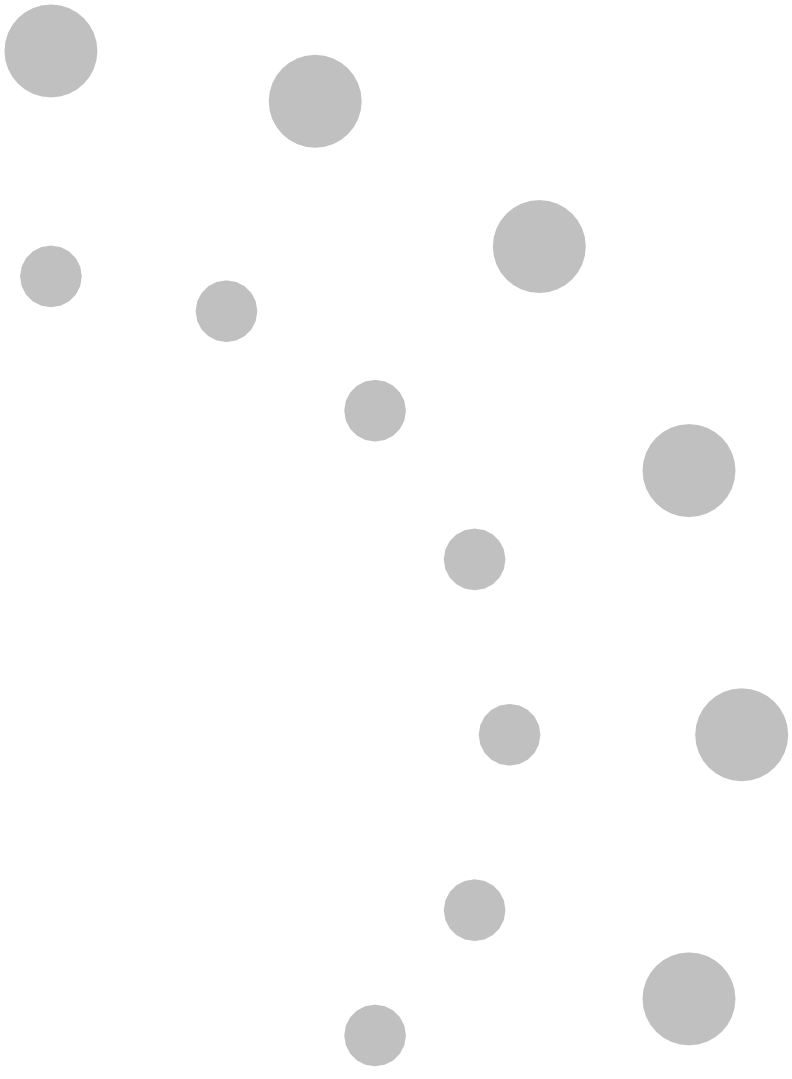
Association of
Comms & Technology

Migration to a 4G and 5G Digital Society

A proposed approach to switching off South Africa's 2G and 3G networks

www.actforsa.co.za



Contents

Abbreviations

ACT	Association of Comms & Technology
GDP	Gross Domestic Product
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communication Technology
IMDA	Info-communications Media Development Authority (Singapore)
IoT	Internet of Things
ITU	International Telecommunication Union
JENDELA	Jalinan Digital Negara (Malaysia)
LMICs	Low- and Middle-Income Countries
LSM	Living Standards Measure
LTE	Long-Term Evolution
M2M	Machine-to-M
MCMC	Malaysian Communications and Multimedia Commission
MIOT	Machine Internet of Things
MNO	Mobile Network Operator
OEMs	Original Equipment Manufacturers
OpEx	Operating Expenditure
PC4IR	Presidential Commission on the Fourth Industrial Revolution
PEST	Political, Economic, Social and Technological
POS	Point of Sale
RAN	Radio Access Network
SADC	Southern African Development Community
USAF	Universal Service and Access Fund
VoLTE	Voice Over LTE

1 Executive Summary

Radio Frequency spectrum ("spectrum") is the lifeblood of communications in South Africa. StatsSA reports that 88.7% of households use mobile phones as their exclusive means of communications in 2022. StatsSA also reports that only 13% of households have fixed line access to the Internet, whilst almost 70% of households rely exclusively on mobile communications for access to the Internet. These statistics expose both the importance of radio frequency spectrum as well as the role that mobile communication plays in South Africa's development towards a Digital Society.

Key to increasing the amount of spectrum available for high-speed connectivity to the Internet (4G/5G services) is to free up low-band spectrum used by old technologies, such as 2G and 3G. Migrating to the newer technologies could also reduce power consumption and mitigate against the current power supply challenges in South Africa. On 28 May 2024, the DCDT issued the new Spectrum Policy, which proposed that 2G and 3G networks be switched off by 31 December 2027.

The DCDT's policy proposes this date, subject to the conclusion of an economic and regulatory impact assessment. In this paper, the ACT provides a synopsis of the key components of such a plan, identifying key roles of both government and the private sector.

Core principles of 2G and 3G switch-off

Our response to switching off the 2G and 3G network infrastructure will be guided by three core principles:

Principle 1: Consider every single user, industry and consumer to ensure they have prospects of connectivity.

Principle 2: Switching off the 2G & 3G networks should have minimal impact on the costs of both end-users and network operators.

Principle 3: Every step of the switch-off process is made transparent with ongoing engagement with all stakeholders.

Principle 1: Consider every single user, industry and consumer to ensure they have prospects of connectivity

End-users, signalling systems on railways, emergency services systems and other machine to machine communications all rely in 2G technologies. The cheapest handset on the market today is a feature phone that relies exclusively on 2G. Further, based on a review of devices on our networks as well as engagement with industrial users, there is less reliance and a lower cost of migration off 3G technologies than 2G.

To ensure that connectivity is always available to every user it is critical that the timing of the 2G and 3G network switch-off be linked to the successful completion of a clear and transparent device migration and digital readiness strategy, particularly for the most vulnerable of society.

Principle 2: Switching off the 2G & 3G networks has minimal impact on the costs of both end-users and network operators

It is possible that some users may no longer have signal coverage if the 2G and 3G networks are switched off. Whilst 4G technologies cover 98.8% of the population, approximately 35% of the current subscriber base is exclusively dependent on either the 2G or 3G network. This means that switching off the 2G and 3G networks will require end-users to acquire new devices.

To ensure that any migration does not lead to unnecessary costs across all user groups, we recommend the creation of a Working Group with ICASA, End-User and Industry groups to assess potential network gaps, potential migration timelines (particularly for industrial and government users) and the potential necessary coverage obligations. Further we also recommend a review of all instruments that may drive higher costs of end-user devices (e.g. taxes on 4G & 5G smartphones make up 22% of the retail price).

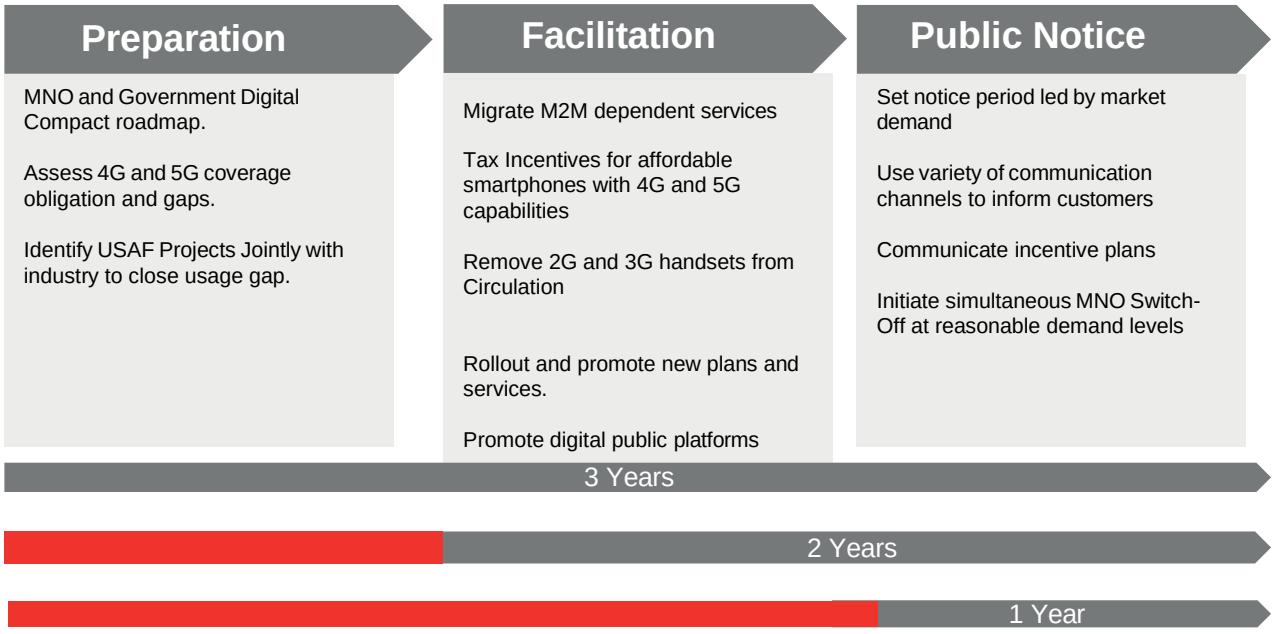
Our final recommendation under this principle is that the Government conclude the Rapid Deployment policy regulations as well as provide ongoing support to the MNOs in network roll-out. It is important that Government, at all levels, recognises the importance of land acquisition and land use in the timely deployment of network infrastructure.

Principle 3: Every step of the switch-off process is made transparent with ongoing engagement with all stakeholders

Switching off the 2G & 3G networks for the MNOs requires investment and swapping out of equipment. However, it requires far more exploration and time by end-users to ensure that their current devices, systems and operations can be updated to ensure a seamless transition. Therefore, any successful switch-off will necessarily need to be market-determined by what end-user groupings can achieve rather than what can be done at the network level.

Below we propose an indicative roadmap for the switching off of 2G and 3G technologies

ACT Proposed Roadmap to 2G and 3G Sunset



Source: ACT

In conclusion, we wish to open up a period of engagement with all stakeholders, including all levels of Government, End-User and Industry groupings to define a time-based action-plan to successfully migrate to the use of new technologies into the future.

Why Migration

- Free up spectrum for 4G and 5G which offers faster data speeds and better performance to meet customer demands and the growing demand for mobile data.
- An estimated 30% of consumers are still using 2G and 3G networks; with maximum usage of less than 25%, 2G and 3G networks are expensive to maintain and are energy inefficient.
- Maintaining 2G, 3G, 4G and 5G networks increase operators' operational expenses.
- South Africa, in line with the International Telecommunication Union (ITU) has set targets to achieve universal and meaningful digital connectivity for all.
- 2G and 3G networks are vulnerable from a cybersecurity perspective.

Benefits of Migration

- 4G and 5G networks could potentially require less maintenance and energy specifically considering South Africa's energy situation.
- Spectrum currently used by 2G technologies in some instances have superior propagation characteristics providing increased coverage and penetration.
- 5G is expected to have a positive impact on the overall economy by increasing productivity and innovation.
- Facilitate participation by citizens in the digital economy.
- Ability to integrate e-gov into smartphone platforms specifically for people in remote areas where government services are not easily accessible.
- E-gov will empower citizens and improve communication with the government.

Impact of Migration

- Increased bandwidth requirements will require additional investment in fibre (upgrade of backhaul networks).
- 4G and 5G networks require more spectrum than previous generations networks.
- Decommissioning 2G and 3G networks requires the replanning of radio coverage areas and deployment of new Radio Access Network (RAN) infrastructure.
- Vulnerable and poor customers may have difficulty upgrading to new 4G and 5G devices and services and inadequate digital literacy can impede the adoption of 5G.
- Business customers of M2Mconnections may be impacted due to the current use of 2G.
- Existing feature-phone end-users will require suport and assistance in accessing new 4G and 5G capable smartphones.

How

- 2G and 3G switch-off to be phased out with 2G having a long tail – set reasonable period to switch-off and clear communication channels to inform customers.
- To maximise 4G and 5G coverage.
- Import and sale of 2G and 3G devices should be banned by Government going forward to facilitate smartphone uptake and no further type-approval of such devices.
- Government to incentivise smartphone uptake by reducing import taxes and reclassifying it not to be luxury goods.
- Use a Universal Service and Access Fund (USAF) to subsidise device costs for deserving groups.
- Introduce less expensive smartphones and handset subsidies, possibly by reviewing tax- driven higher prices.

2 Background

Globally, MNOs have already begun decommissioning legacy 2G and 3G networks. Diverse factors influence decisions to discontinue 2G services and, more recently, 3G services. As more spectrally efficient technologies emerge and consumer demand shifts, MNOs strive to rationalise legacy network technologies (GSMA, 2020).

Most of these network shutdowns have been operator-led, mainly caused by the need to dedicate additional spectrum to 4G to accommodate the significant growth in 4G data traffic (Xiang, 2019). Although OpEx savings have also been a consideration, some of these network shutdowns have been initiated by regulators after consultation with the industry.

Mobile network technology has evolved rapidly over the past few decades, with each generation offering significant improvements in speed, capacity, and coverage. 2G networks, first introduced in the early 1990s, were the dominant mobile networking technology for two decades. However, the growing demand for mobile data led to the introduction of 3G networks in the early 2000s, followed by 4G networks in the late 2000s. 5G networks, the latest generation of mobile network technology, were first deployed in 2020 and are expected to offer global population coverage of 97% by 2030.

Developing countries still rely on 2G networks because historically they have been relatively inexpensive to set up and maintain (GSMA, 2023b) as well as high terminal penetration in these markets. However, the cost of maintaining aging 2G and 3G networks is expected to increase in the future, as it becomes more difficult to find spare parts and support for these technologies. Eventually, the cost per customer of maintaining 2G and 3G networks will be higher than the cost of maintaining 4G and 5G networks. This means that 2G and 3G networks will ultimately be decommissioned.

The widespread adoption of 4G and 5G is having a significant impact on the global economy and society. These technologies are enabling new and innovative services, such as self-driving cars, remote surgery, and smart cities. They are also helping to bridge the digital divide and connect people in underserved areas. This widespread adoption of 4G and 5G is being driven by a number of factors: first the growing demand for bandwidth-hungry applications, such as streaming video, gaming, and augmented reality; second the benefits of 4G and 5G technologies, such as improved battery life, low power consumption, and greater penetration for indoor and outdoor locations; and third the efforts of mobile network operators to rebalance network resources away from the declining traffic in 2G and 3G technologies.

3 Problem statement

The South African government has introduced a strict deadline for the shutdown of 2G and 3G networks, in the Next-Generation Radio Frequency Spectrum for Economic Development policy, published on 28 May 2024 (RSA, 2024). With the Spectrum Policy, the government aims to promote long-term public interest derived from the use of spectrum as a finite natural resource. The Spectrum Policy states that there are shortages and limitations on the availability of spectrum on specific bands. Although the Government has specified particular timeframes for the migration away from 2G and 3G technologies, the Spectrum Policy does not provide a well-considered transition plan.

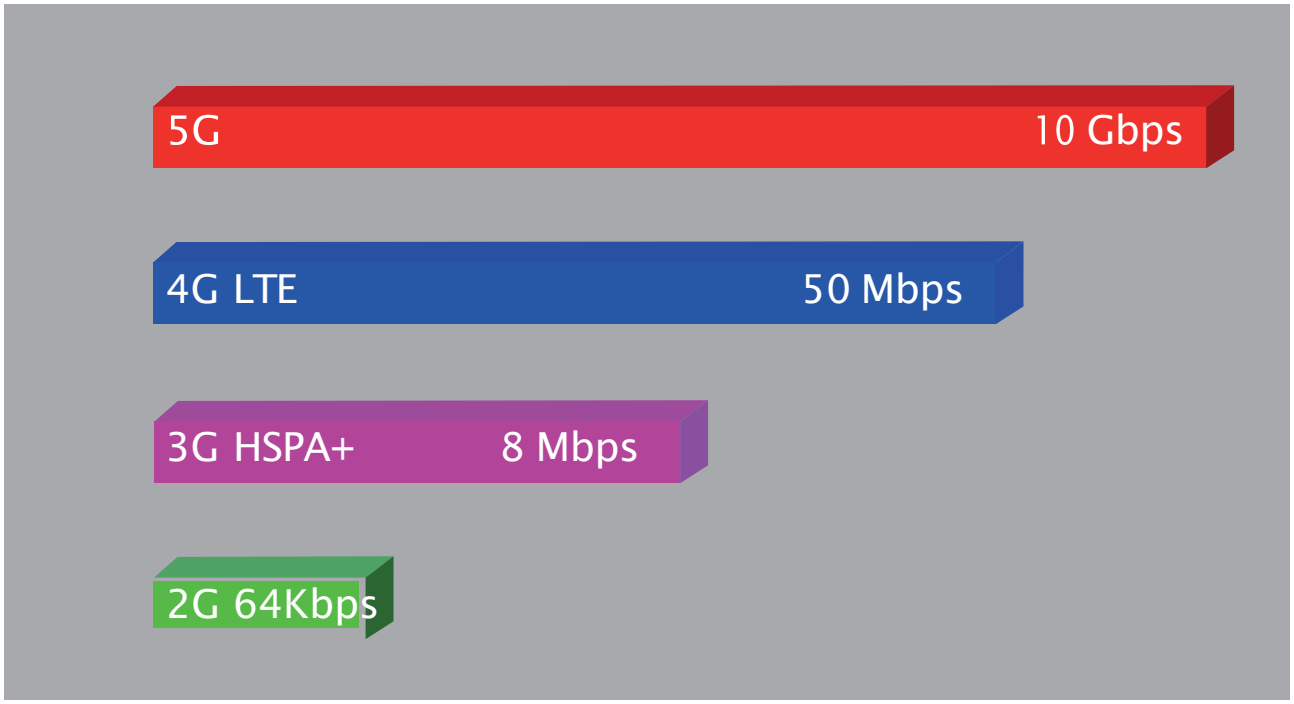
The shutdown could leave some people behind and make it more difficult for them to access essential services, as the government has not provided the necessary plan to ensure a smooth transition. The following challenges need to examined and addressed:

- Rational for sunsetting 2G and 3G network;
- The implications of upgrading to newer devices and networks;
- South Africa current network coverage and usage; and
- Case studies, frameworks and best practices.

4 Rationale for sunsetting 2G and 3G network

In the past eight years, 2G and 3G sunsetting commenced globally, with the GSMA issuing its 2G-3G sunset guidelines paper in 2021 (GSMA, 2021). The process of decommissioning necessitates an integrated plan and a comprehensive strategy that considers the risks to both the operator and the customer. Some MNOs began consolidating 2G services as early as 2008 to 2012, with several more following in more recent years (GSMA, 2020; Xiang, 2019). Telecommunication regulators and associations such as the GSMA have been monitoring global events in respect to technology sunsets.

Table 1: Data Rate Improvements: 2G to 5G



Source: RantCell, 2019.

As of the start of 2022, a total of 56 networks had been shut down, of which 36 were 2G networks and 20 were 3G networks. None of the observed network shutdowns observed globally were the result of severe deadlines imposed by the government. These closures were largely prompted by the market, with regulatory guidelines provided by the Regulator.

MNOs are decommissioning 2G and 3G networks for a number of reasons that include refarming spectrum, reducing operational cost, meeting demand, first mover advantage and meeting regulatory requirements.

4.1 Refarming spectrum

Refarming is a strategy whereby MNOs reuse their radio frequency resources to introduce the most advanced radio communication technologies to increase spectral efficiency, data throughput, and cost-effectiveness. Assigning spectrum to mobile operators using technology-neutral spectrum licensing is widely acknowledged as the best method. Technology-neutral spectrum licenses permit mobile operators to refarm spectrum used for 2G, 3G, 4G and 5G, based on market demand.

In South Africa, the Independent Communications Authority of South Africa (ICASA) has embraced the use of spectrum on a technology-neutral basis. This also aligned with the Competition Commission's paper on Competition in The Digital Economy (Competition Commission, 2020) which stated that :

> *"As such, we advocate for a technology-neutral approach that minimizes distortions in markets. The Commission supports the stance where rules are applied equally across the board amongst competitors, with regulation that is aimed at levelling the playing field and reducing regulatory barriers to entry and expansion."*

The sub-1GHz bands, which are used by the majority of 2G systems, are particularly advantageous due to their superior propagation characteristics, providing increased coverage and in-building penetration. Due to the propagation properties of the spectrum, which has contributed to its high demand, network operators now have the option of refarming the bands of frequency used by legacy networks. As a result, MNOs reallocate spectrum and implement more cost-effective technologies, allowing 4G and 5G networks to transmit more data over the same amount of spectrum as 2G and 3G networks. Because of this, MNOs can more economically provide their consumers with quicker speeds and more dependable services.

4.2 Reducing operational costs

MNOs have been running multiple generations of mobile networks with the aim of trying to accommodate every type of customer, to ensure network coverage and avoid customer churn. Some network operators simultaneously operate 2G, 3G, 4G, and 5G, which requires an additional layer of expertise and resources. Operating multiple generations of mobile networks concurrently is economically inefficient; consequently, operators tend to decommission redundant legacy networks to reduce operational expenses. These costs range from software licences, spectrum fees, electricity and backups, maintenance resources, and in some cases site space rental (Chaudron, 2018).

When base stations are operational, operators typically pay software licence fees for the stations they run. When an entire network is shut down, these software licence fees may be saved. In addition to software licences, hardware licences are required to operate at a specific capacity. When a station is no longer in use, the hardware licences no longer need to be renewed.

Energy use is one of the biggest cost factors to be considered. Currently, wireless access networks already consume a great deal of energy and are thus a significant source of CO2 emissions. As more and more devices incorporate wireless interfaces, new networks must be designed and existing networks must be expanded. Therefore, it is essential to have a clear understanding of the power consumption of the various wireless access network components. Given that older generation networks are less energy efficient than newer generation networks, and that base stations consume the most energy in a mobile network, 2G and 3G base stations are energy inefficient. As the circumstances for each type of base station vary, the new network accommodates the use of different propagation models for each type of base station (Deruyck et al., 2012).

5G enables significant energy savings, and as a result, numerous industries are compelled to adopt new energy-saving practices and procedures. Due to the rapid evolution of technology, 5G also encourages the incorporation of AI/ML (artificial intelligence/machine learning) mechanisms that will further support the potential for reducing energy consumption within the underlying networks (Chochliouros et al., 2021). The emerging technology will enable "smart" communications networks in the future. This will be achieved through promoting cognitive solutions capable of achieving significantly lower energy consumption by dynamically adapting their modules to emergent needs.

South Africa's loadshedding situation has an additional impact on the operational costs of multiple networks. Network operators have invested heavily in battery, generator, and alternate backup power solutions at base station sites instead of accelerating rural coverage to address the digital divide (IT-Online, 2022; ACT, 2022). In 2022, a total of R2.6 billion was spent on batteries by licensees during loadshedding. During this time period, R873 million was allocated to generators. Approximately 16 660 generators and 98 733 batteries were acquired by licensees in 2022 (ICASA, 2023). With prolonged and increased loadshedding beyond Stage 4, however, these batteries do not have enough time (usually 12 to 18 hours) to fully recharge between outages. As a result, certain coverage areas may be at risk of intermittent service when there is no power. Another factor to consider is that the 2G and 3G networks are used as a fallback solution to continue providing connectivity

during loadshedding or load reduction periods, further driving up costs and preventing the migration from 2G and 3G technologies. Any proposed timelines for migration need to firmly account for how security of supply of electricity may impact on the availability of connectivity.

The expensive maintenance of legacy 2G and 3G networks is another one of the factors that contribute to cost. By decommissioning these networks, MNOs can reduce their operating costs further by simplifying network management operations and radio frequency planning; avoiding costly maintenance of aging network equipment, including equipment spares; eliminating ongoing costs of software licences; reducing the lease cost of tower space for multiple antennas; and decreasing the network's energy consumption (Deruyck et al., 2012).

4.3 Meeting demand for data-intensive users and applications

Consumers are increasingly using data-intensive applications, such as streaming video and online gaming. To meet this increased demand for data, MNOs are installing 4G and 5G networks, which are capable of providing the speeds and bandwidth required to support data-intensive users, smart devices, M2M computing and many more such as streaming services for work from home, e-education and e-health.

The ability of an MNO to provide content and services has become a competitive lever, driving people online as they become more available, accessible, and relevant. The relationship is reciprocal, as more people online incentivises more content creation and service provision. Consequently, subscribers enjoy increased connectivity and functionality.

The GSMA report, The State of Mobile Internet Connectivity 2022, indicates that mobile internet use has reached 55% of the world's population (Delaporte & Bahia, 2022). It also indicates that data usage and network quality continue to increase – but with a persistent gap between high- and low-income countries. Global mobile data traffic per user reached more than 8.2GB per month in 2021, compared to 6.2GB per month in 2020, and by the end of 2021, 4.3 billion people were using mobile internet, an increase of nearly 300 million from the end of 2020.

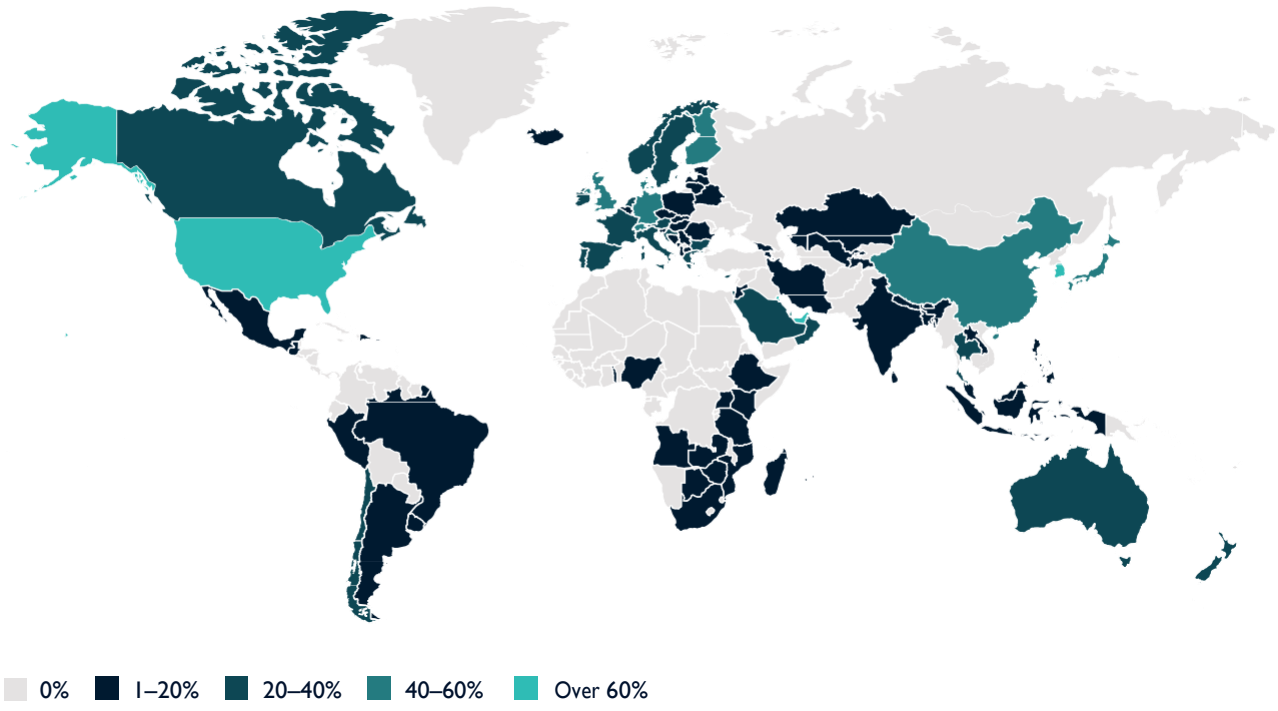
In the South African context, the State of the ICT Sector Report in South Africa (ICASA, 2023), reports mobile voice is now contributing only 27.35% of total mobile service revenue, down from 43.95% in 2018, whereas mobile data is increasing at a rate of 17.14% annually and is now over 50% of revenue. Prepaid mobile data revenue increased by 5.42% in 2022 and by 8.2% in 2021, while prepaid voice and messaging revenue decreased by 10.29% and 8.95%, respectively (ICASA, 2023).

4.4 Government expectations

In addition to market demand, meeting government expectations is a factor. Globally, governments are encouraging MNOs to deploy 4G and 5G networks. The South African government Spectrum Draft Policy (RSA, 2022) is one of the examples. Recent geopolitical tensions can be attributed to the competition between governments over 5G. Spectrum allocation is one of the primary regulatory concerns for 5G. Governments are debating the optimal means of regulating 5G networks and ensuring their security. In addition, governments are competing to develop the most advanced 5G networks. The ITU, a specialised agency of the United Nations, has played a vital role in identifying enablers for achieving the ITU 2030 targets and baseline, which aim to achieve universal and meaningful digital connectivity for all. (ITU, 2021).

In the European Union, the European Commission has issued a set of guidelines for the deployment of 5G networks (European Commission, 2020). The guidelines focus on security, competition, and spectrum allocation. In China, the government has been investing heavily in 5G infrastructure. The Chinese government has also been promoting the use of Huawei equipment in 5G networks (Triolo, 2020).

Figure 1: 5G Market Penetration Globally 2023



Source: GSMA Intelligence

5G is expected to have a significant economic impact, both globally and in individual countries. According to a study by the World Economic Forum in collaboration with PWC, The Impact of 5G: Creating New Value across Industries and Society (2020); 5G is expected to contribute US$13.2 trillion to global gross domestic product (GDP) by 2035, and create 22.3 million jobs (WEF & PwC, 2020). MNOs can improve the quality of service and meet these government expectations.

5G is also expected to have a positive impact on the overall economy by increasing productivity and innovation provided affordable use is facilitated. For example, 5G will make it possible for businesses to operate more efficiently by connecting and automating more of their operations. It will also make it easier for businesses to develop new products and services by providing them with access to more data and computing resources.

5 The implications of upgrading to newer devices and networks

The operating environment for MNOs is becoming progressively more complex. MNOs that grew on the back of traditional voice and data services are realising that as consumption patterns change rapidly, value moves not only to other stages of the MNOs value chain, but also into entirely new markets. As a result, their old business models are under increasing pressure and appear to be crumbling (Rao & Prasad, 2018). MNOs must take a critical view of the rapidly changing situation and take measures to ensure they are in step with the changing times.

To introduce new generation networks and decommission legacy 2G/3G networks, trade-offs must be made, and it is important for operators to quantify the benefits and the risks involved to make an informed decision. It is important to develop comprehensive strategies for decommissioning 2G and 3G networks to minimise the risk of disruption for both operators and consumers.

There are several considerations to ensure that risks are minimised and that the operator and the consumer are not adversely impacted by the decommissioning of 2G and 3G. These considerations include strategies for new generation network infrastructure investment, customer consideration, countries' socio-economic factors, not losing coverage, ensuring network reliability, M2M communications, and smartphone penetration.

5.1 New generation network infrastructure investment

New generation network infrastructure investment for 4G and 5G is essential to support the growing demand for mobile data as well as South Africa's ability to capture the benefits of the digital society. Besides the great promises offered by new generation networks, investing in new generation network infrastructure can also be a significant challenge.

4G and 5G networks require the deployment of new and more complex network infrastructure. This is true despite the availability of approaches that allow cellular networks to serve 5G service without physically upgrading their radios. For instance, dynamic spectrum sharing is an antenna technology that allows 4G LTE and 5G cellular wireless technologies to be used in the same frequency band, while dynamically allocating bandwidth based on user demand.

Concurrently, the increased bandwidth requirements require additional investment in fibre. The backhaul for network generations prior to 5G will not be able to withstand the needs of

ultra-reliability, low latency, and network density that 5G requires. The move to 5G requires end-to-end planning and significant financial and engineering resources (Taheribakhsh et al., 2020).

In addition, 4G and 5G networks require more spectrum than previous generations of mobile networks, which has been difficult to obtain in South Africa until recently. In South Africa the total telecommunications investment increased by 17.16% from R33.9 billion in 2021 to R39.7 billion in 2022 (ICASA, 2023). However, the total spectrum auction by ICASA which was concluded on 17 March 2022 generated a revenue totalling R14.4 billion which went into the national fiscus (ICASA, 2022).

The article published by McKinsey & Company, The road to 5G: The Inevitable Growth of Infrastructure Cost (Grijpink et.at., 2018), suggested at least two options are available to operators: the first involves a lean-in strategy in which they prioritise 5G investments in the hopes of accelerating commercial prospects; and the second involves a more conservative approach in which they delay 5G investments as long as possible while upgrading existing networks.

With a small number of initial 5G users, 5G service investments can be quite costly. In the early stages of 5G deployment, 5G cells would not be widely distributed, resulting in coverage gaps. By interoperating with the existing 4G Long-Term Evolution (LTE) network, operators can provide seamless services to 5G users (Agiwal et al., 2021). Even if operators delay 5G investments, they will need to spend more on infrastructure to accommodate traffic growth. There is no reason to believe that the historical annual growth rate of 20% to 50% will change. In an analysis of a single European nation, it is predicted that the total cost of ownership for RAN would increase significantly between 2020 and 2025, compared to the level anticipated for 2018 (Grijpink et al., 2018).

Recently, the fragmentation of the telecommunications market, intense competition, and declining revenues have made it difficult for the telecommunications industry to attract investment – even in developed countries. In practice, this is compounded by a regulatory framework and competition assessment that overemphasises static welfare effects while ignoring dynamic effects, the dubious value of strict net neutrality rules, and uncertain business cases for 5G (Parcu et al., 2023).

According to the European Commission (2020), the European telecommunication sector has an annual investment shortfall of €65 billion this cumulatively amounts to €250 billion, in order to meet the 2025 interim targets for the European Gigabit Society. While the three largest network operators in the United States, Verizon, AT&T, and T-Mobile, have invested over US$100 billion in 5G, they have no revenue or new business to show for it, and consumers have largely been unconscious of its arrival (Moritz & Golum, 2022).

The South Africa Government led by President Cyril Ramaphosa actively solicited investment pledges from the industry with the promise to work with the business community to unlock some of the regulatory bottlenecks. Pledges were made during the fifth South Africa Investment Conference, in support of President Ramaphosa's initiative to drive investment into South Africa. Telkom, Rain, Vodacom and Cassava Technologies were among the eight companies that pledged to invest a total of about R81billion in global business services, information and communication technology (ICT), and digital services in South Africa (Odendaal, 2023). The telecommunication sector investment has been directed to improve 4G coverage, expanding fibre network, building data centres, and with projects to stabilise the network with reliable energy.

5.1.1 Radio Access Network (RAN)

Decommissioning 2G and 3G and deploying new generation network requires the replanning of radio coverage areas, based on the spectrum used, the geographic area, and the technology used. The new generation networks require the reconstruction of radio and core networks that will support features such as network slicing to support new technologies such as Software Defined Networking, Network Function Visualisation, and Microcells. Deployment of new RAN infrastructure includes the base stations and antennas that provide wireless coverage defined for macro densification and micro cells hyperdense deployments (Grijpink et al., 2018).

5.1.2 Upgrade of backhaul networks

Backhaul networks connect RAN infrastructure to the core network of a mobile operator, where the core network consist of fibre, microwave and sometimes satellite. 4G and 5G networks require high-capacity backhaul networks to support the increased traffic volumes. To enhance transmission, network operators must engage in extensive fibre footprint extension initiatives. To support networks in meeting capacity and latency requirements for 5G, fibre footprint extension is crucial for supporting the deployment of small cells in urban areas (Grijpink et al., 2018).

Deploying backhaul networks for small cells – to support high data rates and low latency – is one of the greatest challenges for operators, mainly due to the lack of adequate fibre networks in many different regions (Taheribakhsh et al., 2020). This, as has been said, has created a new bottleneck in the backhaul, because it requires the backhaul and fronthaul to transfer the heavy traffic of the high-dense cells with capacity constraints.

In the South African context, network operators are consolidating their national footprint in the fibre markets. As 5G assumes centre stage, access to fibre has become crucial; and the entity that manages to establish a significant presence in both the 5G and fibre markets will have at its disposal two of the most crucial elements of the future of telecommunications (Modise, 2022).

5.1.3 Investment in new spectrum and area usage

While South Africa has made some progress in making spectrum available, even if new spectrum is introduced, mobile operators will need to increase their infrastructure investment significantly to overcome certain limitations. For example, high-frequency spectrum provides extra capacity but comes with much greater propagation limitations. In many densely populated urban areas, the MNOs will need to rely on small-cell solutions for two reasons: a higher concentration of traffic, as measured by traffic load per square kilometre; and the use of higher spectrum bands above three gigahertz (Grijpink et al., 2018).

The reconfiguration of 2G and 3G spectrum will provide capacity for 4G and 5G. Given the high penetration of existing 4G, dynamic technology application of spectrum is still required not only to enable the operation of 5G on existing low frequency bands, but also to prevent interference with 4G or 5G services for all end users (Agiwal et al., 2021).

5.2 Customer consideration

Customers must be aware of how the decommissioning of 2G and 3G networks may affect their voice and data services. Customers who are still using 2G or 3G devices must upgrade to 4G or 5G devices to continue using services. Customers may incur additional costs as they prepare to upgrade their devices and services prior to the decommissioning of the 2G and 3G networks. Customers may require assurance that they will have access to alternative networks prior to the decommissioning of 2G and 3G networks. Customers who reside in areas with poor 4G or 5G coverage, where backup 2G and 3G services of an operator are no longer available, may wish to switch to a different mobile provider. Customers who are vulnerable, such as the elderly and those with low incomes, may have difficulty upgrading to new 4G or 5G devices and services. Mobile operators and governments often collaborate to provide vulnerable customers with affordable and readily available 4G and 5G services.

Avoiding customer churn is one of the priorities MNOs will prioritise, particularly when operators do not switch off at the same time (GSMA, 2020). MNOs therefore implement

campaigns to inform their customers of the impending decommissioning of 2G and 3G networks. This provides customers with sufficient time to migrate to 4G or 5G networks. MNOs also consider the need to provide assistance to vulnerable customers, such as the elderly and the disabled, to facilitate their migration to 4G or 5G networks.

Inadequate digital literacy in the use of new 5G services can impede the adoption of 5G and impact operator revenue. The process of accelerating emotional, cognitive, and behavioural responses to the digital environment through education can generate opportunities. In such a case, it could hopefully create new markets for operators offering new services (Taheribakhsh et al., 2020).

53 Countries' socio-economic factors

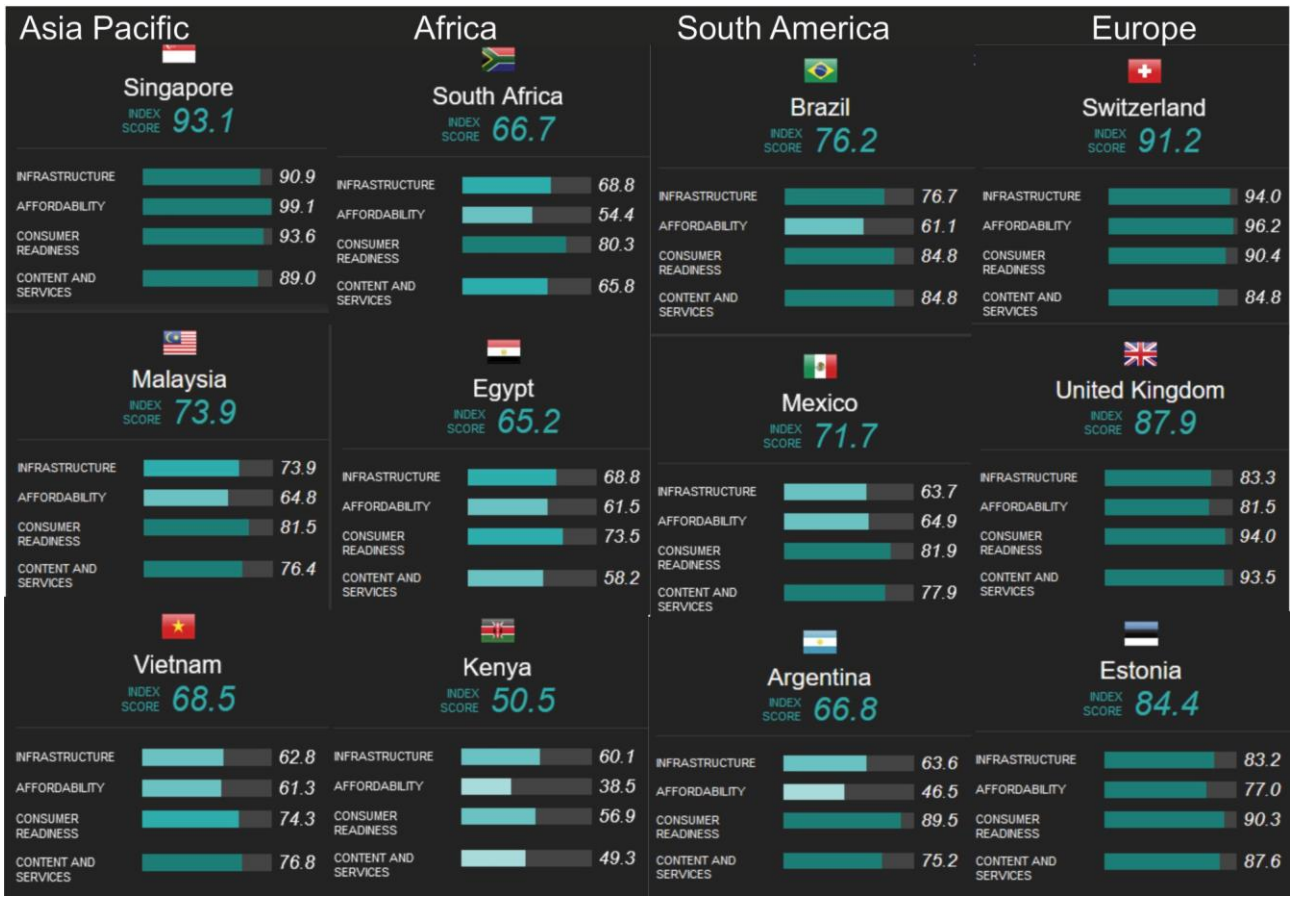
Connectivity varies significantly by socio-economic group and country income level. In low- and middle-income countries (LMICs), 94% of people without internet access live in rural areas. Adults in rural areas are 33% less likely to use mobile internet than those living in urban areas. Women in LMICs are 16% less likely to use mobile internet than men, and progress in reducing the mobile internet gender gap has stalled (GSMA, 2022). Thus, rural and female LMIC residents are less likely to have internet and mobile internet access. This can hinder their access to information, education, and jobs.

According to the GSMA report – The Mobile Economy 2023, in countries such as Zambia, 2G coverage increased from 78% to 98% between 2014 and 2021 and mobile voice access is now almost universal. In the same period, 3G coverage increased from 38% to 82%, while 4G coverage increased from 9% to 69% (GSMA, 2023). Less than 2% of monthly GDP per capita is needed to buy 1GB of data, down from 10% in 2014. Affordable smartphones and smart feature phones like the MTN Ka Toffee or Mobicel S4 Cloud Phone, which costs less than US$20 (as low as circa US$14), have reduced the cost of an entry-level device from more than 50% of monthly GDP per capita in 2016 to less than 20% in 2021 (GSMA, 2023a).

In Western Europe, it is projected that active handsets supporting only 2G, or 2G and 3G, will fall out of use by the end of 2025. 4G and 5G accounted for approximately 98% of mobile data traffic in the region in 2021. In general, 3G network decommissioning is happening before 2G decommissioning, as 2G networks are still needed for a while longer to maintain some legacy voice (and inbound roaming) businesses and M2M devices (GSMA, 2022).

Figure 2 from the 2023 GSMA Mobile Connectivity Index shows the connectivity index scores of Asia Pacific, Africa, South America, and Europe. Infrastructure, Affordability, Consumer Readiness, and Content and Services contribute to a 100-point index. Singapore leads the 2023 global connectivity index with 93.1, South Africa leads in Africa with 66.7, and Brazil has one of the highest indexes in South America, with most countries comparable to South Africa in South America edging ahead. While South Africa has the consumer readiness index of 80.4, the highest unemployment and inequality in South Africa may to some extent explain its low affordability index of 54.4%.

Figure 2 : GSMA Connectivity Index 2023



Source: GSMA, 2023b.

5.4 Not losing coverage

4G and 5G are rapidly becoming the dominant mobile network technologies around the world. In developed markets, 4G is already the coverage layer in most areas, with low-band spectrum providing the foundation and mid-band spectrum delivering additional capacity as 5G networks are rolled out. Developing markets also have a high level of 4G coverage overall, with South Africa leading the trend in the sub-region.

2G and 3G legacy networks are still supporting voice and some M2M devices. The State of the ICT Sector Report in South Africa (ICASA, 2023) indicates 2G and 3G network has 100% coverage in all provinces, while 4G ranges from 93% in rural areas to 99% in urban areas. Given 2G legacy technology to transmit information via voice signal and its low cost in infrastructure setup, most developing countries are still dependent on this legacy network. However, it is expected that the maintenance cost of this aging network infrastructure will increase in future due to a decrease in availability of spare parts and vendors no longer providing support. Eventually the cost per customer for maintaining 2G and 3G networks will be higher than for 4G and 5G networks. This means 2G and 3G will, inevitably, eventually be decommissioned.

5.5 Machine-to-machine (M2M) communications

Over a decade ago, the first M2M devices were sensors and actuators that exchanged data via the internet. The earliest M2M devices are now reaching their end-of-life, with the need to face the first obstacles associated with their eventual decommissioning beginning (Soos et al., 2018). 2G networks are still widely used for M2M communication, but they are becoming increasingly obsolete. The potential risk remains that business customers or large numbers of M2M connections may be left without coverage, if they refuse to migrate[1]. Although the migration from 2G to 5G networks has a significant impact on M2M communication, 4G and 5G networks offer a number of advantages for M2M communication.

The proliferation of the Internet of Things (IoT) also drives the need to migrate M2M communications to 5G networks. IoT is a network of physical objects embedded with sensors, software, and other technologies that enable them to connect and exchange data. 5G networks are essential for IoT because they can support the massive number of devices that will be connected to the IoT and the large volumes of data that will be transmitted (Soos et al., 2018).

[1] The hurdles that 2G/3G M2M customers face in migration may include deep integration of devices, accessibility in remote or challenging locations, plant downtime, end-user convenience and cost implications.

Due to the security risk and resource consumption posed by abandoned M2M devices, studies are being conducted to determine how to decommission them properly. As a result of the IoT boom, it is anticipated that the proportion of abandoned devices in the coming years will be significantly higher than in existing networks (Soos & Varga, 2019). The current study on detecting the presence of abandoned devices and disabling them by the network provider is merely the beginning of a long process. It is crucial to have a standardised method for detecting and dealing with the end-of-life of such devices. The standards for all types of IoT-related radio control technologies should evolve so that operators or other authorities can force zombie devices into radio silence or to ultimately power off.

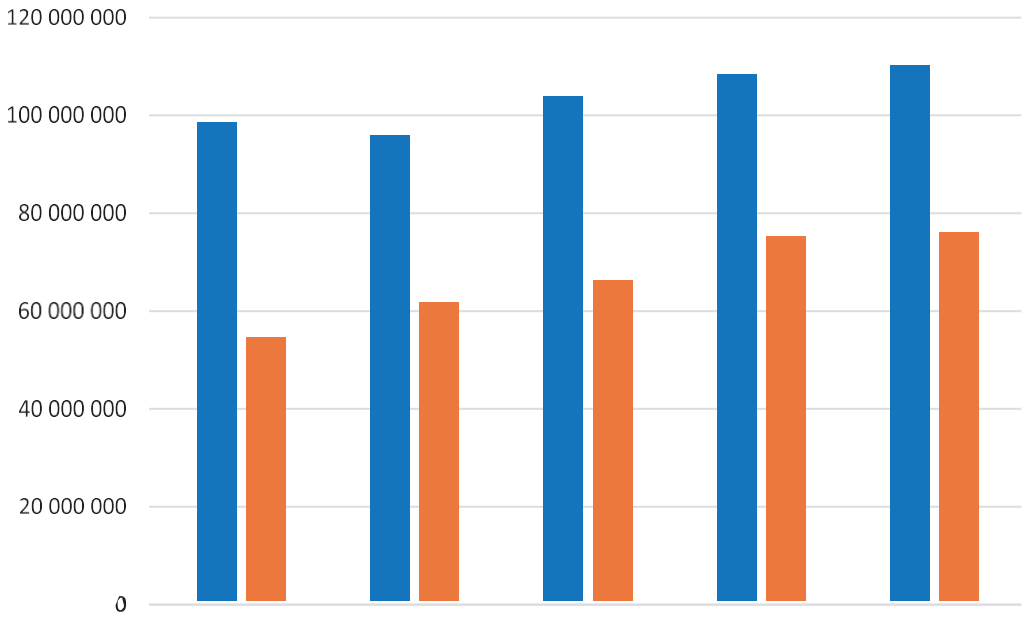
South Africa will need to develop a policy towards e-waste that particularly targets the migration process and collection of 2G and 3G devices.

5.6 Smartphone penetration

Smartphones are capable devices with advanced features such as Wi-Fi connectivity, web browsing capabilities, a high-resolution touchscreen display, and the capacity to use applications. These devices give users access to vital information and services, including healthcare, education, e-commerce, financial services, and income-generating opportunities.

The State of the ICT Sector Report in South Africa (ICASA, 2023), indicates that while mobile phone subscriptions have continued to increase, a significant share of 2G and 3G phones are still being used in South Africa (ICASA, 2024). In South Africa, out of 108 million mobile cellular subscriptions in 2023, 75 million were smartphone subscriptions, accounting for 70% of mobile cellular subscriptions (see Figure 3). The remaining 30% consisted of a combination of 2G and 3G devices, as well as some non-smartphones operating on 4G. According to high level market research, there are between 10 and 20 million active 2G and 3G users . M2M continued to expand as industries adopted LTE-devices with Internet of Things capability for higher throughput requirements; however, ACT data analysis indicates that industries continue to use a substantial number of 2G and 3G M2M devices that still need to be upgraded.

Figure 3: Mobile Cellular and Smartphone Subscriptions in South Africa



	2019	2020	2021	2022	2023
Mobile cellular subsciptions	96 972 459	94 952 509	103 167 525	106 800 158	108 700 620
Smartphone subsciptions	53 380 748	60 438 901	65 313 134	73 883 537	74 977 556

Source: ICASA, 2023.

Device accessibility and affordability is still a barrier in 4G subscription, while 2G and 3G only devices are more affordable than 4G smartphones devices. Hence such 2G and 3G services are still widely used in South Africa. The World Wide Web Foundation Affordability Report 2021, indicates that while ICTs have enjoyed political popularity as a means for governments to pursue their dreams and envision a better future, the reality is that millions of people around the world cannot afford data and devices (Alliance for Affordable Internet, 2021).

The South African access to smartphones is hampered by affordability, which is exacerbated by South Africa's triple scourge of unemployment, poverty, and inequality. Consequently, the unconnected are disproportionately poorer, less educated, female, disabled, and living in rural areas. South Africans can connect to, and participate in, the digital economy by enabling affordable access and reliable digital infrastructure. Access to the internet is a prerequisite for digital transformations, and ACT believes that this must be accompanied by interventions that remove the obstacles preventing South Africa from achieving universal digital inclusion, so that all South Africans have access to economic opportunities in the digital economy.

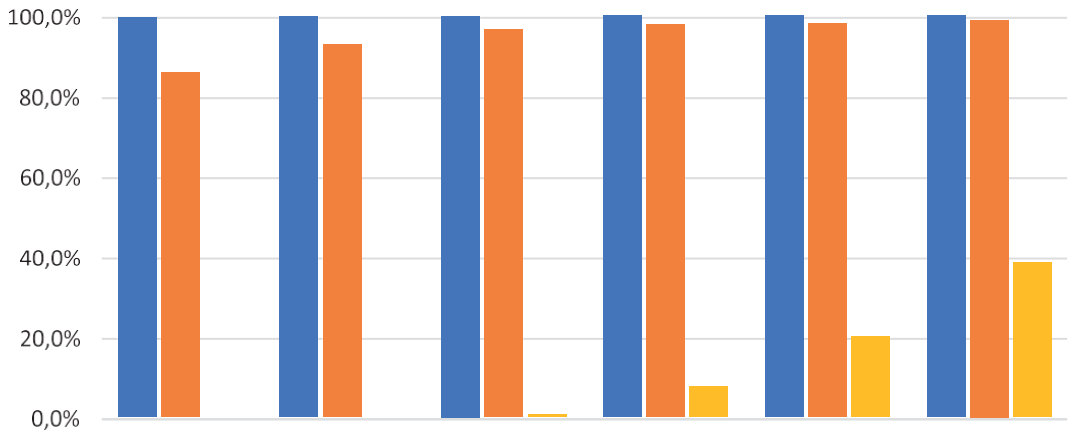
The GSMA Mobile Connectivity Index 2023 score South Africa affordability at 54.4 and readiness index at 80.4, respectively. The State of the ICT Sector Report in South Africa (ICASA, 2023) indicates that by 2021 mobile phone subscriptions were 103 million and smartphone subscriptions 65 million. The report also indicates that there are still 9.3 million M2M devices in the field. The device subscription numbers indicate that the cost of devices is the main factor that has prevented the transition to smart devices. This has left most communities lagging in benefitting from using smart devices with features using advanced data intensive services, which include government online services.

6 South Africa current network coverage and usage

While South Africa is leading in coverage in the Southern African Development Community (SADC) region for quality and network coverage, the digital divide persists with regards to universal access and connectivity. Some of the funds set aside by the government have not done enough to close the digital divide and build an inclusive, strong digital economy. As governments consider constructing the foundation of their digital economy, investment in USAFs to promote inclusive innovation in the sector has been a critical factor. In the past decade, there are some examples of USAFs and public access projects that have proven to be an instrumental policy tool for achieving greater access, provided it is appropriately planned and executed. In turn, given the significance of affordable and universal access as a solid foundation for an inclusive and scalable digital economy, rethinking USAFs becomes critical to effect the investment projects funding gap (Alliance for Affordable Internet, 2021).

Figure 4 compares 3G, 4G, and 5G population coverage nationwide. The indicators show that 3G has 100% national population coverage, 4G/LTE 98%, and 5G 38%.

Figure 4: National Population Coverage



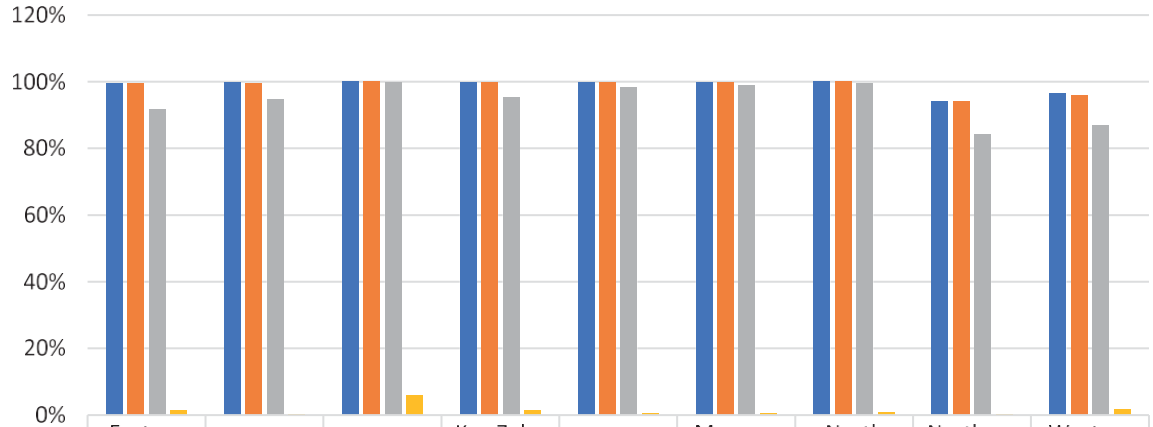
	2018	2019	2020	2021	2022	2023
3G Population Coverage	99,5%	99,7%	99,8%	99,9%	100,0%	100,0%
4G Population Coverage	85,7%	92,8%	96,4%	97,7%	98,0%	98,8%
5G Population Coverage			0,7%	7,5%	20,0%	38,4%

Source: ICASA, 2023.

The State of the ICT Sector Report in South Africa (ICASA, 2023) indicates 2G and 3G network has 100% coverage in all provinces, while 4G ranges from 93% in rural areas to 99% in urban areas. Most 5G coverage has begun in cities or metros in South Africa. The rural areas have been challenging to cover due to the coverage for the population being dispersed, and also due to the demand of services. Figure 5 shows that for 2G, 3G and 4G/LTE, all provinces stood above 84% coverage in 2022. 5G coverage in Free State, Limpopo, Mpumalanga, and Northern Cape provinces stood at 0%.

South Africa's market-led approach to legacy network shutdowns will be influenced by factors like declining 2G and 3G device and network equipment support, declining user experience on content optimised for 4G and 5G networks, and roaming issues in countries without 2G and 3G networks or roamers that only have 2G/3G devices.

Figure 5: Rural Population Covered by Province in 2022



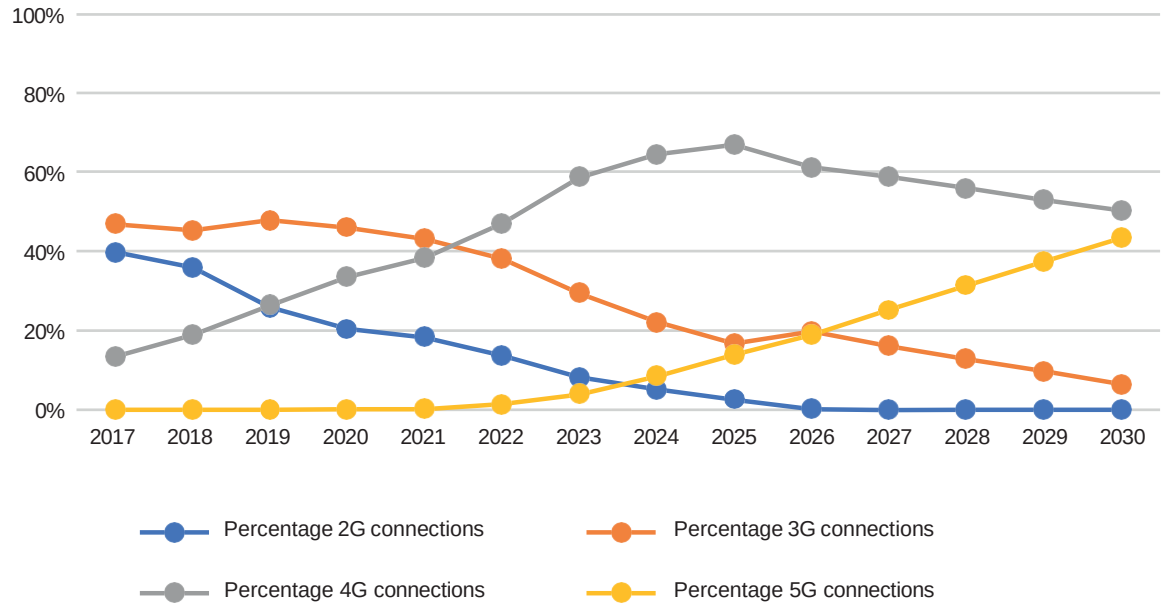
	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Limpopo	Mpuma-langa	North West	Northern Cape	Western Cape
2G	100%	100%	100%	100%	100%	100%	100%	94%	96%
3G	100%	100%	100%	100%	100%	100%	100%	94%	96%
4G/LTE	92%	95%	100%	95%	98%	99%	100%	84%	87%
5G	1%	0%	6%	1%	0%	0%	1%	0%	2%

Source: ICASA, 2023.

While there is a trend of significant decline in legacy network connections, the GSMA connection projection model indicates that 2G and 3G network connections will remain the key means of connectivity for a portion of total connections that cannot be ignored (see Figure 6).

The GSMA forecast indicates that a significant number of end-users are likely to rely on 2G and/or 3G connectivity beyond the stipulated timeframes in the Spectrum Policy. One mechanism to address the migration away from 2G and 3G connections is to rely on the market, allowing end-users to effectively determine when 2G and 3G networks are to be switched off. In this situation, operators have an incentive to introduce packages that include affordable smartphones (although subsidies may still be required to address those end-users who fall within Universal Service/within specified affordability bands – similar to that of the Broadcasting Digital Migration policy). Another alternative, in line with the existing timelines in the Spectrum Policy, involves the rapid roll-out of 4G capable smartphones as well as Digital Literacy programmes. Such an initiative would require significant coordination within Government, including the provision of funds for handset subsidies.

Figure 6: South Africa Connection Projections
(excluding licensed cellular IoT)



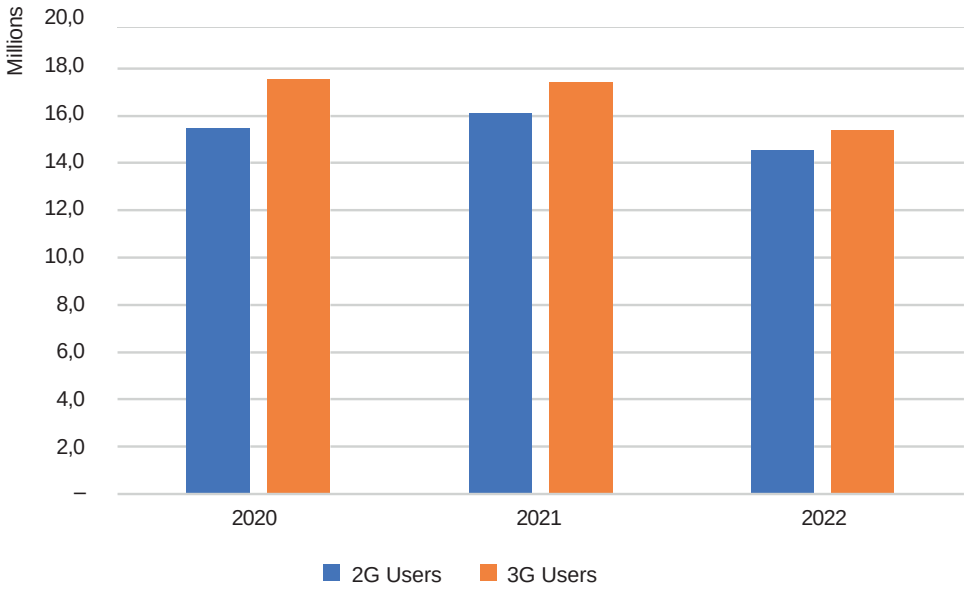
Source: GSMA Intelligence.

7 ACT research on 2G and 3G network usage

To identify patterns of the proliferation of 2G and 3G devices still in circulation in the network, ACT conducted research on the usage of 2G and 3G among its members. The constraint of that data collection was the inability to distinguish M2M data from data from mobile phones or 3G routers. A questionnaire was sent to members as the collection method. The information was categorised as follows: the total number of active users; the duration of usage in minutes annually; the total number of active users assigned to a year period; and demographics expressed as percentages of provinces. The number of users does not necessarily indicate the number of 2G devices or 3G devices in the population but merely the users connected in the 2G and 3G network.

Figure 7 shows the number of 2G and 3G users in the network from 2020 to 2022. The data indicates a 9% decrease from 2021 to 2022 of 2G users while 3G users decreased by 11.5% in the same period.

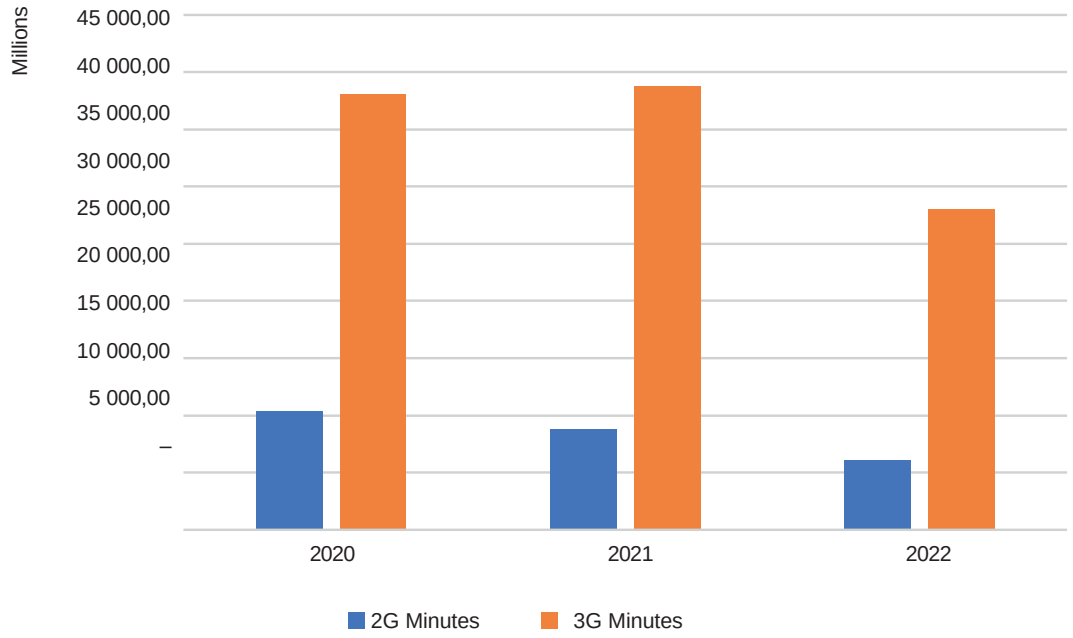
Figure 7: 2G and 3G Users



Source: ACT membership

Figure 8 shows usage of 2G and 3G in the number of minutes spent in the network. The data indicates that 2G voice usage compared to 3G usage in the network was 78% less in 2022, 77% less in 2021 and 72% less in 2020. The average usage continues to decrease.

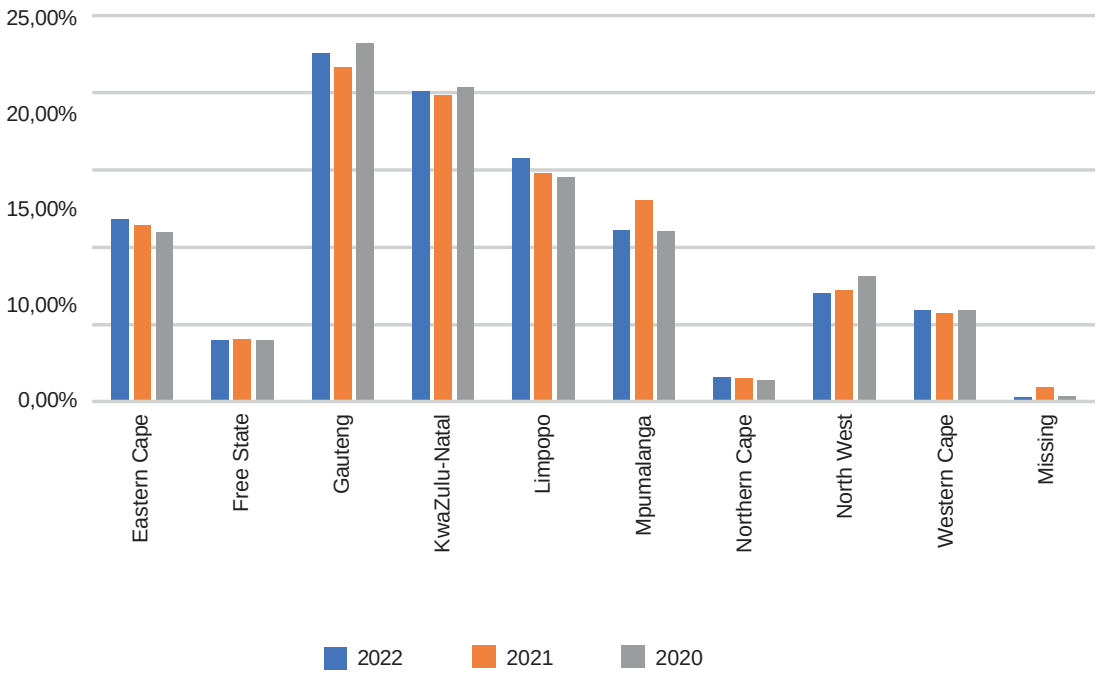
Figure 8: 2G and 3G Minutes Spend



Source: ACT membership

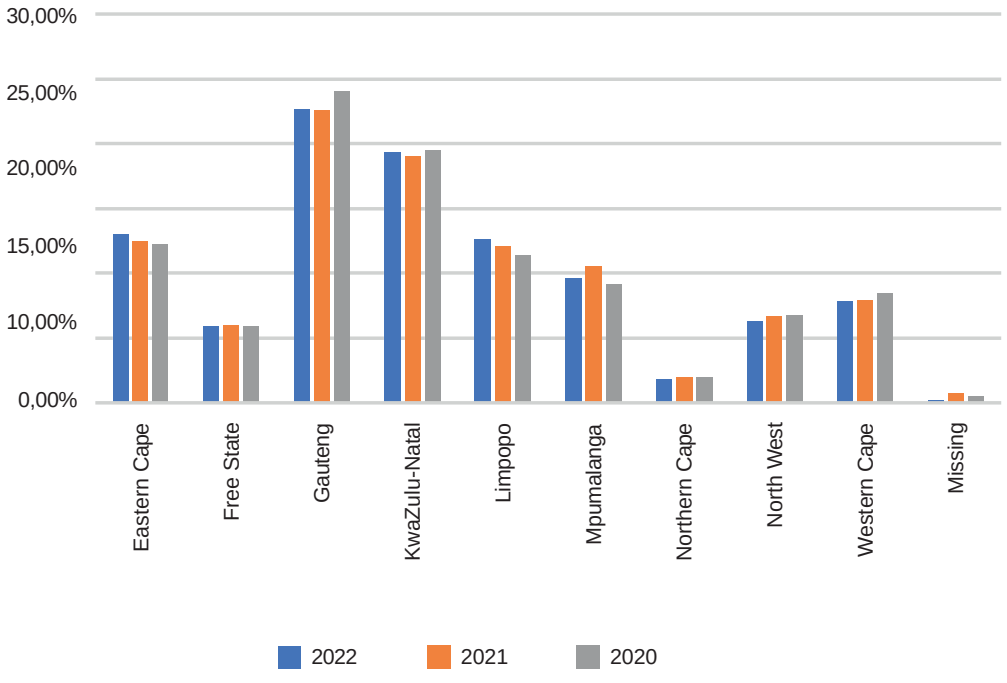
Figures 9 and 10 show the distribution of users by province, with Gauteng showing the highest number of 2G and 3G network users, followed by Kwazulu-Natal, Limpopo, Eastern Cape and Mpumalanga. Northern Cape has the lowest number of users.

Figure 9: 2G Users per Province



Source: ACT membership

Figure 10: 3G Users per Province



Source: ACT membership

8 Trends, case studies and stakeholder survey

The sunsetting of 2G and 3G is not unique to the MNOs but common in other sectors where discontinuation of technology and new products or services are introduced. Change management is essential for the successful journey of a society through digital transformation. It is essential to analyse what precedes technology diffusion so that when the use of technology or technology activation occurs, external, non-user-related factors that enable or impede a value proposition based on the new technology can be identified (Ghezzi et al., 2013).

Appendix A depicts countries that have successfully transitioned and have scheduled to shutdown 2G and 3G networks. Countries are planning their 2G and 3G sunset following their countries customer assessments; Asia, Oceania and North America are first decommissioning 2G while Europe is starting first with 3G. In some instances, APAC (Asia-Pacific region) countries are also doing 2G partial shutdowns (GSMA, 2021).

The Malaysia and Singapore case studies (GSMA, 2021) have elements that are consistent with the PEST (Political, Economic, Social and Technological) framework that can be applied as lessons learned. The PEST is a framework for scanning the business environment, which identifies factors that could influence the external market, and then categorises these factors into four clusters, namely political, economic, social and technological.

The political factors are legislation, taxes, political factors, and regulations that play a key role in the successful shutdown of 2G and 3G. Political factors are demonstrated by governments around the world providing financial and other support for the deployment of 5G networks to accelerate the migration from 2G and 3G to 5G. Governments around the world are playing a key role in the rollout of 5G networks. Governments are responsible for allocating spectrum to mobile operators and developing policies to promote 5G deployment.

Economic factors such as economic growth, affordability index, state of employment, inflation and interest rates are critical factors in transforming the consumption patterns of society. Statistics South Africa reported that the South African economy grew 0.6% in Q2 2023, after a 0.4% expansion in Q1 and better than the Q2 market expectation of 0.1%, due to easing rolling blackouts while at the time unemployment stood at 32.9% (Stats SA, 2023). Consequently, in the case of adoption of the latest smartphones and usage of digital services, even though the cost of entry-level smartphones and services has been declining in recent years, and the rate of economic growth to support adoption is still disappointing. 5G promises

to enable new applications and services that will increase economic growth and productivity. Migration to 5G is also still expensive, however, South African MNOs are making significant investments into new generation infrastructure expansion.

Social factor considerations for South Africa are factors such as population demographic, income distribution, and digital literacy education. Society outreach programmes will be crucial for the success of 2G and 3G migration. These need to find ways to bridge the digital divide, and aimed at the entire population, including supporting the elderly, providing subsidies to the low-income population, and making digital literacy of services available. The full exploitation of 4G and 5G services in society can only be realised when most of the population is included. The large-scale rollout of 5G means increasing accessibility of mobile broadband access, which will result in a more interconnected society.

Critical to the success of 2G and 3G migration will be consumer awareness campaigns on changing preferences in favour of smartphone digital services. Further research and development is required to support innovation and management of obsolescence, e.g. the management of an increase in electronic waste. Moreover, further to 2G and 3G networks becoming obsolete and incapable of providing performance and capacity, they are also vulnerable to cyber attacks.

8.1 Case 1: The Malaysia study case on 3G sunsetting under Jalinan Digital Negara (JENDELA) Program

In preparing Malaysia for a steady transition to 5G technology, the Government of Malaysia launched Jalinan Digital Negara (JENDELA). One of the initiatives under JENDELA is the 3G Network Sunset project, with the aim of switching off the 3G network at the end of 2021. For a successful 3G Network Sunset, voice calls need to be migrated from Circuit Switch (CS) to Packet Switch (PS) using Voice Over LTE (VoLTE) or 4G services because the 2G network will not be able to support the voice calls traffic over CS after the 3G switch-off, due to the limited bandwidth. The low penetration of VoLTE provisioned devices in the market, and the tedious and costly VoLTE provisioning process, was identified as an obstacle to the success of the 3G Network Sunset initiative.

As part of the Government's JENDELA initiative, the Prime Minister, Tan Sri Muhyiddin Yassin, announced the 3G Network Sunset project on 30 August 2020. Consequently, the Government supported the 3G Network Sunset project in its entirety, and the Malaysian Communications and Multimedia Commission (MCMC) was tasked with overseeing the project and ensuring its success. Government support was: the support of all stakeholders enabling and advancing the rollout of 5G services and satellite connectivity to address connectivity challenges in rural and remote areas; standardisation of electricity tariff for communications services based on industrial rates; and zero/lower-interest loans for infrastructure in rural/remote areas; ensuring building can accommodate digital infrastructures; and blanket approval from the State Governments and Local Authorities to expedite the infrastructure rollout.

To ensure project success, MCMC, MNOs, and MNFs (device manufacturers) collaborated to improve the VoTLE provisioning framework. All MNOs had VoLTE agreements with Apple, Huawei, Oppo, and Xiaomi. Realme, Asus, One Plus. Other smaller smartphone brands do not have a presence in Malaysia, so MNOs had trouble providing VoLTE to them. Contributing factors to integrate smaller brands is that the smaller brands appoint an agent in Malaysia, and these agents cannot decide on the VoLTE provisioning arrangement between the MNOs and the smaller brands owners. The smaller brands may have some reservations to enable VoLTE in their 4G smartphones because the current process is tedious and costly for the MNFs.

Identified challenges: As the project is an initiative of the government, it is heavily influenced by political factors. Political instability has a significant impact on the project, and if the government were to change, the project could be scrapped. However, there are numerous benefits to decommissioning the 3G network, and all stakeholders are fully behind the initiative.

Lessons for South Africa: The Regulator, Government, and the network operators working on common plan and process; bringing on-board device manufactures as key stakeholders; promoting and supporting innovation in the local context; and political instability affecting long-term project success.

Source: Azhar, 2022; MCMC, 2022

8.2 Case 2: 2G Sunsetting in Singapore

Singapore discontinued 2G in 2018, and its 3G and 4G mobile networks cover 100% of the population as of June 2019 with a penetration rate of 154% and an annual decrease of 16.5% in 3G subscribers. The Info-communications Media Development Authority (IMDA) is responsible for spectrum allocation, management, and monitoring in the telecommunications sector in Singapore. There are now more than 10 companies providing mobile services, including MNOs and Mobile Virtual Network Operators. Mobile broadband traffic density (per urban km2) in Singapore is one of the highest in the world, indicating high customer and networking infrastructure density. Mobile revenues are falling due to fierce market competition. Reasons for 2G shutdown were 2G expiring on 31 March 2017, declining demand, and uptake of 3G/4G devices. In Singapore, spectrum is not technology neutral therefore IMDA must approve the technology use and specify new conditions. The IMDA approved the shutdown of 2G due to rapid migration of consumers to 3G and 4G technologies – 2G subscriptions declined steadily from over two million in 2011 to about 250 000 subscribers in 2015; widespread coverage of 3G/4G; obsolescence of some 2G network components; international trends to close down 2G: and the fact that many 2G subscribers were unaware of the technology being used for their mobile services. Further to the process the shutdown of 3G was left to the network operators.

In the facilitation, MNOs held media campaigns and roadshows to help migrants. MNOs announced the changes on their websites and shops, while IMDA reached consumers through Members of Parliament and roadshows. Marketing campaigns to inform consumers offered a range of plans to encourage subscribers to sign up with new devices. The switch-off was co-ordinated among MNOs. The three operators agreed to switch off simultaneously, preventing any one operator from taking advantage. International roaming partners were informed of the switch-off plans with 3G handsets available to rent in airports.

IMDA partnered with the MNOs to ensure that a range of handsets was available to meet various customer needs, from basic models costing below S$50 to feature-rich smartphones. Handsets with features similar to 2G phones were also available; and support for senior users – IMDA and MNOs partnered with community groups to reach out to seniors for providing support for the upcoming 2G switch-off. Also, IT learning hubs offered courses.

Identified challenges: MNOs found that handset stores were still selling 2G handsets at discounted prices. IMDA deregistered 2G-only mobile devices for sale for use in Singapore from 1 January 2017, and retailers were not allowed to sell 2G devices. M2M challenges were who should bear the migration cost.

Lessons for South Africa: The Singapore Authority was constructively involved to make the migration a success. The Authority and MNOs ensured a range of affordable handsets were available to meet various needs. Community support for the elderly and digital skills were made available.

Source: GSMA, 2020

8.3 ACT stakeholder consultation and outcomes

On 18 October 2022, ACT hosted a round table dialogue with ACT members, original equipment manufacturers (OEMs), civil society, and the Regulator, under the theme: The role of the Government and private sector in the successful decommissioning of 2G and 3G networks.

There is a common view among network operators that 2G and 3G needs to be phased out, given that it is neither cost nor spectrum efficient for network operators to run parallel networks.

The preliminary dates provided in the Next Generation Spectrum Policy for the sunset of 2G and 3G are aggressive and not supported by an articulated plan that is informed by the reality on the ground. It will therefore not be feasible to implement these without an evidence-based intervention that will migrate M2M users and 2G phone subscribers to the latest 4G and 5G network. Furthermore, ACT considers 2G as having a long tail to sunset compared to 3G, which is contrary to the set timelines requiring 2G to be shutdown first.

Network operators will not be able to switch off 2G and 3G networks while millions of subscribers are still using them and depend largely on these legacy networks for connectivity. Moreover, network operators are unwilling to rapidly switch-off legacy networks at the expense of the 2G and 3G subscribers' rights to connectivity.

ACT members are of the view that the sunset of 2G and 3G should be mostly market-led, while enforcing the migration requires a collaborative strategy following a step-by-step approach, which is measured and eventually the success of the strategy must inform the sunset dates.

The first step identified is to deal with the importing of 2G and 3G devices. Government will need to ban all imports of these devices and the Regulator should not authorise any new type approvals of these devices.

The second step is to revisit tax policy in terms of premium taxation and VAT on smartphones. This is to ensure that smart devices using 4G and 5G are no longer taxed as luxury items. Instead, the government should consider incentivising 4G/5G smartphone devices, which will in turn promote interconnectivity and the migration from 2G devices.

The introduction of 5G has previously resulted in hysteria, the spread of fake news, and a distrust of new technologies. A well-thought-out plan of action with progressively realisable timelines can avert this.

Civil society raised a particular public interest concern about the affordability of the devices, highlighting a specific need for consumers to be adequately consulted and capacitated, which includes a cross-functionality and inter-governmental approach for addressing issues of unemployment.

Similarly, a representative of Transnet was also brought into the discussion. The representative highlighted that consideration needs to be given to utilities with a large M2M installed base, as forced migration of these applications will require a massive infrastructure upgrade which will interrupt services and have a significant cost.

Industry noted that the migration from 2G and 3G can occur naturally if mechanisms and plans are put into place, such as effective communication that is easily digestible and puts forward a value proposition to consumers and the public at large on the benefits of 4G and 5G.

Further steps should be determined through consultation among the industry players and the Regulator, which will consider interventions such as, but not limited to, digital literacy for consumers still using 2G and 3G devices; awareness campaigns; phased retail regulations for selling of legacy devices; and increasing the lifespan of 4G devices such as fixing devices.

ACT recommends that the Minister (Communications and Digital Technologies) conducts public consultations with all stakeholders that will pave a feasible roadmap for the shutdown of 2G and 3G networks, which in the main should be industry-led.

ACT further recommends a government-enabled but industry-led approach to the migration, with a reasonable and realisable date of migration being set. Operators can commit to putting into place structures and action plans that are within their strategy but more so in pursuit of South Africa's National Development Plan and the Sustainable Development Goals, which are rooted in the principle of "leaving no-one behind".

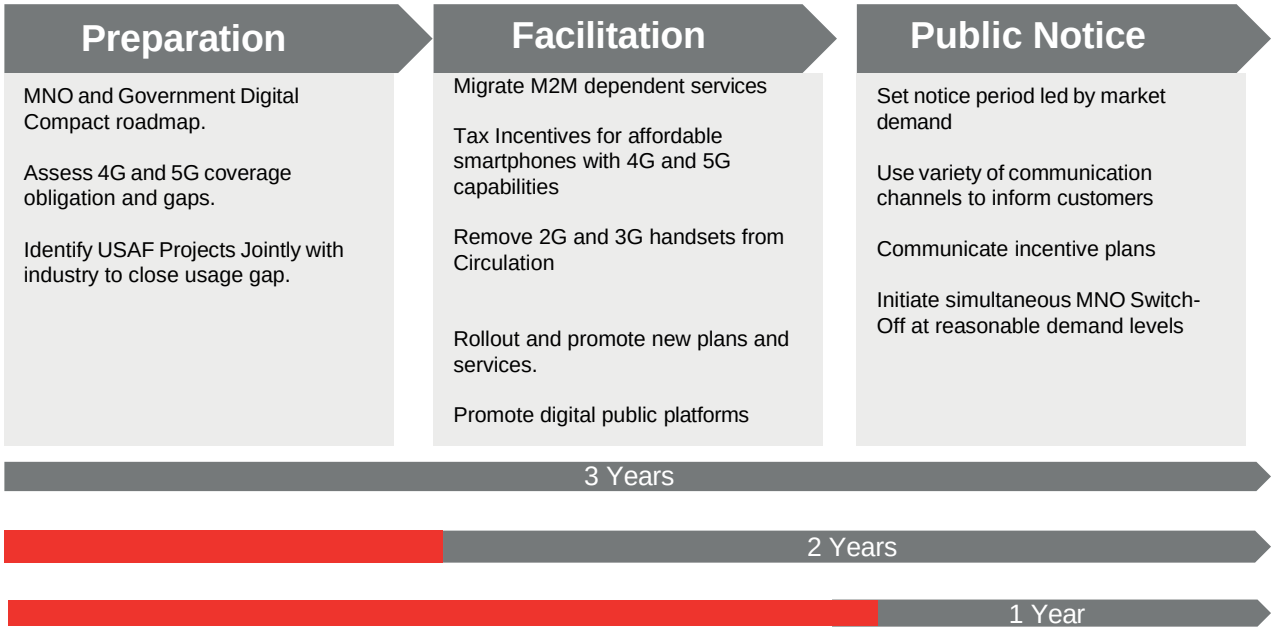
9 ACT-proposed process framework for a 2G and 3G sunsetting roadmap in South Africa

While ACT members are of the view that the sunset of 2G and 3G should be mostly market-led, enforcing the migration requires a collaborative strategy that follows a measured, step-by-step approach. The success of the strategy must ultimately inform the sunset dates. The slow transition from 2G to 3G services in South Africa, relative to developed nations, has been attributed, in part, to the slow adoption of newer devices, which is primarily driven by the market's inability to afford them due to the country's poor economic conditions.

Figure 11 depicts a framework proposed by ACT for the successful migration of 2G and 3G in South Africa. The phases necessary are preparation phase, facilitation phase, and public notice. The entire process proposed would take over three years. The South African economic condition has some unique challengers in the lower Living Standards Measure (LSM) user demographic that requires co-ordination with government agencies. All parties involved must be aware of the length of time it will take for consumers to switch to a new generation network, given the size of the customer base currently using 2G and 3G networks in South Africa. Failure to do so would probably have a significant negative reputational impact on both industry and government.

Delays in access to land for the deployment of new sites for 4G and 5G networks will delay any phase-out plans. It is crucial that municipalities and other government landowners are included in this stakeholder-driven process.

Figure 11: ACT Proposed Roadmap to 2G and 3G Sunset



Source: ACT

9.1 Preparations

Preparation is the necessary step to ensure all challenges and requirements are properly dealt with in the planning phase. Due to the high rate of legal challenges to processes in the South African industry, preparation is also required to prevent legal challenges from public interest groups. Three elements are identified in the preparation phase: first is the MNO and Government Digital Compact Roadmap; second is assessing 4G and 5G coverage obligations and gaps; and the third is to identify USAF projects jointly with industry to close the usage gap.

9.1.1 MNO and Government Digital Compact Roadmap

The South African government has initiated a number of interventions to accelerate South Africa's participation in the digital economy, however, these interventions require collaboration across all government departments. The government has drafted a number of policies, including the Presidential Commission on the Fourth Industrial Revolution PC4IR Report (2020), Digital Economy Master Plan (2020), and Draft National Data and Cloud Policy (2021), which were based on the emergence of new digital ecosystems and markets. Given that the sector is a catalyst in many sectors that will use technology to create new products and markets, a digital compact between MNOs and the government is necessary to provide certainty in the implementation of government digital transformation programmes. This compact will also enhance the digital economy.

Regulators and governments should help to encourage operators to modernise their network, however, the cost of transition requires a collaborative effort. They need to jointly undertake measures to assist the consumer with the transition to newer technologies. Public awareness, marketing and communication campaigns with all stakeholders involved are needed.

South African operators and regulators need to be mindful of the suppressed economic situation and timing of the transition for subscribers to adopt new services offered by the latest network. South Africa has learned a lot of lessons from the broadcasting digital migration which can be reviewed to better develop a practical model for South Africa migration from 2G and 3G services.

9.1.2 4G and 5G coverage

Digital exclusion has mostly affected poor communities, which are mainly in rural areas. The State of the ICT Sector Report in South Africa (ICASA, 2023) indicates that 4G is 99% to 100% available in urban areas while rural areas are still 100% covered by 2G and 3G network.

Not moving these consumers to newer networks and smart devices, risks digital exclusion. Both Government and the MNOs must balance the introduction of newer technologies and the reality that rural communities must not be left behind. Operators and government-led decommissioning need to identify and address the root cause for the reliance on these legacy networks. Therefore, the decommissioning of 2G and 3G networks should consider principles of fairness, reasonableness, responsiveness, courtesy, care and disclosure. Before turning off 2G and 3G to allow the new generation network technology to cover throughout the customer base, operators should reach a substantial level of 4G or 5G penetration.

9.1.3 Identifying USAF projects

Programmes that support universal access to connectivity use USAFs, which are underutilised in most countries. Such USAFs could be used more efficiently and targeted to lower device prices, especially for those least likely to use the internet. African women are included. In last-mile access initiatives, USAFs can be used to subsidise device costs for underserved groups like women, people with disability, and the elderly. Partnering with mobile network operators, other internet service providers, and community networks is possible. Through universal service and access funds, governments should consider mobile device subsidies (USAF).

9.2 Facilitation

The GSMA 2G and 3G sunset guidelines list three major challenges, namely regulation, devices and network. Regulatory support and intervention is critical to ensure emergency services depending on 2G services are smoothly migrated. Five elements have been identified as necessary to create the conducive environment for a 2G and 3G shutdown: remove 2G handsets from circulation; migrate M2M dependent services; introduce tax incentives for affordable smartphones with 4G and 5G capabilities; roll out and promote new plans and services; and promote digital public platforms.

Device issues require educating the public and the promotion of entry-level smartphones; and also, the migration of 2G and 3G M2M to 4G MIOT (Machine Internet of Things). The evaluation of the network usage at the time is a critical element to consider for the decision criteria, such as the number of 2G and 3G network towers still in service, revenue, user, expenditure and 4G network readiness. Uncoordinated and poorly understood network use patterns risk losing subscribers that only use legacy 2G and 3G networks. The untimely shutdown of 2G and 3G networks will lock out communities from accessing these essential services, specifically voice services and emergency services used by M2M devices.

9.2.1 Remove 2G and 3G devices from circulation

The first step identified is to deal with the importation of 2G and 3G devices. Government will need to ban all importation of these devices and the regulator should not authorise any new approvals of these devices. The sale of 2G handsets must be discontinued, potentially prior to any public announcement, to facilitate migration to smartphones. The authority to stop type approval of 2G and 3G can be initiated at an earlier phase.

9.2.2 Migrate M2M dependent services

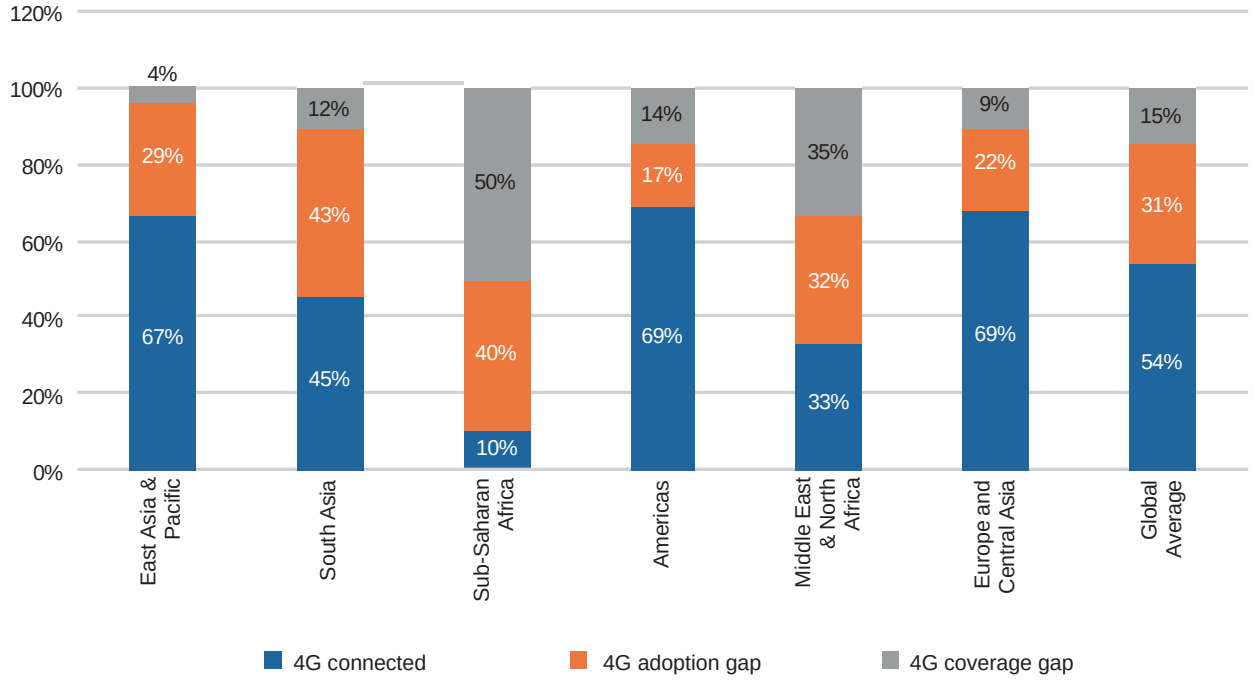
Migration of long-lived M2M services is a major obstacle to switching off. Security, vehicle telematics, asset tracking, and point-of-sale (POS) terminals are South African M2M prevalent use cases. M2M may need individual attention and communication due to MNO-business customer long-term contracts. While mobile industry players have an important role in facilitating the migration to 4G (and later) devices, partnerships across the entire ecosystem can accelerate the transition and, as a result, promote digital inclusion. Subsidised replacement at scale of M2M/IoT device consumers that rely on 2G/3G devices. In addition, special consideration must be given to 2G/3G-enabled critical services such as security services, emergency services, logistics, and POS systems. Such services are likely to necessitate special consideration for timely transfer prior to the decommissioning of legacy networks. In this context, it is possible that further government help will be required.

9.2.3 Tax incentives for affordable smartphones with 4G and 5G capabilities

The Broadband Commission (2022) has found that the lack of affordable devices, such as smartphones, are a key constraint to broadband take-up, particularly in low and middle- income countries (see the 4G adoption gap in Figure 12). The 2022 report recommends two interventions to address device affordability: device subsidies and the reuse of preowned devices.

Subsidies to lower the retail cost of smartphones can be provided by MNOs, governments, handset manufacturers, and third-party financers. Partnerships with device manufacturers, MNOs, governments and resellers can also identify opportunities for costs savings across the supply chain and therefore deliver more affordable devices to end-users, with the end impact of facilitating broader mobile Internet access.

Figure 12: 4G connectedness, adoption gap, and coverage gap by region, 2019



Souce: Broadband Commission, 2022

The ACT, through its own consultation with civil society, has found that device affordability is a key barrier to the adoption of smartphones. Indeed, Stats SA (2024) reports that over 72% of South African households used smartphones to access the Internet in 2023. (Stats SA, 2024), compared to less than 15% of homes having access via a fixed line. Access to an affordable smartphone device is therefore critical to resolve the existing digital divide in South Africa.

South Africa could immediately reduce the cost of smartphones (and other devices) by reviewing the taxation regime. Currently, imported smartphones incur an ad valorem 9% luxury tax, a customs duty of 7% and Value Added Tax of 15%. In practice, a smartphone that arrives at a South Africa port for a price of R10 000 immediately incurs taxes of over R2000, or more than 20% of the value of the device.

The removal of the luxury tax and the customs duty represent the first step towards a more affordable device ecosystem. A second step would include the design of smartphone subsidies that are attached to digital literacy programmes, and a third step could include the recycling of existing phones to remove them from the device ecosystem as well as the collection of older, but still functional, 4G and 5G capable devices for refurbishment and redistribution. A critical success factor would be collaboration with manufacturers to source more affordable components for 4G devices that make them a better long-term investment than older phones.

9.2.4 Rollout and promote new plans and services

Rollout of plans and services may consist of providing assistance with:

- Recycling handsets to remove them from the environment,
- Introducing the availability of inexpensive smartphones and/or handset subsidies,
- Ensuring that a variety of handsets are available to meet the diverse needs of customers, from basic models to feature-rich smartphones, and providing handsets with similar functionality to 2G phones, and
- Providing support for senior users – partnerships with community organisations to reach out to seniors to provide support for the upcoming shutdown.

9.2.5 Promote digital public platforms

The main source of access to digital platforms has been access to smart devices that are capable of running on these platforms. However, in South Africa these devices are still not affordable compared to other countries. Smartphones are one of South Africa's leading electronic imports. According to Genesis Analytics et al (2019), the digital economy not only provides opportunities in the tradable sector, but also generates a significant number of new jobs and incomes in the domestic economy. Many of these positions require relatively low skills. The rise of digital platforms is the main driver, digital platforms are rewiring national economic sectors in their entirety.

Despite the prominence of global platforms like Uber, Airbnb, and Amazon, more than 90 digital platforms are active in South Africa's real economy.

Integrating e-gov into smartphone platforms specifically for people in remote areas where government services are not easily accessible is an additional possibility. It is crucial that there is good communication between the public and the government for the successful implementation of e-government strategies. According to research, technology is becoming more and more important, and e-government initiatives offer fresh chances to potentially empower citizens, review methods of communication between the government and the public, boost citizen participation, and improve the efficiency of public service delivery. Recognising the challenges presented by digital government and coming to the aid of both citizens and the government to improve service delivery is the best course of action (Jakoet-Salie, 2020). South Africans can have the ability to connect to digital platforms and participate in the digital economy by enabling affordable access and reliable digital infrastructure. Access to the internet is a prerequisite for digital transformations, and this could be accompanied by

interventions that remove the obstacles preventing South Africa from achieving universal digital inclusion, so that all South Africans have access to economic opportunities in the digital economy.

9.3 Public notice

Public announcements of switch-off vary, based on market conditions such as demand level and rate of adoption of newer technology. Long enough transition periods are required to allow for the optimisation of the succeeding mobile technology. Fair-trading rules and/or other legal obligations towards customers must be considered if the notice period is too short. The South African broadcasting digital migration lessons learned can be used to determine the public notification period and the communication channels to use.

9.3.1 Set notice period led by market demand targets

Setting a reasonable period to switch-off is critical for business and the public to make plans towards ordering and acquiring new devices and choosing suitable services and plans for their ideal application. Monitoring of usage will be crucial, to ensure that usage is transparent, and the effect of interventions are reducing the number of devices in the network. Setting a long transition period is essential to allow higher smartphone penetration and for customers to embrace new services. In other cases, a longer formal notice period was less pressing, as smartphone penetration was already high. Nevertheless, the company began preparing for the switch-off about three years prior to the public announcement.

9.3.2 Use variety of communication channels to inform customers

It is important to use a variety of communication channels to reach as many customers as possible. The government and MNOs should also target their communication messages to specific customer groups. For example, they may need to develop different messages for customers who are using 2G services and customers who are using 3G services. MNOs can also inform customers about the switch-off through their customer service centres and retail stores. Customer service representatives and retail staff can be trained to answer customer questions about the switch-off and to help them upgrade to newer devices. Other mediums can be, but not limited to, radio, television and print media including magazines.

Direct contact such as SMS is an effective way to reach customers with important information. The government and MNOs can send SMS messages to all customers who are still using 2G or 3G services, informing them of the switch-off date and advising them to

upgrade to a newer device if necessary. Social media platforms such as Facebook, X (formerly Twitter), and WhatsApp can be used to reach a large audience with information about the switch-off. Government and MNOs can create social media posts, videos, and infographics to explain the switch-off and encourage customers to upgrade.

9.3.3 Communicate incentivised plans

To ensure customer migration and new devices discounts on 4G and 5G smartphones and other devices is a simple and effective way to make it more affordable for customers to switch to newer devices. Making it easy for customers to switch to 4G and 5G by offering online and in-store support could include things like providing online chat support and having dedicated staff in stores to help customers switch devices and data plans.

9.3.4 Initiate switch-off at reasonable demand levels

It is important to agree on a switch-off plan at the industry level related to technical utilisation of the network. For example, regions with low demand or usage can be shut down first, and then progressively more congested areas.

10 Conclusion and recommendations

Market-led South African MNOs are of the view that the Sunset of 2G and 3G should be mostly market-led. However, enforcing the migration requires a collaborative strategy, following a step-by-step approach that is measured, and eventually the success of the strategy must inform the sunset dates.

Prohibit the importation of 2G and 3G devices: The first step identified is to deal with the importation of 2G and 3G devices. DTIC will need to ban all importation of these devices and the Regulator should not authorise any new type approvals of these devices.

Retail circulation: Through coordination with the DTIC, DCDT and ICASA, and before the public notice and transition date, 2G and 3G devices must be removed from the wholesale and retail distribution chain, and the sale of 2G and 3G devices should be prohibited. Further, all consumer protection bodies should be on the look-out and to prevent any heavy discounting of 2G and 3G devices.

Tax of smartphone: Revisit tax policy in terms of premium taxation on importation of smartphones. This is to ensure that smart devices using 4G and 5G are no longer taxed as luxury items. Instead, government should consider incentivising smartphone devices, which will in turn promote interconnectivity and the migration from 2G devices.

Collaboration: Despite the promising futures of 4G and 5G for national development, it is crucial that the transition to these new networks be carried out in a co-operative way.

Collaboration between the mobile industry and the government will enable the best possible outcome in the shift to enhance broadband connectivity, expanding access to the advantages of digital services for more people and advancing South Africa towards a future that is inclusive of a digital society.

Using USAFs: Identifying projects jointly with the DCDT, ICASA and USAASA that can be funded with USAF can unlock low-hanging opportunities to digital inclusion through the 2G and 3G sunsetting programme. ACT believes that this must be accompanied by interventions that remove the obstacles preventing South Africa from achieving universal digital inclusion, so that all South Africans have access to economic opportunities in the digital economy.

Subsidies: Ensure that government introduces a form of subsidies to assist indigent individuals to adopt smartphones, such as subsidised entry-level LTE/4G devices, which meet minimum performance criteria.Due to unemployment, poverty, and inequality, smartphones are

expensive in South Africa. Thus, the unconnected are poorer, less educated, female, disabled, and rural.

Digital literacy: Through NEMISA and social society organisations, assist the elderly and the low skilled in digital skills training as well as in local digital start-ups and small businesses that create a viable, innovative 4G and 5G ecosystem that can support a digitalised environment in South Africa. This should include training the youth in basic support and maintenance of smartphones.

Device manufactures: Engage smartphone manufacturers as a key partner in obtaining affordable and unique devices that advance digital inclusion. This includes collaboration with manufacturers to find 4G gadget components that are more reasonably priced, making them a wiser long-term investment than older phones.

Public notice, roadshows, and public campaigns: Communication and timely engagement of the public about the changes will be crucial; communication should take place across multiple media platforms. Communication can also take the shape of roadshows and public campaigns that promote new services and raise knowledge of the shutdown while still dealing with previous fake news on 5G and distrust of new technologies. Initiatives to inform consumers about the advantages of 4G/5G over 2G/3G are needed. To get support from the public, such efforts could be led by the Ministry of Communications and Digital Technologies.

Roaming from neighbouring countries: Engaging neighbouring states on the change in roaming environment is essential. This will also be important to deal with the black market where devices are flowing from neighbouring states.

Promote digital public platforms: Integrating e-gov into smartphone platforms specifically for people in remote areas where government services are not easily accessible is an additional possibility. It is crucial that there is good communication between the public and the government for the successful implementation of e-government strategies.

Rollout and promote new plans and services: Network operators will need to promote and introduce new plans and services where subscribers are offered discounted plans to switch to new services.

Ensure simultaneous switch-off of 2G and 3G of all networks: To prevent customers from switching service providers, and so giving operators the chance to postpone a switch-off, operators must perform a simultaneous switch-down.

Appendix A: 2G and 3G Sunset dates by region

Europe			
Country	Network Operator	2G Status/Sunset Date	3G Status/Sunset Date
Albania	Vodafone	31.12.25	
Austria	A1		31.12.25
	T-Mobile		31.12.24
Belgium	Orange	31.12.30	31.12.25
	Base		30.09.24
	Proximus		31.12.25
Bulgaria	A1		31.12.25
Czech Republic	Vodafone	31.12.25	No service on all networks
	O2		
	T-Mobile	31.12.25	
Cyprus	CYTAmobile -Vodafone		31.12.2025
Denmark	Telenor		17.04.23
	Hi3G	No service	31.12.25
	Telia		17.04.23
	TDC		Partial: 01.02.23
			Full: 31.12.23
Estonia	Telia		31.12.23
	Tele2		31.12.25
Falkland Islands	Sure		No service
Finland	Alands	31.12.25	
	DNA	31.12.25	Started: May 2023
			Finalised: 31.12.23
	Elisa		31.12.23
	Telia		31.12.23
France	Free Mobile	No service	
	Orange	31.12.25	31.12.28
	SFR	31.12.26	31.12.28
	Bouygues	31.12.26	31.12.29
Georgia	Beeline	No service	
Germany	Telekom		No service on all networks
	Vodafone	31.12.25	
	Telefonica O2		
Greece	Cosmote		30.11.21
	Vodafone	31.12.25	31.05.23
	Wind		13.03.23
Greenland	TELE		03.05.23
Hungary	Vodafone	31.12.25	30.11.23
	T-Mobile		30.06.22
	Telenor		31.12.23

Europe continued			
Country	Network Operator	2G Status/Sunset Date	3G Status/Sunset Date
Iceland	Nova		31.12.25
	Viking	31.12.25	No service
	Vodafone	31.12.25	31.12.25
Ireland	Vodafone	31.12.25	31.12.23
	3		31.12.24
Italy	Vodafone		28.02.21
	Telecom Italia Mobile	31.12.29	31.12.22
	ILIAD	No service	
Latvia	LMT		31.12.25
Liechtenstein	FL1		Partial: 31.12.23
Lithuania	Telia	31.12.28	31.12.22
	Bite	31.12.28	31.12.25
Luxembourg	Orange	31.12.30	31.12.25
	Post	31.12.26	30.06.22
	Tango		31.01.24
Macedonia	Telekom.mk		31.12.22
Malta	Melita	No service	
Monaco	Monaco Telecom	No service	
Montenegro	Mtel	01.01.25	01.01.25
Netherlands	Vodafone (Ziggo)	31.12.25	04.02.20
	KPN		01.04.22
	T-Mobile	01.06.23	
Norway	Telenor	31.12.25	31.12.21
	Telia	31.12.25	09.11.21
Poland	Orange	31.12.30	31.12.25
	T-Mobile		30.04.23
Portugal	Vodafone	31.12.25	31.12.23
Romania	Orange	31.12.30	31.12.25
	Telekom		01.07.22
	Vodafone	31.12.25	
Russia	MOTIV (LLC Ekater…)		No service
Slovenia	A1	31.12.30	30.06.23
	Telekom		30.09.22
Slovakia	Orange	31.12.30	01.01.24
	Slovak Telekom		31.12.23
Spain	Movistar		31.12.25
	Orange	31.12.30	31.12.25
	Vodafone	31.12.25	07.11.22
Sweden	Tele2	31.12.25	31.12.24
	Telia	31.12.25	31.12.23
	Telenor		31.12.25
	3	No service	

Europe continued			
Country	Network Operator	2G Status/Sunset Date	3G Status/Sunset Date
Switzerland	Salt	No service	
	Sunrise	No service	
	Swisscom	No service	31.12.25
Ukraine	3Mob	No service	
United Kingdom	EE	31.12.25	31.12.24
	3	No service	31.12.24
	Vodafone	31.12.25	31.12.23
Americas			
Country	Network Operator	2G Status/Sunset Date	3G Status/Sunset Date
Argentina	Personal		31.12.23
Belize	Smart	No service	
Bermuda	ONE	01.01.17	01.01.24
Bonaire / Sint Eustatius / Saba / Curacao / Saint Martin (French part)	TelCell SX	01.01.19	
Canada	Bragg	No service	
	TELUS	31.05.17	
	Videotron	No service	
	Wind	No service	
Chile	WOM S.A.	No service	
	Telefonica	03.23 - 12.23	
	Entel	30.11.24	
Colombia	Claro	28.02.23	
	Tigo	01.11.22	
Costa Rica	Claro	31.12.23	
Jamaica	FLOW	30.09.22	
Mexico	AT&T	01.09.19	
	Movistar	30.04.21	
Panama	Claro	31.12.24	31.12.26
	Digicel	08.03.20	
Puerto Rico	Claro	31.03.22	31.12.23
St. Pierre and Miquelon	SPM		No service
United States	AT&T	01.01.17	22.02.22
	Verizon	No service	31.12.22
	Limitless Mobile	No service	
	T-Mobile	02.04.24	01.07.22
	Union	31.12.19	22.09.23
	Viaero	09.05.18	

Oceana			
Country	Network Operator	2G Status/Sunset Date	3G Status/Sunset Date
Australia	Telstra		30.06.24
	Optus		
	Vodafone	01.06.18	31.12.23
Guam / N. Mariana Islands	Docomo	No service on all networks	
	IT&E		
New Caledonia	OPT (Mobilis)	01.01.25	01.01.30
New Zealand	2degrees	01.03.18	31.12.25
	Spark	31.03.07	
	Vodafone	31.12.25	31.08.24
Norfolk Island	Norfolk Telecom		No service

Asia			
Country	Network Operator	2G Status/Sunset Date	3G Status/Sunset Date
Bangladesh	Grameenphone	31.12.25	31.12.26
Bahrain	Batelco	30.11.21	
Brunei		No service on all networks	
Cambodia	SEATel	No service	07.06.15
	Smart		27.06.22
China	China Telecom	No service	
	China Unicom	31.12.24	
Hong Kong	CMHK		No service
	3	No service	
India	Airtel Punjab	01.12.23	30.09.20
	Vodafone Delhi		01.04.22
	BSNL		31.12.24
	Jio	No service	No service
Indonesia	AXIS		31.03.22
	3		31.12.22
	Indosat Ooredoo		01.12.22
	Telkomsel		31.05.23
Israel & Palestine	Cellcom	31.12.25	31.12.25
	Golan		31.12.25
	HOT mobile	No service	31.12.25
	Partner	31.12.25	31.12.25
	Pelephone	No service	31.12.25
Japan	KDDI (au)	No service on all networks	31.03.22
	SoftBank		31.01.24
	NTT DOCOMO		31.03.26
Korea (South)	KT	No service on all networks	
	SKTelecom		
Kuwait	Wataniya		30.06.23

Asia continued			
Country	Network Operator	2G Status/Sunset Date	3G Status/Sunset Date
Macao	CTM	No service on all networks	
	Hutchison (3)		
	SmarTone		
Malaysia	Maxis		31.12.21
	Celcom		31.12.21
	U Mobile	No service	31.12.21
	DiGi		31.12.21
	YES	No service	No service
Mongolia	Skytel	No service	
Myanmar	Telenor	31.12.24	31.12.25
	Mytel (Viettel)		No service
Oman	Omantel (Oman Mobile)		31.12.2025
	Ooredoo		31.12.2024
Pakistan	Mobilink		31.12.23
	Telenor	31.12.25	31.12.25
Saudi Arabia	STC Al-Jawal		31.12.22
Singapore	M1	No service on all networks	31.07.24
	SingTel		
	StarHub		
Sri Lanka	Dialog		31.12.22
Taiwan	APTG		No service
	Chunghwa	01.06.17	30.06.24
	FarEasTone	01.06.17	31.12.23
	T Star	31.12.18	
	Taiwan Mobile	01.06.17	
Thailand	dtac		31.12.25
United Arab Emirates	DU	31.12.22	
	Etisalat	31.12.23	
Vietnam	Gtel Mobile (Gmobile)		No service
	Viettel		30.06.22
Yemen	MTN		No service on all networks
	SabaFon		
	Y-Telecom		

References

ACT. (2022). Impact of load shedding to Telcos. Press Briefing Paper. Association of Comms & Technology. 21 December 2022.

Agiwal, M., Kwon, H., Park, S., & Jin, H. (2021). A Survey on 4G-5G Dual Connectivity: Road to 5G Implementation. *IEEE Access, 9,* 16193–16210. Available at: https://doi.org/10.1109/ACCESS.2021.3052462

Alliance for Affordable Internet (2021). Affordability Report 2021. World Wide Web Foundation. Available at: A new strategy for universal access. https://a4ai.org/wp-content/uploads/2021/12/A4AI_2021_AR_AW.pdf

Azhar, A.H. (2022). Enhancement to the volte provisioning framework to enable volte in 4G smartphones. Azman Hashim International Business School. Universiti Teknologi Malaysia. Available at: http://eprints.utm.my/id/eprint/102373/1/AimanHilmiAzharMAHIBS2022.pdf

Broadband Commission, 2022: Strategies Towards Universal Smartphone Access. Available at: https://www.broadbandcommission.org/wp-content/uploads/2022/10/Strategies-Towards-Universal-Smartphone-Access-Report-.pdf

Chaudron, E. (2018). Closing of 3G Sites: Model for Decision Making. Thesis. Available at: https://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-237529

Chochliouros, I.P., Kourtis, M.-A., Spiliopoulou, A.S., Lazaridis, P., Zaharis, Z., Zarakovitis, C., & Kourtis, A. (2021). Energy Efficiency Concerns and Trends in Future 5G Network Infrastructures. *Energies, 14*(17), 5392. Available at: https://doi.org/10.3390/en14175392

Competition Commission. (2020). Competition in The Digital Economy. Version 2. Competition Commission South Africa. Available at: https://www.compcom.co.za/wp-content/uploads/2021/03/Digital-Markets-Paper-2021-002-1.pdf

Delaporte, A., & Bahia, K. (2022). The State of Mobile Internet Connectivity Report 2022. GSM Association. Available at: https://www.gsma.com/r/wp-content/uploads/2022/12/The-State- of-Mobile-Internet-Connectivity-Report-2022.pdf?utm_source=website&utm_medium= download-button&utm_campaign=somic22

Deruyck, M., Vereecken, W., Joseph, W., Lannoo, B., Pickavet, M., & Martens, L. 2012. Reducing the power consumption in wireless access networks: Overview and recommendations. *Progress In Electromagnetics Research,* 132, 255–274. Available at: https://doi.org/10.2528/PIER12061301

European Commisison. (2020). Shaping Europe's digital future – 5G. Available at: https://digital-strategy.ec.europa.eu/en/policies/5g

Genesis Analytics, GIBS, & Pathways for Prosperity Commission. (2019). Pathways to Digital Work – A Strategy Primer for South Africa's Digital Economy. South Africa in the Digital Age (SADA). Available at: https://genesis.imgix.net/uploads/files/Pathways-to-Digital-Work-SADA-Strategy-Primer-full-report.pdf

Ghezzi, A., Rangone, A., & Balocco, R. (2013). Technology diffusion theory revisited: A regulation, environment, strategy, technology model for technology activation analysis of mobile ICT. *Technology Analysis & Strategic Management, 25*(10), 1223–1249. Available at: https://doi.org/10.1080/09537325.2013.843657

Grijpink, F., Ménard, A., Sigurdsson, H., & Vucevic, N. (2018). The road to 5G: The inevitable growth of infrastructure cost. McKinsey & Company. 23 February 2018. Available at: https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost

GSMA. (2020). Legacy mobile network rationalisation Experiences of 2G and 3G migrations in Asia-Pacific. GSM Association. Available at: https://www.gsma.com/spectrum/wp-content/uploads/2020/06/Legacy-mobile-network-rationalisation.pdf

GSMA. (2021). 2G-3G Sunset Guidelines. GSM Association. Available at: https://www.gsma.com/newsroom/wp-content/uploads/NG.121-v1.0-2.pdf

GSMA. (2023a). The Mobile Economy 2023. GSM Association. Available at: https://www.gsma.com/mobileeconomy/wp-content/uploads/2023/03/270223-The-Mobile-Economy-2023.pdf

GSMA. (2023b). 2023 – GSMA Mobile Connectivity Index. 2023 – GSM Association. Available at: https://www.mobileconnectivityindex.com/

ICASA. (2022). ICASA concludes successful spectrum auction and collects more than R14.4 billion proceeds. Independent Communications Authority of South Africa. 17 March 2022. Available at: https://www.icasa.org.za/news/2022/icasa-concludes-successful-spectrum-auction-and-collects-more-than-r14-4-billion-proceeds

ICASA. (2023). The State of the ICT Sector Report in South Africa. Independent Communications Authority of South Africa. Updated Version. March 2023. Available at: https://www.icasa.org.za/legislation-and-regulations/state-of-ict-sector-report-2023-report

IT-Online. (2022). Sustained loadshedding puts pressure on network operators. 22 December 2022. Available at: https://it-online.co.za/2022/12/22/sustained-loadshedding-puts-pressure-on-network-operators/

ITU. (2021). Achieving universal and meaningful digital connectivity Setting a baseline and targets for 2030. International Telecommunication Union. Available at: https://www.itu.int/itu-d/meetings/statistics/wp-content/uploads/sites/8/2022/04/UniversalMeaningful DigitalConnectivityTargets2030_BackgroundPaper.pdf

Jakoet-Salie, A. (2020). E-government Strategies in South Africa. *Administratio Publica, 28*(3), 1–22. Available at: https://journals.co.za/doi/pdf/10.10520/ejc-adminpub-v28-n3-a2

MCMC. (2022). JENDELA Q3 2022 Report. Malaysian Communications and Multimedia Commission. Available at: https://myjendela.my/Sitejendela/media/Doc/JENDELA-Booklet-Q3-Option-2-6-6_Completed.pdf

Modise, E. (2022). To dominate 5G,SA telcos are making a play for fibre. *TechCabal*. 27 September 2022. Available at: https://techcabal.com/2022/09/27/5g-fibre-south-africa/

Moritz, S., & Golum, R. (2022). 5G Has Been a $100 Billion Whiff So Far. Bloomberg. 3 March 2022. https://www.bloomberg.com/news/articles/2022-03-03/5g-internet-big-whiff

Odendaal, N. (2023). Companies pledge billions for ICT investment in South Africa. Engineering News. 14 April 2023. Available at: https://www.engineeringnews.co.za/article/companies-pledge-billions-for-ict-investment-in-south-africa-2023-04-14

Parcu, P. L., Pisarkiewicz, A. R., Carrozza, C., & Innocenti, N. (2023). The future of 5G and beyond: Leadership, deployment and European policies. *Telecommunications Policy,* 102622. Available at: https://doi.org/10.1016/j.telpol.2023.102622

Rao, S. K., & Prasad, R., (2018). Telecom Operators' Business Model Innovation in a 5G World. Department of Business and Technology, Aarhus University, Herning, 7400, Denmark. *Journal of Multi Business Model Innovation and Technology, 4*(3), 149–178. Available at: https://doi.org/10.13052/jmbmit2245-456X.431

RantCell. (2019). What are the differences between 2G, 3G, 4G LTE, and 5G networks? July 2019.

RSA. (2022). Government Gazette No. 46873. Invitation to provide written submissions on the Proposed Next Generation Radio Frequency Spectrum for Economic Development. Republic of South Africa. 8 September 2022.

RSA. 2024. Government Gazette No. 50725. Next Generation Radio Frequency Spectrum Policy for Economic Development (Spectrum Policy). Republic of South Africa. 28 May 2024.

Soos, G., Kozma, D., Janky, F. N., & Varga, P. (2018). IoT Device Lifecycle – A Generic Model and a Use Case for Cellular Mobile Networks. *2018 IEEE 6th International Conference on Future Internet of Things and Cloud* (FiCloud), 176–183. Available at: https://doi.org/10.1109/FiCloud.2018.00033

Soos, G., & Varga, P. (2019). On the Security Threat of Abandoned and Zombie Cellular IoT Devices. *2019 IEEE 17th International Conference on Industrial Informatics (INDIN),* 996–1001. Available at: https://doi.org/10.1109/INDIN41052.2019.8972107

Stats SA. (2023). South African economy expands by 0,4%. Statistics South Africa. 6 June 2023. https://www.statssa.gov.za/?p=16379

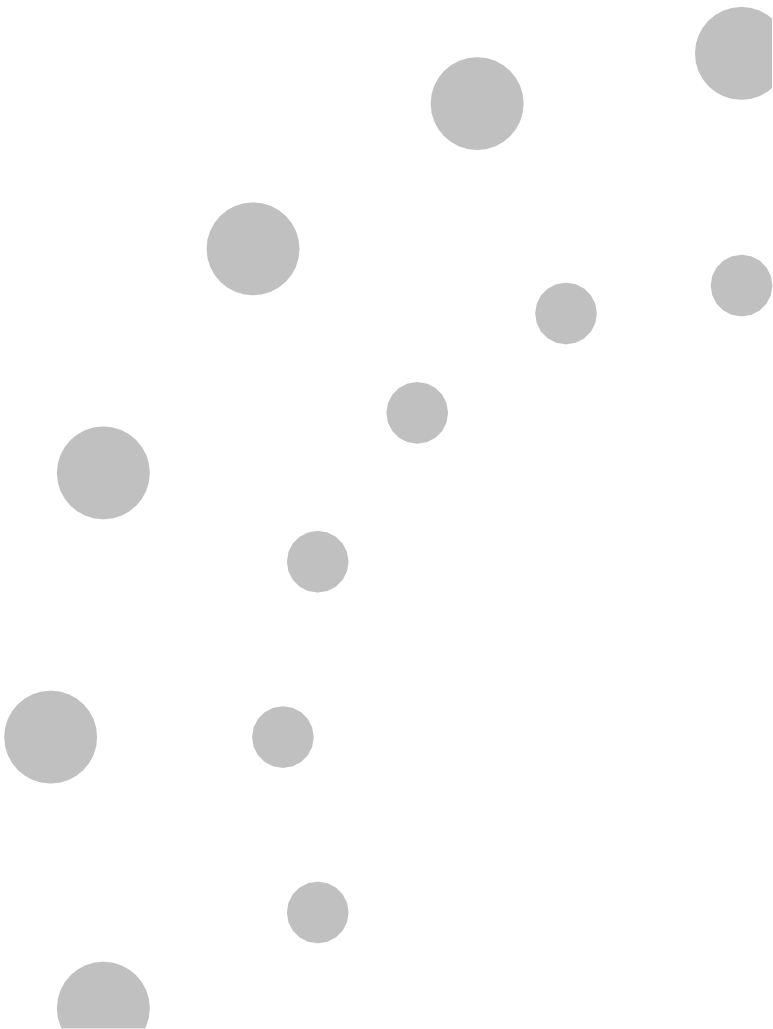
Stats SA. 2024: General Household Survey, 2023. Statistics South Africa. Available at: https://www.statssa.gov.za/publications/P0318/P03182023.pdf

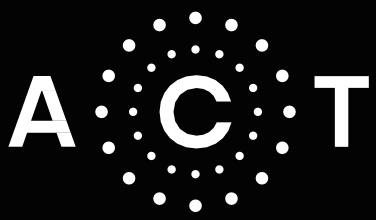
Taheribakhsh, M., Jafari, A., Peiro, M. M., & Kazemifard, N. (2020). 5G Implementation: Major Issues and Challenges. *2020 25th International Computer Conference, Computer Society of Iran (CSICC),* 1–5. Available at: https://doi.org/10.1109/CSICC49403.2020.9050110

Triolo, P. (2020). China's 5G Strategy: Be First Out of the Gate and Ready to Innovate. *China's Uneven High-Tech Drive: Implications for the United States,* pp. 21–28. Center for Strategic and International Studies (CSIS). https://www.jstor.org/stable/resrep22605.10

WEF & PwC. (2020). The Impact of 5G: Creating New Value across Industries and Society. World Economic Forum. January 2020. Available at: https://www.pwc.com/gx/en/about-pwc/contribution-to-debate/wef-the-impact-of-fiveg-report.pdf

Xiang, D.T.Z. (2019). Operators' decisions to shut down legacy 2G/3G networks need to be commercially driven. Analysys Mason. Available at: https://www.analysysmason.com/about-us/news/newsletter/legacy-network-shutdown-oct2019/





www.actforsa.co.za