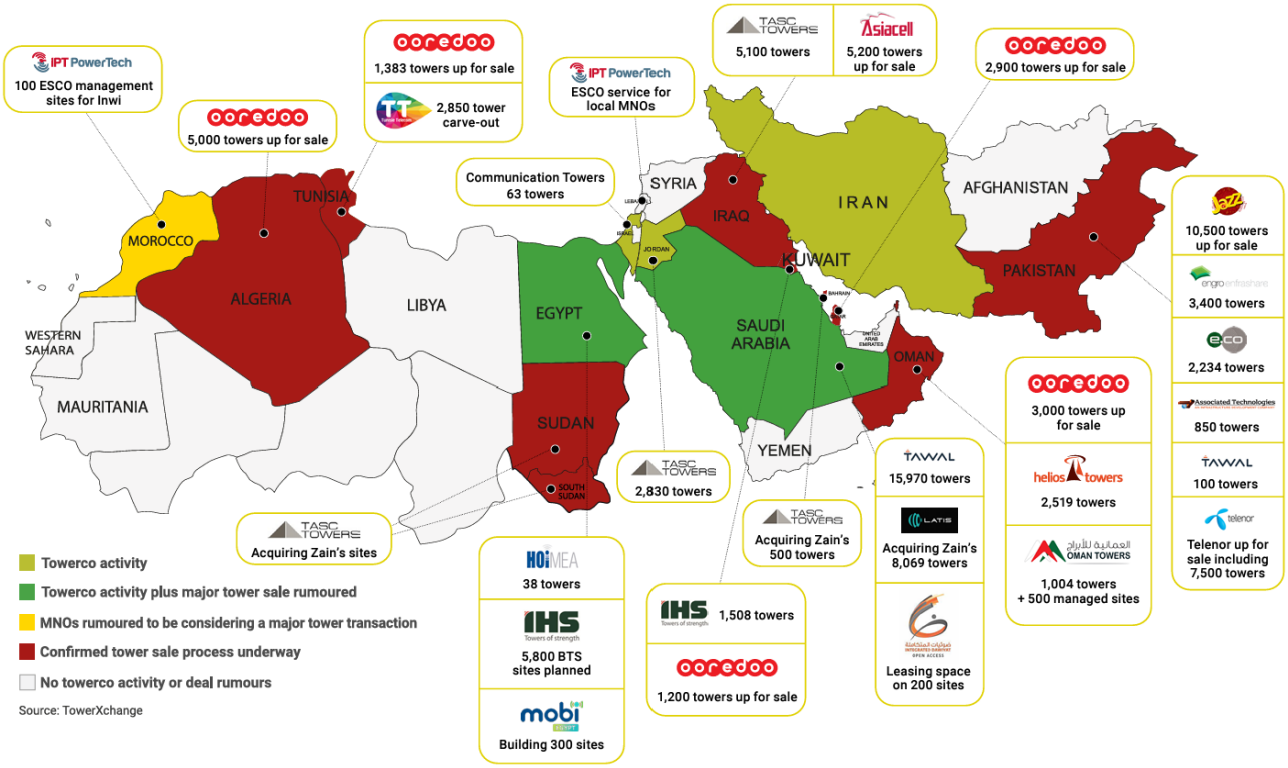
for Iraq to consider, offering a means to achieve sustainable coverage expansion without necessitating extensive investments.

The main priority with infrastructure sharing is primarily on the passive infrastructure layer, i.e. cell sites, towers and masts, and associated power and cooling required. Encouraging passive infrastructure sharing in the telecommunications industry is essential for fostering efficiency, promoting sustainability, and accelerating the deployment of robust network infrastructure for mobile and fixed broadband. By encouraging telecom operators to share these passive elements of the network, redundant investments and infrastructure duplication can be minimised, leading to significant cost and time savings. Moreover, passive infrastructure sharing also reduces the overall carbon footprint associated with construction and maintenance activities.

Tower sharing for example can involve sharing of towers between operators or the sale of towers and management responsibilities to a third party (e.g. a tower company or “towerco”). Furthermore, multi-tenant models are encouraged to maximise operational efficiency and lower expenses and investment required overall by telecoms operators.

Across MENA, tower sharing activity continues to be prevalent, with deals made across several countries on the sale and leaseback of towers to major towercos.

Figure 61: Map of tower deals and activity in MENA



Source: TowerXchange report

This is also not a new concept to Iraq. Zain Iraq[56] has recently agreed a 15-year deal with TASC Towers Iraq on the sale and leaseback of 4,968 towers. This includes the responsibility of TASC Towers Iraq to manage the tower portfolio and a commitment expand the network by building new tower sites to support growing traffic demands, with an agreed 198 new sites. Zain Iraq retains its role in operating the active infrastructure on top. This makes TASC the dominant tower owner in Iraq, operating an estimated 70% of the country's towers.

Given the unique challenges that the Iraqi telecoms sector faces (see **Section 2.4 Primary challenges faced by the telecoms sector and key considerations**), the CMC strongly encourages passive infrastructure sharing in Iraq to better meet 4G expansion (particularly for rural coverage) and 5G rollout targets. To foster an environment that encourages infrastructure sharing, any barriers that restrict opportunities for passive infrastructure sharing should be removed to enable opportunities for sharing to be pursued. This includes any legal or operational barriers, such as any existing or new agreements between operators and partners. In terms of passing on actual opportunities for sharing, sufficient reasoning and associated evidence should be provided to the CMC to justify any cases that involve the rollout of infrastructure that will not be shared.

[56] Zain Iraq finalises sale, leaseback of almost 5000 towers

Passive infrastructure sharing should also be mandated for non-telecoms public stakeholders such as utility companies. For example, in Peru and Brazil, passive infrastructure owned by the public electricity (and hydrocarbon) utility is shared by law with local telecoms operators[57].

4.2.2 Decommissioning of legacy networks (copper)

In the medium term, the Iraqi telecoms industry and stakeholders should consider decommissioning its copper network for several reasons. The copper network has limitations in terms of bandwidth and speed. Decommissioning copper infrastructure in favour of modern and more efficient technologies, such as fibre-optic networks, would significantly enhance the country's telecommunications capabilities. Fibre-optic networks provide higher data transfer rates, lower latency, and greater reliability, enabling faster and more stable internet connections.

Legacy copper networks are also expensive to maintain due to aging infrastructure and potential need for frequent repairs. Additional limitations of copper include signal degradation over longer distances which requires additional equipment and energy to compensate and boost signal. In contrast, fibre networks consume less power than legacy copper networks as they do not require signal amplification over long distances and can support higher volumes of data. These factors mean that decommissioning copper can bring significant cost and energy savings, which can be redirected to more efficient and advanced broadband technologies.

This transition aligns with global trends as many countries are moving towards other fixed broadband technologies such as fixed wireless access and fibre, that are able to meet the evolving demands of consumers, enterprises and public services. It allows operators to move towards more future-proofed technologies to support use cases that require high speed, reliable connectivity.

The decommissioning plan for each provider should consider the planned rollout and timelines for fixed wireless access and fibre rollout to devise a holistic, strategic phased network upgrade plan that considers customer needs and technology feasibility. Providers of copper-based services should undertake the following activities:

- Conduct comprehensive assessment of live customer base on copper network (e.g. number of subscribers, % of active subscribers, type of services, use cases, capacity) and impact analysis
- Identify areas with low utilisation and declining demand for copper-based services
- Identify potential alternatives to support copper-based services and align with planned FWA and fibre rollout

[57] Broadband policies for Latin America and the Caribbean

- Develop a phased decommissioning timeline, starting with areas where alternative technologies are fully deployed and operational
- Develop customer migration programme(s) with communication plan, campaign and potential incentives to accelerate transition
- Secure approval on decommissioning plans and timeline
- Set up customer support mechanisms (e.g. helplines, online resources, in-store retail support) to facilitate customer migration
- Launch campaign to communicate timelines to customers
- Execute phased decommissioning plan in parallel with FWA and fibre rollout

4.2.3 Strengthening talent and skills development

Iraq faces a relative deficiency in ICT skills development at various levels of its population. Policymakers must address these systemic differences to bridge the literacy gaps to enable users to better harness the technologies at their disposal and increase broadband penetration.

To accelerate the impact of the ICT sector in Iraq, the CMC prioritises activities focused on improving the skills and talents of the workforce. This can be achieved through strategic programs geared towards increasing access to quality education, training, courses in computing and coding, setting up the national ICT qualifications and encouraging policy, promoting cooperation with well-established global ICT academies, organising ICT competitions to thereby offering Iraqi citizens (especially youth) with the opportunity to become more proficient in digital technology and skills. Enhancing these skills will enable the development of software and application development expertise, aligning with the global demand for such capabilities across several roles and industries, particularly in entrepreneurship and innovation. Suggested measures include cooperation between the private and public sectors to provide and promote ICT certifications, innovation competitions for the ICT sector and ICT job fairs.

Although this will require significant financing and return on investments will be slow, such skills are vital in empowering people with the relevant ICT skills. Initiatives of this nature will drive Iraq towards a more digitally advanced economy and support the growth of a more knowledge-intensive workforce economy. This transformation will, in turn, contribute to innovative solutions across key sectors that underpins the country’s economic activity such as oil production, agriculture, and industry.

4.2.4 Embracing the cloud imperative for digital transformation

Recognising the pivotal role of cloud technology in shaping Iraq's digital landscape, the CMC underscores the urgent need for mobile carriers and ISPs to embrace the cloud imperative.

This imperative transcends simple technological advancements. It represents a fundamental shift towards resilience, scalability, and heightened accessibility in the digital realm.

By embracing private cloud solutions, carriers and ISPs can unlock a plethora of opportunities, serving as catalysts for innovation and driving forward the nation's economic engine. Cloud technology is the key to enabling more innovative services such as Artificial Intelligence (AI), IoT, and Business-to-Business (B2B) solutions. These advancements can revolutionise industries, streamline operations, and create new business models. Moreover, by democratising access to transformative digital services, they can empower Iraqi citizens, bridging the digital divide and ushering in a new era of opportunity and progress.

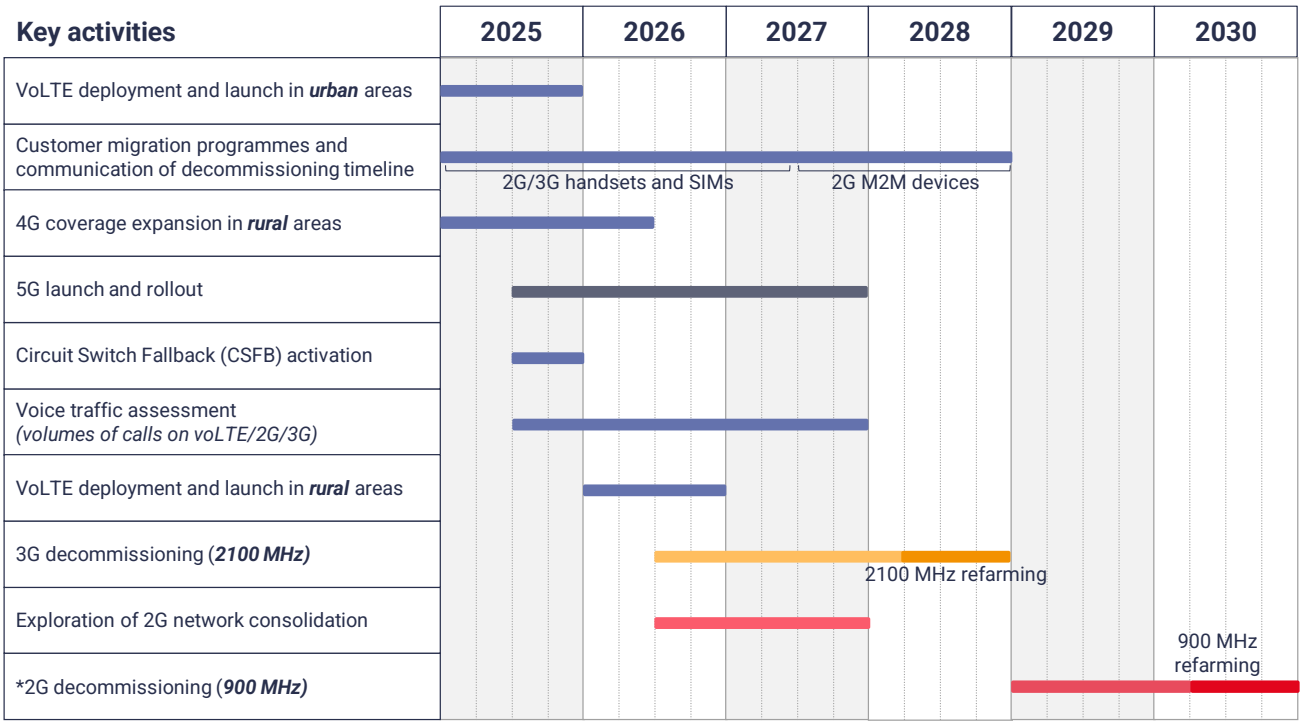
As stewards of Iraq's digital destiny, carriers and ISPs are urged to heed this call to action, understanding that the integration of cloud infrastructure is not merely an option but a necessity for sustainable growth and development. Failure to adopt cloud solutions not only undermines competitiveness, but also poses significant barriers to achieving digital inclusion and fostering economic prosperity.

4.3 Long term actions: 2028 onwards

4.3.1 Decommissioning of legacy mobile networks (3G, 2G)

To facilitate the adoption of more advanced mobile technologies (4G, 5G) and better services, the CMC proposes the following time for the decommissioning of legacy mobile networks:

Figure 62: Proposed 2G/3G decommissioning and voLTE/4G/5G transition



The following technical aspects should be integrated into the decommissioning process:

- 3G decommissioning should be strategically coupled with the deployment of voice over LTE (VoLTE) technology to support voice calls and the expansion/upgrade of 4G infrastructure and 5G launch to ensure seamless transition in voice services for users.
- This includes upgrading the core network if required to support VoLTE (e.g. the IP Multimedia Subsystem)
- Mobile network operators should confirm device compatibility and user readiness for voLTE with device manufacturers (e.g. automatic switch-on activation)
- The implementation of circuit switch fallback (CSFB) should also be prioritised while decommissioning 3G to ensure continued voice services for devices not yet compatible or connected via VoLTE technology (i.e. fallback onto the 2G network).

4.3.2 Strengthening international cooperation

Finally, the imperative for international cooperation, precisely in the realm of spectrum management, stems from the inherent nature of radio waves that transcend national borders, evading confinement within jurisdictional limits. This is a key characteristic of spectrum

which gives rise to challenges such as the potential for interference between national and regional users that are occupants of neighbouring territories. To minimise the challenges posed by RF's widespread propagation, national efforts, including the establishment of technical standards and guard bands to restrict the transmission of vulnerable and harmful frequencies within national borders, can be undertaken. Beyond this, strengthening international coordination and cooperation becomes critical.

Figure 63: Benefits of international cooperation and coordination

International harmonisation can augment broadband connectivity, providing a gateway for open access across borders. It also presents an opportunity for operators to explore synergies and scale economies in large-scale infrastructure deployment for last mile connectivity, particularly in edge-to-edge or border-to-border connectivity. For instance, the cost-effective provision of national MBB and FWA coverage using a combination of spectrum bands like sub-1 GHz (e.g. 700MHz) with mid-bands like 2.6GHz or 3.5GHz spectrum bands (i.e. the Digital Dividend spectrum) underscores the importance of international agreements on spectrum harmonisation. By collaborating on spectrum use, countries can work together regionally and internationally, resulting in reduced costs, improved investment viability of developing local and remote markets, and accelerated universal service access.

Another way scale economies can be achieved is by developing communication network and equipment ecosystems. Network equipment manufacturers (NEPs) and vendors can develop devices and equipment compatible with specific frequency bands such as technology neutral and spectrum neutral high volume chip sets. These devices can be adopted by many users, even across numerous regions and jurisdictions because of the standardisation from regional adoption of frequency bands for particular communication services and the compatibility of equipment and devices to these bands. Expanding marketplaces therefore

reduces operators' costs in developing and setting up communications networks and producing less specialised and more harmonised equipment.

The benefits of international harmonisation and coordination are far-reaching, but this constitutes a global effort. Effective coordination and collaboration among neighbouring countries requires a global governance regime implemented by an independent, third-party institution (i.e. the ITU or the GSMA). Their role in monitoring compliance with designated spectrum allocations and maintaining the efficiency in defined standards with new technological advancements becomes critical in ensuring the benefits of international cooperation are realised. By engaging in regional spectrum band allocation, Iraq can experience lower cost of devices and services for its consumers and promote interoperability and roaming across borders. These outcomes increase the affordability of broadband services, which holds importance given the nations relatively lower per capita income.

5. Conclusion and next steps

Positive improvements in Iraq have been made in the broadband sector but progress needs to continue and accelerate in order to drive greater socioeconomic development.

In the short term, the focus of key telecoms stakeholders should be on implementing supportive spectrum policies to optimise spectrum use efficiently, enabling telecom operators to extend coverage and increase data speeds cost-effectively. This involves allocating spectrum frequency bands based on their suitability for different purposes, such as providing basic coverage in rural areas and supporting higher-speed connectivity for urban centres. Concurrently, establishing operational facilitation measures such as clear RoW processes, incumbent equal access obligations, and regulated pricing for RoW will streamline infrastructure development and accelerate network deployment. Iraqi communications service providers should also adopt standardised network evaluation and performance measures to ensure effective monitoring of key network metrics against national broadband access progress. This enables better informed decision-making in the longer term, ultimately enabling involved parties to better address collective goals.

In the mid-term (2025-2027), Iraq should prioritise identifying opportunities for passive infrastructure sharing, particularly tower sharing, to enhance cost and operational efficiency in network deployment. Decommissioning legacy copper networks should be undertaken in favour of modern alternatives (FWA and fibre) to transition to higher-speed and higher reliability connectivity. Strengthening talent and skills development is recommended to bridge literacy gaps and empower the workforce with ICT skills, fostering innovation and driving Iraq towards a more digitally advanced economy.

In the longer term, Iraq should continue to coordinate with international bodies such as the ITU to ensure adherence to industry standards and best practices, to ensure that the Iraqi ICT sector and all of its constituents are able to flourish and deliver quality services for all customers in the country.

6. Acronyms and abbreviations

An index of key acronyms and abbreviations used throughout the whitepaper.

AI	Artificial intelligence
CAF	Connect America Fund
CERT	Computer Emergency Response Teams
CIIP	Critical Infrastructure Protection
CMC	Communications and Media Commission in Iraq
CSP	Communication service providers
DSL	Digital subscriber line
eMBB	Enhance mobile broadband
EU	European Union
FBB	Fixed-line broadband
FTTB	Fibre-to-the-building
FTTC	Fibre-to-the-curb
FTTH	Fibre-to-the-home
FTTP	Fibre-to-the-premise
FTTS	Fibre-to-the-site
FWA	Fixed wireless access
GCC	Gulf Cooperation Council
GEO	Geostationary Earth orbit
GSMA	GSM Association
HAPs	High-altitude platforms
ICT	Information and communication technology
ICS	Iraqi Cybersecurity Strategy
ICT	Information and communication technology
IoT	Internet of things
ISP	Independent service providers
IT	Information technology
ITPC	Informatics and Telecommunication Public Company
ITU	International Telecommunication Union
KPI	Key performance indicators

LATAM	Latin America
LEO	Low Earth orbit
LTE	Long-term evolution
MEO	Middle Earth orbit
M2M	Machine-to-machine
MBB	Mobile broadband
mMTC	Massive machine type communication
MNO	Mobile network operator
NEP	Network equipment manufacturers
NESAS	Network Equipment Security Assurance Scheme
NGA	Next-generation access
NSA	Non-standalone
NTN	Non-terrestrial networks
OT	Operational technology
QoS	Quality of service
RDOF	Rural Digital Opportunity
RF	Radio frequency
RoW	Rights of way
SCAS	Security Assurance Specifications
SDG	Sustainability development goals
SLA	Service level agreements
URLLC	Ultra-reliable, low latency communications
VHCN	Very high-capacity networks
VoLTE	Voice over LTE
Wi-Fi	Wireless fidelity
WiLL	Wireless in Local Loop
WiMAX	Worldwide Interoperability for Microwave Access
3GPP	3rd Generation Partnership Project