Modernising quality of service regulations in Sub-Saharan Africa

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Executive summary

Mobile technology is the foundation for the emerging digital economy in Sub-Saharan Africa. At the start of this decade, there were 477 million unique mobile subscribers in the region, representing a penetration rate of 45%. Another 138 million people will subscribe to a mobile service by 2025, taking the penetration rate to just over half the population. Mobile internet adoption is also rising, helped by private and public sector investment in the deployment of 3G and 4G networks, as well as the increasing availability and affordability of smartphones. As a result, the region will see a fourfold increase in monthly mobile data traffic over the five years to 2025.

Changing consumer needs and behaviours, coupled with increased adoption of mobile services, is resulting in broad stakeholder interest in the quality of all services provided to individuals and businesses that rely on mobile connectivity to participate in the digital economy. Policymakers and regulators are primarily keen to safeguard the interest of consumers and ensure that mobile operators deliver on the service levels stipulated in their licence terms. For their part, mobile operators are naturally interested in improving the quality of the services they provide, as this makes it possible to meet the expectations of increasingly demanding users to achieve a ubiquitous and satisfying communication and digital experience.

Quality of service (QoS) regulation is at the heart of efforts to realise the goal of high service quality levels. In Sub-Saharan Africa, most countries follow a direct regulatory approach, which involves the regulator setting QoS parameters, targets and measurement criteria, and in most cases using sanctions to enforce compliance. However, key findings from a GSMA survey of national regulatory authorities (NRAs) and service providers conducted for this report reveal the limitations of current QoS regulatory regimes in the region. These include complex and disproportionate targets, a lack of technical standardisation and industry collaboration or consultation, outdated and homogeneous frameworks, and the potential for financial sanctions to be counterproductive.

Against this backdrop, it is essential for policymakers and regulators to adopt QoS policies that are fit for purpose in the modern age. This involves moving from a 'command and control' regime to an ex-post model that protects the interest of consumers, promotes fair competition and choice, and encourages investments in network infrastructure and services.

In this report, we highlight key considerations for realising the goal of effective QoS regulation in Sub-Saharan Africa:

- **Streamline KPIs –** Progressive regulation should establish a concise list of practical and achievable KPIs that are understandable to consumers to allow for meaningful comparisons of available services. This means discarding the 'more KPIs, more sanctions' approach in favour of a modern, simplified monitoring and enforcement regime.
- **Align QoS regulations with local market dynamics –** No two markets are the same, even within a fairly homogenous region such as Sub-Saharan Africa. Therefore, the development and selection of KPIs and the level of quality requirements must be determined in relation to a specific context, which takes into account local dependencies.
- **Establish objective measurements –** To measure QoS effectively and objectively, regulators need to keep pace with technology, market and business innovations. For example, regulators should perform tests on an end-to-end basis within the edges of a single access network, rather than across networks, and apply a significant call sample size to ensure test results are representative of the network situation within the area of service.
- **Increase collaboration with service providers –** In countries where regulators are able to develop relationships to collaborate more closely with mobile operators, more favourable arrangements and outcomes are likely. This is especially relevant to defining appropriate parameters and to finding the right solutions to measure and improve quality, considering external factors that may be beyond the operators' control.
- **Leverage all technological capabilities –** Regulators need to revisit existing measurement practices to take into account new technologies, which represent an opportunity for regulators to incorporate end user interests more effectively into the policymaking process. This will enable them to move progressively towards a data-driven approach built on standardised testing methodologies.
- **Explore alternatives to punitive financial penalties –** Alternative mechanisms to financial sanctions could deliver better QoS outcomes by encouraging operators to invest more in their networks while generating higher tax payments over the longer term from increased usage. For example, regulators should consider mitigation plans, publicising failures or even reallocating proceeds from fines to mandated network investment in areas that need it most, leading to improved QoS.
- **Manage the transition to QoE –** Regulators need to approach quality of experience (QoE) with caution given the subjective nature of measurements and the consumer-related factors that could be out of the control of operators, including device specification, power supply and digital skills level. QoE frameworks need to be objective, developed in collaboration with operators and not subject to sanctions.
- **Monitor international best practice –** The best direction for QoS is still being discussed in national and international fora, with stakeholders exploring the most appropriate methods for addressing changing customer expectations. Regulators should keep abreast of these conversations, especially in relation to the impact of new technologies, such as 4G and 5G, AI and IoT, on network usage patterns.

Beyond regulation, policymakers and regulators have an opportunity to support QoS improvements with policy levers that complement mobile operators' investments in network infrastructure and services while keeping the consumer at the centre of QoS developments. Fundamentally, policymakers should ensure that operators have access to spectrum at the right conditions – quantity, frequency band and pricing – to enhance network performance, mobile broadband capacity and coverage expansion. Governments should also avoid inconsistent or unpredictable fiscal policies, including special taxes that discriminate against the mobile sector, which can lead to delayed or cancelled investments, and identify mechanisms to expedite network deployments, such as easing right-of-way approvals and granting fair access to public infrastructure.

1. Context: understanding mobile QoS

1.1 The importance of mobile connectivity to the emerging digital economy

The mobile market in Sub-Saharan Africa is growing rapidly. At the start of this decade, there were 475 million unique mobile subscribers in the region, representing a penetration rate of 45%. Sub-Saharan Africa will be the fastest-growing region globally in the period to 2025,[1] taking the total subscriber base to nearly 620 million (over half the population). There is also a growing shift in the region from basic voice to data-centric services; mobile broadband[2] technologies now account for nearly 60% of total mobile connections, rising to 88% by 2025.

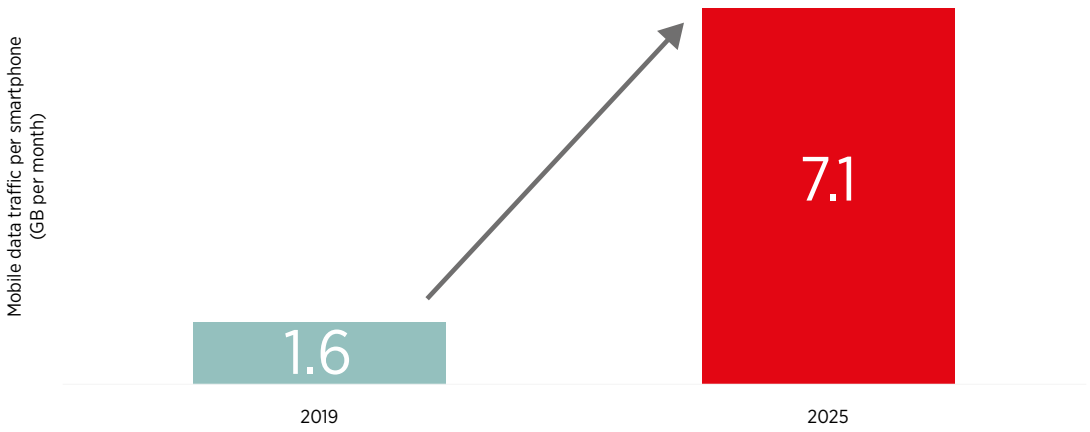
[1] Based on forecasts by GSMA Intelligence
[2] 3G and above

The growth in mobile adoption is mainly being driven by operators' investments in network infrastructure, along with investments by some governments in partnership with organisations such as the World Bank and International Finance Corporation (IFC). During the last decade, mobile operators in Sub-Saharan Africa invested nearly $70 billion in capital expenditure (capex), taking 2G coverage to near ubiquitous levels and 3G and 4G coverage to 75% and 50%, respectively. Achieving 100% broadband access across all of Africa by 2030 will require a further $100 billion.[3] Meanwhile, commercial 5G services have been launched in South Africa, with other countries in the region likely to follow suit in the coming years.

Mobile technology is the foundation for the emerging digital economy in Sub-Saharan Africa, driving digital and financial inclusion. Given the limited development of fixed-line infrastructure, consumers are increasingly relying on mobile connectivity to work, communicate and access online services; similarly, businesses and public institutions utilise mobile platforms to deliver a wide range of services and engage with customers. The mounting popularity of mobile connectivity is underscored by the rapid growth of mobile data traffic, helped by the rising adoption of smartphones. Sub-Saharan Africa is set to experience a fourfold increase in monthly mobile data traffic per smartphone over the five years to 2025, albeit from a relatively low base (Figure 1).

Figure 1

Data traffic to increase more than fourfold in Sub-Saharan Africa by 2025



Source: GSMA Intelligence, Ericsson

Covid-19 has further stressed the importance of reliable connectivity for the social and economic well-being of individuals and communities in the region. As confinement measures to tackle the spread of the virus were implemented, mobile connectivity emerged as a lifeline for accessing many life-enhancing services, including education, health, public services, retail and entertainment. Mobile operators and technologies have also been at the centre of successful strategies to prepare for and contain natural disasters, such as Vodacom's partnerships with humanitarian organisations and UN agencies in Mozambique in the wake of 2019's Cyclone Idai.[4] Resilient mobile networks and connectivity will play an integral role the management of future crises, in addition to underpinning economic recovery and growth across Sub-Saharan Africa.

[3] Connecting Africa Through Broadband: A strategy for doubling connectivity by 2021 and reaching universal access by 2030, The Broadband for All Working Group, 2019
[4] Partnering During Crisis: The Shared Value of Partnerships between Mobile Network Operators and Humanitarian Organisations, GSMA, April 2020

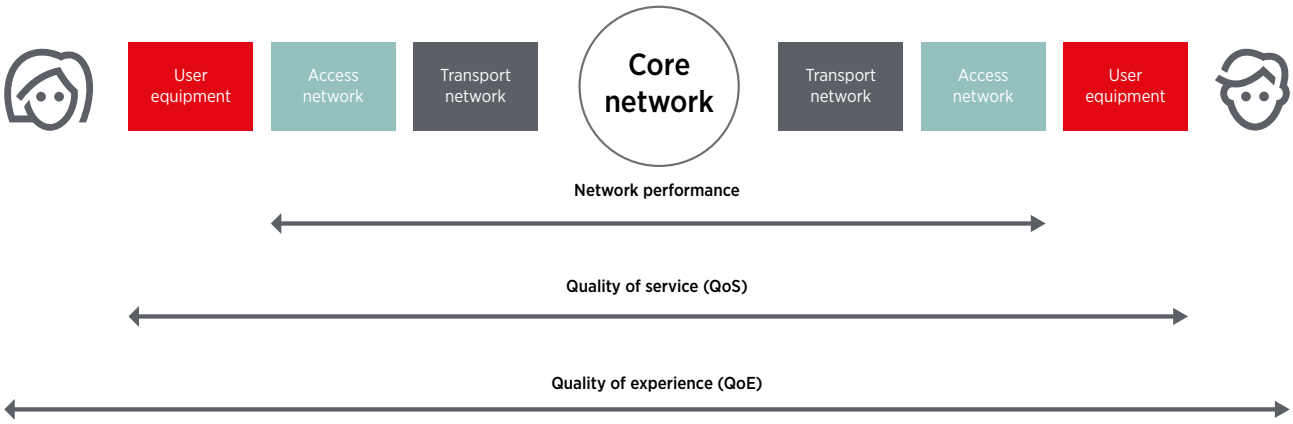
1.2 Key definitions in the QoS space

Quality of service (QoS) is a direct outcome of the network domain and refers to objective and measurable quality. It relates to how well or poorly a subscription service functions and is generally expressed quantitatively in terms of speed, accuracy, dependability and security indicators. Key elements of QoS performance include the reliability of a service and the consistency of connectivity it provides. Hence, policymakers are not only focused on connectivity itself (i.e. call success or throughput) but also on coverage and availability. Whereas network performance measurements are taken across the network between points where the access network serves as the limit, QoS covers the entire communication path from end to end. QoS measurements are taken using specialised equipment that mimics a user interface of the service. This allows objective results to be obtained in the context of illustrating the QoS provided by the network to the point where the user equipment connects to the network.

In contrast, quality of experience (QoE) is a relatively newer area of focus for the industry, the assessment of which generally began with consumer surveys. QoE relates to a consumer's individual perception of an application or service; it therefore involves a subjective determination of end-to-end quality, where a given level of service will be acceptable to some users and not to others. Though QoE is more difficult to measure, it can be used to solve problems such as customer loyalty issues and optimisation of network resources.

Figure 2

Understanding network performance, QoS and QoE



Source: GSMA Intelligence

1.3 Broad stakeholder interest in QoS

The advancement of the digital economy requires universal access to fast, reliable and continuous connectivity. This highlights the broad stakeholder interest in the availability of high-quality mobile networks and services. Figure 3 shows the three main stakeholder groups in mobile QoS – policymakers and regulators, mobile operators, and end users – and their underlying interests.

Figure 3

Underlying interests of QoS stakeholders

Mobile operators

- Maintain a high level of customer satisfaction, which has the potential to reduce churn and increase usage
- Maintain competitive advantage and avoid revenue losses from poor service quality

Policymakers and regulators

- Safeguard the interests of consumers
- Ensure that service providers deliver on the service levels stipulated in their licence terms

Users

- Demand value from expenditure on mobile services
- Good QoS can enhance the digital experience and create new opportunities for individuals and the wider community

Source: GSMA Intelligence

A popular approach for regulators is to base their QoS frameworks on the objectives for QoS regulations outlined by the International Telecommunication Union (ITU).[5] These are to:

- help customers be aware of the service provided by their operator so they can make informed choices
- check claims by operators
- understand the state of the market
- maintain improvements in QoS in the presence or absence of competition
- help operators to achieve fair competition
- make interconnected networks work well together.

As such, the QoS regulatory approach (see section 2.1) applied in any given market mainly reflects these objectives, with a commonly stated intention of these objectives being to stimulate the right levels of investment in network infrastructure and services.

For operators, offering reliable and continuous connectivity is a strategic priority, as it allows them to differentiate the service they provide, relative to their competitors, and meet customer expectations. In addition, a high-quality service is essential to reputation and, in turn, positively balancing subscriber growth and churn. As demand for data and other mobile-enabled services grows, there are clear incentives for operators to improve QoS – even as many have continued to lower prices over time. In recent financial reports and public statements, leading operators in Sub-Saharan Africa – Airtel, Orange, MTN, and Vodacom – have highlighted efforts to improve service quality, especially in rural areas, as a key component of their operating strategies and contribution to digital transformation in the markets where they are present.

[5] Based on a GSMA survey of national regulatory authorities in Sub-Saharan Africa

For the end user, price is not always the sole factor in choosing a service provider.[6] Indeed, quality is an important part of their contract with the provider. Consumers are directly affected by the QoS provided by mobile operators. Poor services, such as dropped calls or unreliable internet connectivity, do not deliver value for money, and they also deny users the opportunity to fully participate in the digital economy. Consumers want a signal that is always available – enabling them to make and receive calls, and to access the internet via smartphones – and good line quality when making and taking calls, including clarity, no dropped calls or echo. Further, in terms of mobile broadband, consumers want a high-quality connection that offers discernible high throughput and low latency, and that enables them to access various applications and platforms, which can support digital and financial inclusion.

[6] See "Unlocking Value in the Sub-Saharan Africa Mobile Market", Bain & Co, August 2019

2. Regulating mobile QoS: regional versus global approaches

QoS mechanisms have been applied to telecoms services for many years, from public switched telephone network (PSTN) services to the various generations of the mobile network. Today, QoS is being monitored in at least 158 countries around the world.[7] Traditionally, QoS mechanisms have been applied to voice services, but more recently regulators have been incorporating minimum QoS requirements for data services. As QoS parameters and measurement tools have evolved alongside the services provided, several regulatory approaches have emerged.

[7] ITU

2.1 QoS regulatory approaches

QoS regulatory approaches around the world can be grouped into four broad categories, as highlighted in Table 1.

Table 1

Common QoS regulatory approaches

Regulatory approach	Key features and considerations
No regulation	Not every country has a specific QoS regulatory framework. There are various reasons for this, ranging from the lack of resources to develop and apply QoS regulations to prevailing consumer satisfaction with the overall quality of services available. Considerations • In some markets, the perceived benefits of measuring and enforcing QoS regulations may not justify the financial burden on service providers and the regulator. • Consumers are disempowered and could be potentially misled by operator claims on network performance and QoS. • Comparable information is not available to consumers, who are therefore unable to make well-informed decisions. • Operators lose some of their ability to compare services relative to other operators, which could lead to a decrease in quality.
Direct regulation	This approach involves the regulator setting QoS parameters, targets and measurement criteria, and using sanctions to enforce compliance. There is limited opportunity for continuous influence by service providers and little or no input from consumers. Considerations • Requires independent testing and validation of the performance data collected and therefore demands more regulator resources, including investment in measuring tools. • With limited service provider influence and consumer input, there is a risk of the regulator setting inappropriate or unrealistic targets. • Consumers get more complete information on the QoS of service providers across a predefined set of metrics and, in some cases, in specific locations.

Regulatory approach	Key features and considerations
Co-regulation	The regulator actively engages with service providers to set minimum performance targets based on a transparent and fair assessment of the factors impacting QoS. Service providers regularly publish performance targets to consumers in a bid to gain a competitive edge and, in some cases, commit to compensating consumers when services fall below stipulated levels. Considerations • This approach is premised on the fact that service providers are determined to meet the expectations of increasingly demanding users to achieve a ubiquitous and satisfactory communications experience, and that they are committed to continuously improving QoS. • Potential to reduce QoS implementation costs for regulators and services providers, as costs (e.g. of an independent testing facility) can be shared by multiple parties. • More awareness and information available to consumers and the potential for competitive gains through increased competition among service providers.
Consumer-focused regulation	This approach incorporates QoE for the consumer. The regulator provides consumers with tools to compare offers and services from service providers, such as speed testing tools, coverage maps, and apps to measure various services, as well as channels to provide feedback and complain about poor services. The tools empower consumers to choose a service provider that meets their required service level or to switch providers if not satisfied. Considerations • The cost of measuring performance, such as through apps and surveys, could be much lower for regulators and service providers. • Consumer feedback is anecdotal, often unaudited and subjective, and may therefore not reflect actual performance in some cases. • Feedback may only be received from a limited number of consumers trying to compare particular metrics or services.

Source: GSMA Intelligence

2.2 QoS regulatory approaches in Sub-Saharan Africa

Sub-Saharan Africa is a diverse region in terms of mobile market maturity. However, QoS regulation has emerged as a clear point of commonality. Many governments and regulators have devised policy frameworks aimed at ensuring a minimum standard of quality delivered to end users. Generally, the QoS regulatory frameworks in the region seek to follow internationally approved standards and recommendations from the ITU and European Telecommunications Standards Institute (ETSI), and are underpinned by government Acts, which set out the legal basis for overseeing and governing QoS regulations.

QoS mechanisms across the region are largely based on the direct regulation approach. Regulators stipulate standards for operators on the quality of voice and data services to be provided, based on a set of predefined KPI targets. Typical measures relate to network characteristics, including data transmission speeds and call success and drop rates. In some cases, regulators consult service providers in the process of setting minimum targets, but operator influence remains largely limited.

Resultant policy interventions are often based on the premise that the most effective way of improving the quality of voice and data services is through ex-ante regulation and the monitoring of a large number of KPIs. These have typically taken the form of minimum standards and reporting obligations imposed on network operators (usually through their licences), complemented by the independent measurement and publication of QoS results by a country's national regulator.

Many regulators see connection throughput as an important attribute of service quality; however, it is also a difficult parameter to define and communicate to mobile users, and can vary dramatically over time due to the nature of radio propagation. Throughput is not the only product attribute that influences consumer choice and should therefore not be the only regulated performance dimension. See Appendix 1 for examples of QoS KPIs and targets from some countries in the region.

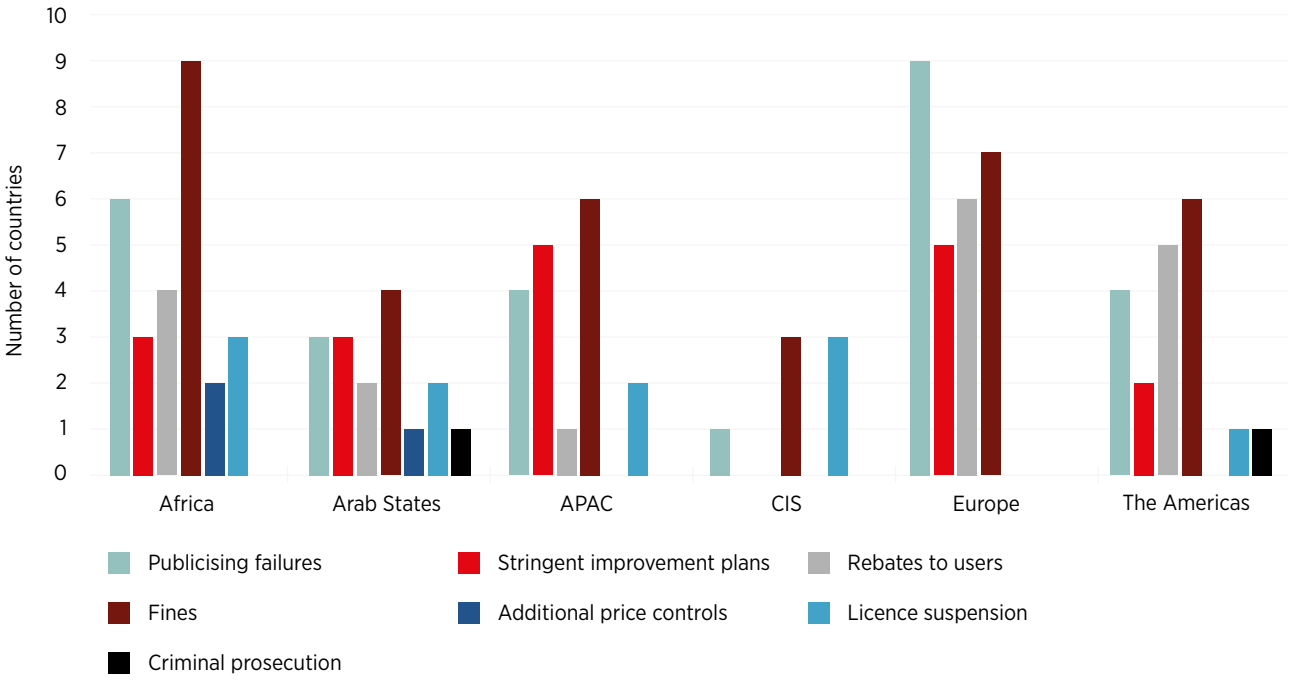
To ensure compliance, the legal frameworks supporting the enforcement of QoS regulations often make provision for a variety of sanctions, including:

- financial penalties (fines and customer redress)
- criminal prosecutions
- suspension of marketing activities, including customer acquisition
- difficult negotiations over licence renewal
- publicising failures, potentially leading to reputational damage.

Financial penalties, comprising fines and customer redress, are the most common type of sanction imposed by regulators in Sub-Saharan Africa for QoS breaches. Publicly available data shows that operators in the region were levied more than $50 million in fines during the last decade. Results of a global survey by the ITU demonstrate the most common QoS sanctions applied by regulatory bodies in 2018 (Figure 4).[9]

Figure 4

QoS-related sanctions around the world, 2018



Source: GSMA Intelligence analysis of ITU data

[8] GSMA Intelligence research
[9] Survey question: Please specify which of these [QoS] sanctions have been applied. This question allows multiple answers per country/economy.

In fact, using historic ITU data, a review of around 50 regulatory sanctions against telecoms operators across 20 African markets between 2011 and 2017 showed that the number of fine procedures has risen steeply across the region. The analysis found that in the 2011–2015 period, three quarters of the regulatory sanctions reviewed were associated with violations pertaining to QoS and network coverage, and almost 60% of the value of regulatory fines imposed in this period were QoS-related. Between 2016 and 2017, about half of the sanctions were related to QoS.[10]

The regulatory appetite for financial penalties has not abated, as evidenced by examples from 2018–2020. In 2018, the National Communications Authority (NCA) in Ghana sanctioned all four mobile network operators for non-compliance with QoS obligations, with the total fine reaching $5.92 million. One of the operators received a fine of GHC9.08 million ($1.58 million), which amounted to 0.3% of service revenue or 1.1% of capex in 2018. Apart from financial penalties, some mobile operators have faced the threat of license suspension or revocation due to poor QoS. Appendix 1 shows the major QoS sanctions in countries across the region between 2014 and 2019.

Spotlight on Kenya

In recent years, some regulators around the world have been moving towards the consumer-focused approach for QoS regulations. Kenya is one of the first countries in Sub-Saharan Africa to move in this direction. The Framework for the Assessment of Service Quality of Telecommunication Systems and Services took effect on 1 July 2017 and is based on three components: end-to-end QoS (60%), network performance (25%), and customer experience (15%). For the customer experience metric, the regulator will incorporate the findings of its annual customer satisfaction surveys in the final QoS report. However, financial penalties remain the main regulatory tool to ensure compliance: operators face a minimum fine of KES500,000 or 0.15% of revenue, whichever is higher, as set out in law, on each breach if they fail to reach an overall score of 80% in the final report.

2.3 QoS regulatory approaches in other regions

QoS regulations vary considerably across other regions and are administered by national and, in some cases, supranational governments. Our research shows a growing trend towards more modern methodologies and tools, which underpin the co-regulatory and consumer-focused approaches. This is an acknowledgement of the importance of a data-driven approach, the role of cooperation among the main stakeholders to achieve the shared objective of improving QoS, and the benefit of capturing the QoE for end users.

EU

The EU's QoS/QoE framework has changed significantly over the past two decades since liberalisation, reflecting the emergence of new services and sources of competition. The 2002 Directive on universal service and users' rights empowered national regulators to set minimum QoS requirements and to define the parameters designated operators should make public in order to ensure that consumers have access to comprehensive, comparable and reliable information. Amendments to the Directive in 2009 and the subsequent 2015 Telecoms Single Market package have evolved the framework, mainly in terms of internet access services (IAS) and the concept of 'net neutrality'.

[10] Another fine mess for African telecoms, Xalam Analytics, 2018

The 2018 European Electronic Communications Code (EECC), which member states must transpose into national law by 21 December 2020, further modernises and broadens the EU's QoS policy, strengthening transparency obligations and setting out quality parameters and monitoring methodologies. Some KPIs have been carried over from earlier regulations, while some new ones have been created to capture online players. The EECC's 'data-driven' approach to regulation also requires the following:

- End users must have the right to access at least one free and independent tool for comparing operators on both price and quality of service.
- Regulators need to be able to collect comparable information on QoS offered by providers of publicly available IAS and number-based and number-independent interpersonal communications services (ICS).
- Operators must outline the compensation or refund arrangements that apply if contracts levels of QoS are not met.

Table 2 highlights some consumer empowerment tools and the status of their application in selected countries in the region.

Table 2

Consumer empowerment tools in European markets

	Regulator survey (measurements)	Regulator survey (users)	Speed test tools	Coverage maps	Providers' rankings
Belgium	Y	Y	Y	Y	Y
France	Y	Y	N	Y	Y
Germany	N	N	Y	Y	Y
Ireland	Y	Y	N	N	Y
Italy	Y	N	Y	Y	Y
Spain	N	N	N	N	N
Sweden	N	N	Y	Y	N
UK	Y	Y	Y	Y	Y

Source: GSMA Intelligence

The Body of European Regulators for Electronic Communications (BEREC) and the European Commission have collaborated on one clear EECC objective: empowering and protecting end users. BEREC has been studying QoS (and network performance and QoE) for the past 10 years, but considers it an increasingly complex area to manage, measure and regulate. Its guidelines serve as a reminder to EU telecoms regulators that quality depends on devices, networks and applications, as well as on unpredictable situations, which occur on an irregular basis and create congestion. They note that minimum QoS obligations should only be used as a last resort, as transparency can be an effective remedy, and that KPIs should be proportionate and defined with respect to the actual customer experience.[11]

[11] Reference for this sub-section: BEREC and OECD Webinar on QoS and QoE, 23 June 2020: https://berec.europa.eu/eng/events/berec_events_2020/244-berec-and-oecd-webinar-on-qos-and-qoe

Spotlight on France

Arcep – the French regulator for telecoms, post and media – was an early advocate of data-driven regulation, a concept which emerged in response to a need for policymakers to be more agile in terms of how they oversee the mobile industry because of rapid developments in technology. In June 2015, Arcep launched its strategic review, taking a "360° view". This resulted in the adoption of a mission statement, which is built on the principle of free access to knowledge and outlines the authority's goal to promote users' freedom of choice and access to clear and accurate information. The review set out Arcep's 12 priorities, which include coverage maps ("enhance mobile coverage data and make them publicly available to provide a more accurate representation of the user experience") and crowdsourcing ("form partnerships and create crowdsourcing tools to enhance the data available on network quality and coverage").

Adopting this position has meant repealing some old regulatory mechanisms and rethinking the policy tools used to stimulate competition for the benefit of consumers. Arcep's leading solution is "Mon Réseau Mobile", which allows users to make informed choices by offering information that is precise and personalised on the quality and coverage of networks in France (down to the neighbourhood level). The regulator collects data from several sources, including operators, crowdsourcing and its own testing using a third party, and then analyses the results. It verifies and publishes the information on the relevant website following an annual operator-funded campaign, which is distributed as "open data" for use by third parties looking to launch or enhance comparison-type services. It communicates the results to the press in order to hold operators to account – although some use these results for their own marketing activities.

In addition, there is the J'alerte l'Arcep platform. This aims to encourage users to report issues through a dedicated app, thereby leveraging public engagement to modernise a classic customer complaints system. The platform does not resolve individual complaints but does enable the regulatory authority to detect and follow problems in real time and provide advice.

South Korea

Though South Korea is frequently lauded as one most advanced markets in the world, with widespread 4G coverage, the National Information Society Agency (NIA) has identified a disparity between urban and rural areas, whereby the latter suffers from relatively lower investment and poorer quality of telecoms services. This is compounded by people in remote parts of the country often having limited access to mobile coverage information and/or paying similar prices as urban consumers. Consequently, the NIA has devised a four-step procedure to evaluate QoS:

1. **Select relevant services.** The NIA focuses not on the best technical capacity but on the quality experienced using real end-user devices, which makes the evaluation more relevant. It currently targets three different fixed broadband speeds (100 Mbps, 1 Gbps and 10 Gbps) and three mobile technologies (3G, 4G and 5G).
2. **Establish a measurement scheme.** This includes determining the measuring terminal, method and metrics – throughput, connection success, transmission success, round trip latency, packet loss and web-page loading time for mobile services – in order to confirm the final evaluation plan.
3. **Perform field tour measurements.** This includes measurements by population density, location (e.g. underground shops, markets, hospitals), sport and leisure areas such as coastal roads and trails, and public transport networks.
4. **Collect and validate data.** The NIA validates data with third-party experts, checking for software errors and removing outliers before publishing the outcomes of the process with breakdowns by operator, service and region.

[12] https://en.arcep.fr/arcep/our-causes.html#c10077

The results for 2019 signal strong improvements in download speeds across fixed and mobile networks, particularly for Wi-Fi and rural 4G services. What is notable is the inclusion of 5G in the NIA's QoS assessment framework. For 5G services only, the agency is measuring a "redirection rate", which shows (as a percentage) the rate at which a connection switches between 4G and 5G networks. A higher figure would indicate a higher frequency of falling back to 4G and therefore lower or patchier 5G coverage. Monitoring this 5G-specific KPI demonstrates how the NIA is seeking to keep pace with South Korea's technological evolution, in which 5G will be a strategic priority.[13]

North America

The Canadian Radio-television and Telecommunications Commission (CRTC) acts as the main telecoms regulator in Canada, enforcing the Telecommunications Act, whose key features include the promotion of economic efficiency, market competitiveness and public accessibility to high-quality services. Meanwhile, in the US, the Federal Communications Commission (FCC) regulates interstate telecoms at the federal level based on the Communications Act and its subsequent amendments.

Though both regulators play a prominent role in consumer protection – such as upholding privacy and preventing spam calls and telemarketing – neither has imposed QoS targets on all operators in their respective markets or obligations around the publication or audit of network performance. Instead, each body has employed a more laissez-faire approach, in which operators set their own targets and publicise their own results while abiding by industry codes of conduct.

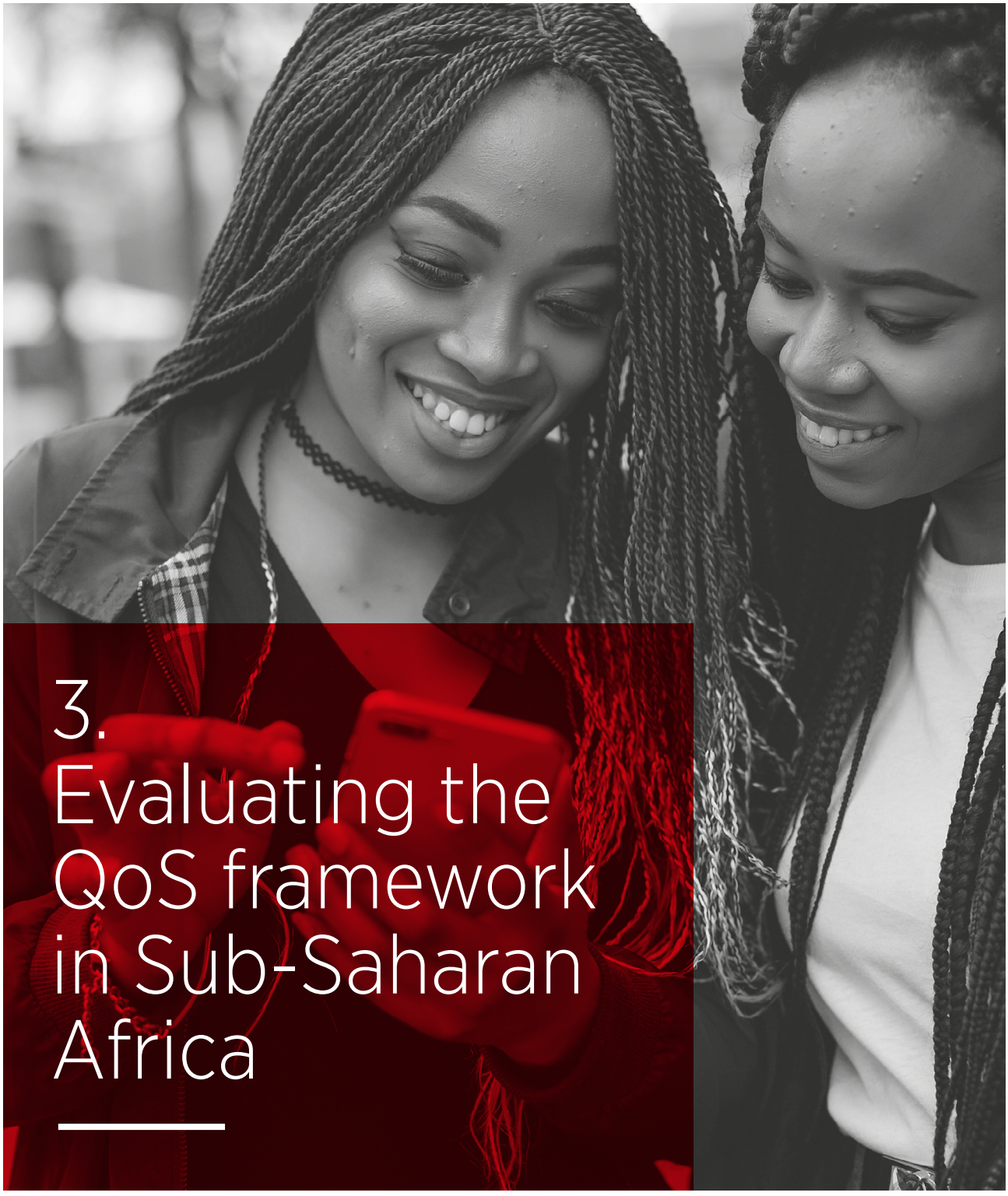
Brazil

Agência Nacional de Telecomunicações (Anatel) is Brazil's telecoms regulator. It is responsible for the regulation, inspection and granting of authorisations required to provide telecoms services in Brazil, and has the power to apply administrative sanctions in the case of contraventions of telecoms laws and regulations. Telecoms consumers' basic rights are enshrined in regulation, and include:

- access to telecoms services that meet a certain standard in terms of quality and consistency
- freedom of choice regarding telecoms operator
- access to adequate information regarding the telecoms services' conditions and tariffs/prices and services suspension
- the right to have complaints duly answered by the operator
- the right to present claims against the operator before Anatel and the consumer defence authorities.

Like EU policy, Brazil's QoS framework has evolved over the past decade, from service-specific regulation to rules that convert fines into investment in underserved areas. More recently, there has been a review of the overall regulatory regime governing quality. In 2012, Anatel launched tools to allow consumers to compare operator services and base stations in a given location and a complaints portal, where the information provided can be used for compliance calculations, operator rankings and consumer education. However, Anatel still defines 14 KPIs for mobile services that all operators must report against and sets specific QoS targets.

[13] BEREC and OECD Webinar on QoS and QoE, June 2020: https://berec.europa.eu/eng/events/berec_events_2020/244-berec-and-oecd-webinar-on-qos-and-qoe



3. Evaluating the QoS framework in Sub-Saharan Africa

An effective QoS regulatory regime protects consumer interests, promotes fair competition and choice, and maintains a basic minimum level of quality while inspiring mobile operators to meet higher standards of service. Realising these objectives in any jurisdiction relies on the implementation of the right QoS regulatory approach that adequately reflects local market conditions and best serves the interest of all stakeholders.

3.1 The impact of current QoS regulations

In Sub-Saharan Africa, QoS regulations are a focal point of many telecoms regulators that are looking to address concerns over network quality. Despite sound motivating factors behind QoS regulations, many of them came into force when governments were privatising old public monopolies. However, most markets in the region are now competitive, generally with a minimum of three mobile operators. As a result, much of the direct regulation currently in force runs counter to new trends in the telecoms sector and does not take into account constraints on operators or have a consumer-oriented policy at its core. Further, the cost burden of ex-ante regulation is increasing for operators and regulators alike, with some cases of a clear divergence from international best practice.

As the transition to mobile broadband is likely to increase pressure on existing infrastructure and drive demand for faster connectivity in previously underserved areas, it is essential that an effective QoS regime is established in markets across the region to serve the interest of policymakers and regulators, services providers and end users. To evaluate the impact of current QoS regulations in the region, the GSMA conducted a survey of regulators and service providers to understand their respective perspectives of QoS regulations. The key findings are discussed below.

Contrasting views on the underlying reasons for QoS failures

Our survey results show differing views between regulators and mobile operators on the main reasons for QoS failures in markets across the region. While the majority of regulators consult with mobile operators to varying degrees in the process of setting KPIs and targets, the evidence suggests that operators' inputs are not always taken into account in the final regulations. This may explain the contrasting views between both parties on QoS failures, as seen in Table 3.

Table 3

Regulator and operator views on the factors behind poor QoS

Regulators	Mobile operators
• Insufficient investment in network infrastructure, impacting coverage and available capacity. • Poor spectrum optimisation. • Inadequate optimisation of networks, leading to improper network configuration with resultant failure in call handover and co-channel interference. • Delay or failure to upgrade ageing equipment to meet growing demand. • Unwillingness to invest in rural areas with lower returns on investment. • Poor signal quality due to interference, especially in border areas. • Poor social infrastructure, including power supply.	• High cost of spectrum for access and wireless backhaul networks. • Scarce spectrum, leading to some operators using coding schemes that offer lower quality than contractual voice quality. • Poor power supply and frequent outages, especially in rural areas. • Vandalism, including theft and cable cuts during road and other construction works. • Seasonal fading, especially during the wet season. • High traffic growth, leading to network congestion. • QoE impact by low smartphone adoption and lack of digital skills.

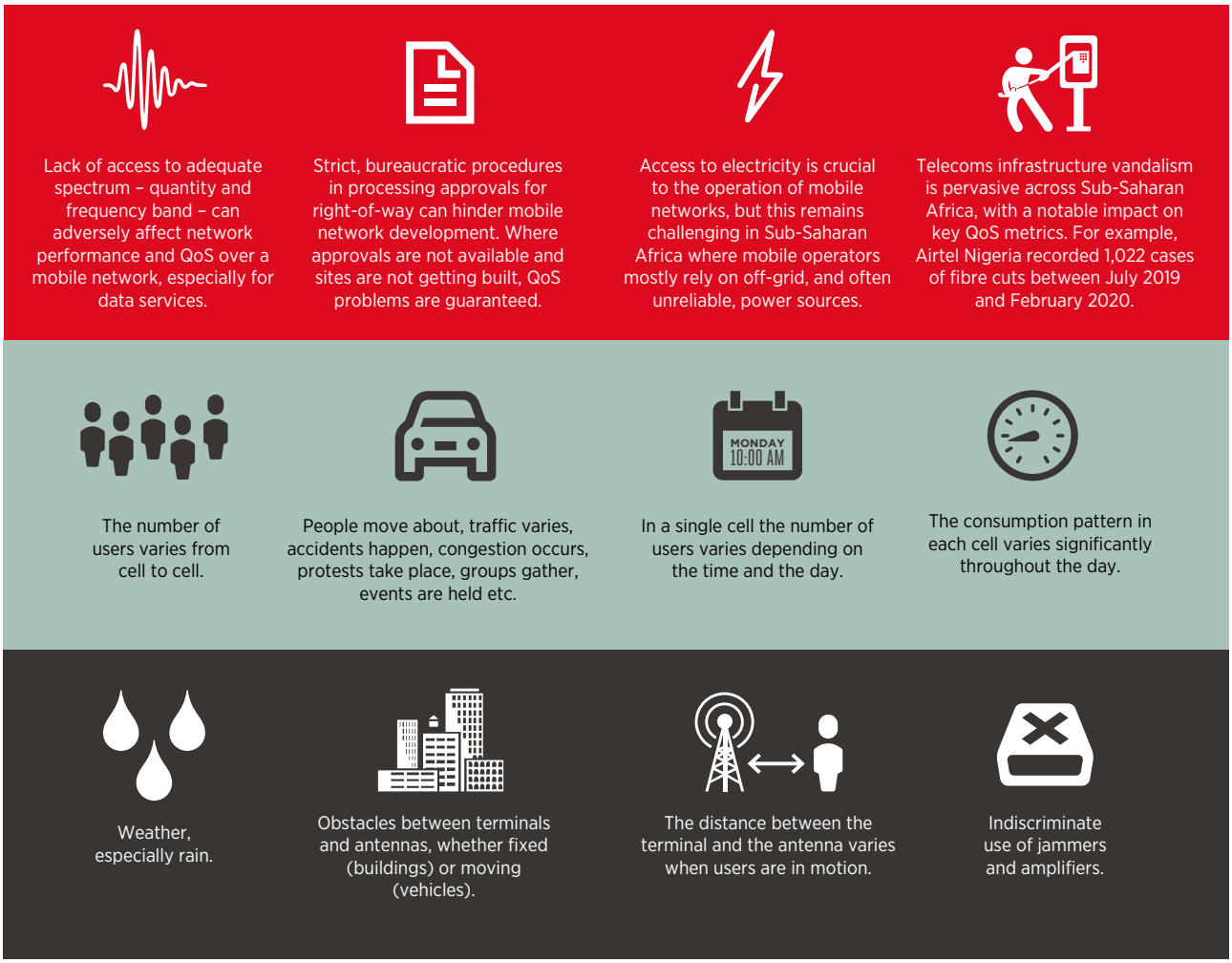
Source: GSMA Regulator and Operator QoS Survey 2020

Regulators usually characterise – and in turn monitor – QoS by a collection of parameters, notably call success, downlink/uplink speed and packet loss. Poor QoS can constrain citizens' participation and contribution to the digital economy. However, failures do not always sit squarely with operators. Quality from the mobile tower to the terminal is also affected by other factors such as consumption patterns, network load, user device (especially counterfeit handsets), weather-related interference, vandalism, fibre transmission networks and the power supply.

In most cases, existing QoS regulations do not take these extraneous factors into account, meaning that mobile operators risk sanctions for QoS failures that are caused by factors beyond their control. In a West African market, for example, a leading operator considers that external factors account for up to 70% of the QoS issues it faces.[14] Furthermore, the prescribed timeline to implement corrective action is very short in many cases (sometimes less than a week), and not long enough to remedy problems caused by the most serious external factors.

Figure 5

Many external factors affect mobile QoS



Source: GSMA

[14] GSMA Regulator and Operator QoS Survey 2020

Complex and disproportionate targets

While there is a degree of variation between markets, findings from our survey show that some QoS frameworks implemented in the region are complex and measure an unreasonably large number of KPIs. For example, in some cases, relevant parameters such as the dropped call rate and call retention rate are both measured even though only one of them needs to be measured, as the other can be derived using an agreed formula. This situation of measuring 'opposite' or 'duplicate' KPIs can occur for several other parameters, including handover success and dropped call rates, SMS delivery rate and SDCCH congestion, and blocked call and call setup success rates. This is another consequence of the limited consideration of operator input in the development of QoS regulations.

Table 4

Examples of duplicate KPIs

KPI	Counterpart
Dropped calls	Call retention
Call completion	Dropped calls
Handover success	Dropped calls
SMS delivery	SDCCH congestion
Call setup	Traffic channel assignment

Source: GSMA Intelligence

The proliferation of indicators may seem reassuring, but it represents a significant cost, both from a financial perspective (testing tools) and a staffing one (conducting tests, analysing results and publishing reports). Further, it does not contribute to achieving the key objective of protecting consumer interests. It also presents the risk of 'double jeopardy': if an operator misses one KPI (e.g. for dropped calls), it automatically fails another closely related but diametrically opposite KPI (e.g. for call retention). The operator could then be sanctioned for not meeting both parameters, even though they are essentially measuring the same quality (i.e. ability to hold a call from start to finish without disruption) when considered from a consumer perspective. Even where there is strong public support for stringent rules, making it difficult for operators to adhere to their licence conditions is not a sustainable strategy.

The benefits of a 'more KPIs, more sanctions' regime are unproven and the approach can have unintended consequences, and possibly detrimental effects. Some KPIs, for example coverage targets based on geography rather than population, can also be unrealistic or even technically unachievable. On occasion, the audit timeframe does not afford operators enough time to implement corrective action in the event of failure. Where KPIs are too stringent, compliance has financial implications that must be weighed against customer needs, but these appear to have not been considered by regulators. These scenarios can compel operators to overengineer QoS to levels that may exceed what is appropriate to indicate customer experience, and result in unfair penalties, which reduce the ability of operators to make crucial network investments.

Lack of technical standardisation

The lack of a defined, standardised and objective QoS measurement methodology has sometimes resulted in different interpretations of performance indicators, leading to discrepancies in results claimed by regulators and those reported by mobile operators. There are instances where regulators do not accurately measure QoS metrics, such as attributing inter-network call failures to the originating network, despite not having a clear indication of where the call failed. Further, there can be ambiguity as to what KPIs should be measured, how they should be measured and what targets should be set for the KPIs, in addition to a general lack of clarity and consensus as to the management and monitoring methodology of QoS.

The challenges associated with measuring service without clear and standardised indicators manifest in the use of 'drive tests'. Regulators and operators typically have different views on how QoS drive tests should be conducted. Potential areas of contention include the following:

- If two user devices are used, should they be mobile and in the area being covered or should one be mobile and the other static?
- If static, what should be the location of the static device – the regulator's office, the operator's premises or a random location?
- What locations should drive tests be done in – near the cell towers or at the edge of the coverage area?
- How is data analysed to produce information about the network – using a generic formula or one provided by the operator/equipment vendor?

In some cases, regulators conduct such tests to take a snapshot of a mobile network in a specific location, sometimes in a reactive way in order to satisfy public sentiment or even as a means of imposing fines. From the operator perspective, the results of these drive tests can be contentious and not objective, considering that they may not be representative of the network, especially if the test covers a relatively narrow geographic area/short timespan or involves a small sample size. If drive testing is performed in an area where an operator has not yet deployed infrastructure, this can have a negative effect on its overall QoS result and lead to potentially erroneous non-compliance with its licence conditions.

Outdated and homogeneous regimes

The mobile industry has evolved dramatically compared to other industries, driven by transformative technology and changing consumer behaviours. Yet, the principles that drive QoS regulations in many countries across Sub-Saharan Africa – such as Tanzania – were designed many years ago and/or have not been reactive to change. For example, regulators have retained a keen focus on voice-related KPIs. And when they introduce new parameters for mobile data services, these just supplement the (already extensive) list of KPIs, thereby increasing the regulatory cost of compliance.

Further, regulations follow a one-size-fits-all principle for locations that are considerably different in nature, which underestimates the importance of market conditions and external factors in delivering high-quality data services. For instance, QoS standards for deep rural areas are often set at the same level as those for very densely populated capital cities. Stringent, uniform obligations that do not consider the actual situation on the ground can be a strong deterrent for operators to invest in the most remote parts of the country – and, more importantly, they do not necessarily address the needs of the concerned populations living in those areas.

Counterproductive financial penalties

In many countries across the region, financial penalties in the form of fines are routinely imposed on operators for failing to meet QoS targets. The justification by regulators is that financial penalties can provoke the required investment to improve QoS. In reality, this is mainly counterproductive, has a stigmatising effect on operators and can mean the consumer loses out in the long run.

First, fines and the threat of fines create uncertainty for operators and affect their ability to make and execute long-term network development plans. Second, the settlement of financial sanctions takes away vital funds that would otherwise have been spent on network improvement – this then reinforces a common perception among regulators in Sub-Saharan Africa that mobile operators are underinvesting. Also, where targets may be technically unachievable, the fines simply become recurring.

A regulatory framework with financial penalties at the centre often leads to operators provisioning for fines, which ultimately deducts from the network expansion and improvement budget. Moreover, the scale of fines in some markets has put pressure on regulators elsewhere in the region to follow suit, or they risk being accused of complacency in addressing QoS concerns. Indeed, there is a perception in some quarters that the ability to levy financial penalties is an indication of regulatory effectiveness.[15] This is especially worrisome in the context of Sub-Saharan Africa, given that a considerable proportion of the population is still unconnected, and onerous fines have the potential to exacerbate the digital divide by adversely affecting network investment plans.

[15] Another fine mess for African telecoms, Xalam Analytics, 2018

3.2 Laying the foundation for modern QoS regulation

Not so long ago, simply having access to a mobile signal was considered innovative. Today, better networks and the digital applications they underpin are having a profound impact on the way people and communities live, work, play and communicate. As a result, the standard for 'good' mobile access has risen dramatically. Mobile devices have facilitated widespread access to voice services, while the exponential growth of smartphone penetration is democratising and universalising internet access.

In light of the assessment of current QoS regulations, policymakers and regulators need to adopt appropriate QoS policies that are fit for the modern age. This involves moving from a 'command and control' regime to an ex-post consumer empowerment model, adopting forward-looking QoS policy frameworks characterised by collaborative action, objective measurement protocols, and fair and reasonable enforcement mechanisms.

This approach recognises that consumer interests are not in opposition to those of mobile operators, and creates connections between the two sides; it also passes decision-making power to users to stimulate operator responses. This leads to lower compliance costs, more informed consumers and regulators, and greater latitude for operators to concentrate financial resources on their networks, thereby improving service quality and bridging the digital divide.

Below, we highlight key steps for policymakers and regulators in the region to transition to modern QoS regulatory frameworks built on the foundational pillars of consultation, cooperation and a consumer focus.

Streamline KPIs

There is a need for a modern, simplified monitoring and enforcement regime, which avoids an overreach of QoS regulations. This means limiting ex-ante obligations to what is strictly necessary and repealing what is not (e.g. streamlining the volume of KPIs to make the burden practical and manageable). Progressive regulation should therefore establish a concise list of practical and achievable KPIs that align to ITU standards (in terms of parameters, definitions and formulae) and are understandable to consumers to allow for meaningful comparisons of available services.

Combined with a reasonable set of associated targets, this approach can strike a balance between guaranteeing proper QoS oversight, minimising manpower requirements and allowing the free functioning of competitive markets. For example, with respect to Ethiopia's proposed QoS directive, the regulator should consider rationalising the number of parameters outlined in the draft legislation in line with international best practice and with the most significant factors influencing the performance experienced by the customer.

Francophone regulators under the auspices of Fratel have engaged in work aiming to reconsider the pros and cons of the 'more KPIs, more sanctions' approach and to explore other avenues, including leveraging data-driven regulation. Similarly, regulator IMDA in Singapore has chosen pragmatically to 'measure less to measure better'. For mobile broadband, the country retains just three coverage-related indicators, which include both indoor and outdoor service availability. IMDA has also developed an app that consumers can voluntarily download to share with it data on their connection. As poor QoS carries the threat of regulatory response, operators are encouraged to ensure high-performing networks across the city state.

Align QoS regulations with local market dynamics

No two markets are the same, even within a fairly homogenous region such as Sub-Saharan Africa. The policy challenge, therefore, is to find the appropriate framework, rules and mechanisms that work for a local market. This means devising targeted recommendations and KPIs, which take into account ongoing market development and transformation (e.g. declining P2P SMS volumes), in collaboration with local stakeholders.

Solutions to improve QoS are unique to each case and require specific measures by mobile operators and regulators. The development and selection of indicators, and the level of quality requirements must be determined in relation to a specific context, which takes into account local dependencies, such as incidences of vandalism, fibre transmission infrastructure, weather, topography and access to reliable power supply.

The type of regulation adopted should also relate to the degree of competition between operators in the various market segments, not only on a nationwide basis but also at a regional or municipal level. This could mean some variation of standard parameters or foregoing uniform obligations to all providers. In Brazil, operators with less than 5% market share enjoy some exemptions, while the DRC regulator has issued for consultation a draft QoS regulation where KPIs are different for urban and rural areas.

A mixed approach between ex-ante licence obligations and ex-post monitoring tools and complaints platforms can be appropriate. However, heavy-handed regulation that increases costs and diverts financial resources away from network investment, leading to bad outcomes for operators and consumers alike, should be avoided. There is also a case for relaxed, light-touch QoS regulation to support capex projects aimed at expanding coverage of mobile services in rural areas, proportionate QoS rules, such as minimal KPIs and standards, and data publications that help end users make informed comparisons and decisions on the service that is best suited to their needs.

Establish objective measurements

Technical measurements of network quality performed by regulators are extremely important for promoting competition but are becoming more complex. Tests conducted from user terminals, through various applications, provide one-sided information that depends on factors outside the network, including the number of users, location, the measurement methodology and reporting device. Applications can be useful but should not be the only way to measure quality – and they should not be used as a basis for sanctions for failing to reach certain levels.

To measure QoS effectively and objectively, regulators need to keep pace with technology, market and business innovations. Hence, a modern approach means:

- considering a combination of statistical tests generated by operators and third parties
- using automated methods for drive tests, with no manual intervention
- performing tests on an end-to-end basis on a single network
- applying a minimum significant call sample size to ensure test results are representative of the network situation within the area of service
- using sufficient testing times of at least 24 hours.

Increase collaboration with service providers

Modern regulation means the private and public sectors engaging in constructive dialogue in finding the solutions to improve quality, especially against the backdrop of external factors that are beyond the control of operators. For operators, there is an encouraging trend towards a greater tendency of regulators to consult the industry when devising QoS policy, but the broad consensus is that very few of their inputs are taken into account in the final regulations. Where regulators are able to develop relationships to collaborate more closely with mobile operators, more favourable arrangements and outcomes are likely. To that end, standardisation through ITU Study Group 12 has helped to build a common understanding and trust between stakeholders and should be leveraged by regulators in Sub-Saharan Africa as a platform for greater collaboration with operators.

The results of objective measurements can be used effectively to discuss with operators the problems encountered and the best solutions available to design improvement plans. Problems are often zone-specific (e.g. installation permits not granted, interference, insufficient spectrum, plans in progress) and solutions are therefore holistic and situation-specific. Allowing a reasonable timeframe before publicly announcing the results of any new measurement gives the regulator an opportunity to correct any results that may have been incorrectly calculated. It also lets operators:

- check the accuracy of the measurements
- work on any network problems they may be unaware of to improve the indicators
- explain the findings and the subsequent steps to deal with them.

Leverage all technological capabilities

The shift to packet-based communications and the increasing usage of over-the-top (OTT) applications has introduced new challenges to the assessment of QoS and QoE. The declining prices of data and smart devices are making these challenges even more significant in Sub-Saharan Africa. Regulators are increasingly interested in the real-time monitoring of network quality and performance prediction; however, in many cases, QoS measurement tools appear to ignore essential aspects of service delivery (such as resource sharing or instances where failures occur in a part of the network not controlled by operators).

Consequently, there is a need for regulators to revisit existing measurement practices and take into account new technologies, which represent an opportunity for regulators to incorporate end user interests more effectively into the policymaking process. The motivation here is not to add new constraints or costs but to move progressively towards a data-driven approach built on standardised testing methodologies. To measure actual QoS, regulators should use a combination of:

- operators' own measurements
- fair and comprehensive drive tests
- the collection of information from users in real-world conditions.

Regulators should define the testing methodologies for each of these techniques in close collaboration with mobile operators and independent experts. They will then be able to verify measurements directly from operators (with problems and outliers detected) before results are published and use structured crowd-sourcing programmes that avoid biases and allow accurate comparisons on customer experience between operators. All of this will provide users with specific and personalised information (e.g. comprehensive maps detailing quality and coverage) to help them make better choices, which should be complemented by the presence of a formal channel by which consumers can inform the regulator of any problems they encounter.

Explore alternatives to financial penalties

Besides addressing non-operator factors (e.g. spectrum), achieving QoS improvements will require a different approach to punitive sanctions for QoS failures. In particular, this means avoiding financial penalties, such as fines and automatic compensation schemes. These measures deliver little in the way of restoring consumer welfare, while the financial pressure they put on operators prevents the allocation of resources to improve various elements of the network infrastructure. In 2015, the Indian Supreme Court invalidated a customer compensation system put in place by the telecoms regulator, TRAI, finding that the sanctions on operators had no positive impact on network investments.[16] Furthermore, findings of a Fratel study indicated that "if the regulator finds itself required to impose penalties, it means that the regulation was not as effective as expected, and can be considered a failure".[17]

A modern regulatory framework recognises the telecoms sector's substantial contribution to the economy and is designed to improve QoS in mobile communications by promoting the right conditions for mobile operators to sustain and target their investments. One alternative would be a mitigation-based approach, whereby regulators agree corrective measures with operators (possibly as part of the licence renewal process) that, if delivered successfully, annuls the penalty. Where fines remain a part of the QoS framework, regulators should consider mandating the reallocation of proceeds to network investment in areas that need it most. For example, in 2019, the regulator in Chad signed a memorandum of understanding with the country's two operators, Tigo and Airtel, so that the outcomes of any fines are invested directly in improving the coverage and quality of their networks. This approach would benefit consumers through better QoS, while operators would invest more. The government would also benefit in the long term through higher tax payments from increased usage.

[16] "What regulation is needed to support good quality of service on mobile networks?", Orange Regulatory Affairs Middle East & Africa, October 2018
[17] Measuring mobile network performance: coverage, quality of service and maps, Fratel, 2020

Spotlight on South Africa

Some countries use non-financial sanctions, such as the obligation to publish information on failures, to meet targets. This creates another form of pressure for operators through market perception and can encourage them to embrace corrective measures. This type of mechanism has, for example, already been in place for several years in South Africa, where the regulator does not always resort to financial sanctions to develop QoS. Though ICASA can enforce fines of up to ZAR5 million, it mainly uses mechanisms designed to put pressure on telecoms operators, including through 'name and shame' tactics, and encouraging (before forcing) them to correct problems on their networks. Non-monetary penalties may include the publication of non-compliance with licence conditions on the websites of the operator and ICASA, as well as awareness campaigns in national newspapers, radio and/or television, and additional platforms as determined by the regulator.[18]

Manage the transition to QoE

In most developed markets, regulators typically include the end-to-end consumer experience in their determination of overall quality. Some regulators in Sub-Saharan Africa, such as those in Ghana, Kenya and Senegal, are either considering or have conducted QoE measurements: some administer end-user surveys, while others have installed QoE measurement applets on a sample set of SIM cards, which send QoE data to the regulator for assessment.

However, this should be approached with caution considering the subjective nature of QoE measurements and the consumer-related factors that could be out of the control of service providers, such as device quality and specification, access to reliable power supply and digital literacy/skills.

Given the growing shift towards QoE, regulators should take into consideration the consumer-related factors that could contribute to a poor QoE rating, and avoid measuring and penalising operators for QoE failures that may be attributable to such factors. QoE frameworks need to be objective and developed in collaboration with the industry – some operators already track various QoE elements and conduct independent net promoter score (NPS) assessments as part of efforts to improve customer experience. Indeed, competitive markets will work to penalise those operators that fail to deliver high QoE, removing the need for regulatory intervention. In addition, authorities should also carry out robust awareness campaigns to educate consumers on QoE, particularly regarding failures that may not be related to operators' networks.

Monitor international best practice

The best direction for QoS is still being discussed in national and international fora, with stakeholders exploring the most appropriate methods for addressing changing customer expectations. Regulators in Sub-Saharan Africa should keep abreast of these conversations and focus on placing consumers at the heart of the process – for example, providing consumers with the tools to access precise and personalised information (including maps), which can stimulate public debate and operator investment.

Looking ahead, 5G will be part of the region's future digital landscape. Several operators have launched commercial 5G networks, and more are expected to follow suit over the decade. The OECD has recognised the impacts that IoT and AI will have on mobile networks in the 5G era, which should prompt regulators to consider developing measures for resilience, robustness, latency, and reliability – service dimensions that will be critical to advanced applications and digital transformation. Some regulators in the region, including those in the DRC and Namibia, have expressed their intention to adjust the QoS policy framework to reflect the emergence of next-generation networks and transformative technologies, evolving KPIs and measurements for QoS/QoE based on collaboration with operators.

[18] End-user and Subscriber Service Charter Regulations 2016

4. Improving mobile QoS and QoE in Sub-Saharan Africa

Mobile connectivity is generating profound benefits across Sub-Saharan Africa, helping to promote inclusion and support the delivery of public policy initiatives. As the mobile subscriber base grows and the digital economy expands, governments and service providers have an interest in providing high-quality connectivity to individuals and businesses. As a result, operators continue to invest vast sums every year to expand coverage and capacity. In 2019, MTN Group rolled out a total of 5,795 3G sites and 10,895 4G sites,[19] while Airtel Africa increased its data capacity by 64% to 7,572 TB despite a daily utilisation rate of less than 40%.[20]

Modern QoS regulations that are developed in collaboration with operators and through a consumer lens are a step in the right direction. Beyond that, there is an opportunity for policymakers and regulators to actively use policy levers to accelerate investment in network infrastructure and, by extension, improve QoS and QoE for end users. In this section, we highlight four policy levers than can help improve QoS in the region: spectrum, tax reform, access to infrastructure and market competition.

[19] MTN FY19 financial report
[20] Airtel Africa FY19/20 financial report

4.1 Spectrum

Spectrum is a precious and finite resource, fundamental to the delivery of mobile services. The availability of spectrum under the right conditions – quantity, frequency band, technology neutrality and pricing – is crucial to network performance, mobile broadband capacity and coverage expansion. It is essential for the development of the mobile sector that a clear and comprehensive spectrum roadmap is in place to provide long-term visibility and certainty. A holistic roadmap that outlines government strategy for the release and renewal of spectrum reduces uncertainty and allows operators to assess the viability of and return on investments.

With mobile data traffic in Sub-Saharan Africa expected to increase more than fourfold by 2025, coordinating and accelerating the analogue to digital switchover (DSO) and freeing the digital dividend spectrum bands for mobile broadband will be essential steps in bridging the digital divide and meeting the strong demand for data services. Sub-1 GHz spectrum has better signal propagation than higher frequencies, and its use can reduce the number of base stations required for rural coverage expansion by up to 50%. In many markets, technology-neutral spectrum-licensing frameworks allow mobile operators to refarm 2G spectrum in the 900 MHz and 1800 MHz bands to provide 3G and 4G services at the risk of degrading 2G voice quality.

4.2 Tax reform

The positive contribution of the mobile sector to the economy is well recognised. However, the tax treatment of the sector is not always aligned with best-practice principles of taxation, which can have a distortive impact on the industry's development. Inconsistent or unpredictable fiscal policies, including special taxes that discriminate against the mobile sector, can lead to delayed or cancelled investment.[21] Excessive tax has a deflating effect on the business environment and reduces operators' ability and incentive to invest in the quality and coverage of their networks. In the Sub-Saharan African countries for which data is available, general and sector-specific taxes paid by the mobile sector in 2017 represented on average 26% of mobile sector revenues.[22]

Countries that have a higher level of taxes and fees as a proportion of sector revenues tend to have relatively low levels of readiness for mobile internet connectivity, as measured by the GSMA's Mobile Connectivity Index. Also, taxation levied on mobile services and devices, especially over and above standard rates, exacerbates affordability challenges (particularly for the poorest consumers) and coverage barriers for the underserved. Chad and Gabon both apply taxes and customs duties to handsets,[23] while Kenyan consumers face a relatively high tax burden compared to their regional counterparts due to the accumulation of excise duties on mobile services and mobile money.[24] Through policy reform, governments have the opportunity to simplify and rebalance mobile industry taxation, and stimulate usage and investment in network infrastructure.

4.3 Access to infrastructure

Strict regulations and procedures for rights of way in Sub-Saharan Africa hinder the deployment of mobile network infrastructure, as substantial resources and time are diverted to tasks not related to overall quality. The rapid and efficient rollout of mobile broadband will require both operator investment and new approaches from regulators. Policymakers should identify mechanisms to streamline and expedite deployments, including non-discriminatory simplified access to federal and municipal infrastructure facilities, connection to municipal or transport energy infrastructure, and facilitation of permissions and standard processes.

Similarly, network sharing can improve QoS for consumers and businesses. For operators, the high upfront investment required to deploy mobile infrastructure and the long repayment cycle present risks and challenges. Network sharing can lower the cost of expanding mobile broadband coverage in remote areas by allowing operators to jointly use resources, creating efficiencies. Regulators should encourage voluntary sharing of passive and active elements of the network to facilitate the efficient expansion of networks to underserved communities.

[21] Digital Nation: Policy Levers for Investment and Growth, AlphaBeta for the Asia Internet Coalition, 2017
[22] Rethinking mobile taxation to improve connectivity, GSMA, 2019
[23] Taxing mobile connectivity in Sub-Saharan Africa, GSMA, 2017
[24] Mobile taxation in Kenya: Accelerating digital development, GSMA/EY, 2020

4.4 Market competition

Ensuring good QoS and QoE requires high network performance. This is a fundamental aspiration for mobile operators, which want to use these levers to differentiate their offerings and gain a competitive advantage. Continuous network improvement has meant high levels of investment in Sub-Saharan Africa in the last decade, with a further $52 billion of capex estimated for the 2020–2025 period. Operators are motivated to improve QoS, as it allows them to differentiate their offerings and meet customer expectations. As a result, operators are keen to manage changing traffic patterns and congestion, and work to augment capacity and expand coverage.

Market pressure on QoS is highest when consumers have the information they need about the service available from different providers and the power to switch between operators. Regulators can use levers around competition to stimulate the required investments to improve QoS. For example, the introduction of mobile number portability (MNP) in various markets across Sub-Saharan Africa has resulted in a marked increase in competition, leading to many operators ramping up coverage and enhancing capacity in a bid to reduce churn.

In addition, regulation around maximum initial commitment periods and the conditions and procedures for contract termination can stimulate competition, as consumers are not 'locked in' and operators are further incentivised to attract and retain subscribers. Regulators can also publicise reports on network performance to incentivise investments and corrective measures to improve performance for operators with low scores in market perception.

Stakeholder collaboration is essential to improve the QoS for mobile services

Universal access to reliable mobile services is crucial to realising the socioeconomic benefits that connectivity and digital services can bring to society. Governments and regulators, mobile operators, and end users across Sub-Saharan Africa have a mutual interest in the provision of mobile services, including mobile broadband, to high service quality levels.

QoS regulation is a vital mechanism to inspire the provision of high QoS and QoE for end users. It is therefore essential to establish and maintain a modern approach to QoS regulations to protect consumers, promote fair competition and encourage continuous investment in network infrastructure and services.

Continuous improvement in the quality of mobile services requires collaboration between regulators, service providers and other stakeholder groups. This facilitates the advancement of QoS regulatory solutions that reflect local market conditions in the KPIs and targets, and best supports the different stakeholders in their respective responsibilities towards the provision of high QoS and QoE.

Appendix

A.1 Supplementary tables and data

Table A1

Common QoS KPIs in Sub-Saharan Africa

KPIs	Markets imposed (examples)
Call setup success rate	Chad, Kenya, Uganda, South Africa, Cameroon, Eswatini, Sudan, Senegal
Call drop/cut-off rate	Chad, DRC, Kenya, Uganda, Namibia, South Africa, Benin, Cameroon, Eswatini, Sudan, Senegal, Côte d'Ivoire
Call success rate	Chad, Namibia, Benin, Nigeria, Ghana
Blocked call rate	Uganda, Benin, Burkina Faso
PS call setup success rate	Chad, Sudan, Nigeria, Ghana
CS voice call drop rate	Chad
PS call drop rate	Chad, Sudan
Service RRC setup success rate	Chad
RRC drop rate	Chad
ERAB drop rate	Chad
Network/cell availability or coverage	Chad, Congo, DRC, Kenya, Uganda, Namibia, Benin, Cameroon, Eswatini, Sudan, Côte d'Ivoire, Senegal
CS fall back	Chad
Mean opinion score	Kenya, South Africa, Eswatini, Burkina Faso
Net promoter score	South Sudan
Call centre complaints handling/resolution	South Sudan, Uganda, Eswatini, Burkina Faso, Côte d'Ivoire
Handover success rate	Kenya, Sudan
SMS delivery rate	Kenya, Namibia, Benin, Eswatini, Sudan, Burkina Faso, Côte d'Ivoire
SMS delivery time	Kenya, Eswatini, Sudan, Ghana
HTTP download rate/throughput	Kenya, Uganda, Namibia, Tanzania, Eswatini, Sudan
Packet loss	Namibia
Latency	Tanzania
Dropped internet sessions	Kenya, Namibia, Benin, Eswatini
Successful internet log-ins/connection	Kenya, Uganda, Namibia, Benin, Eswatini, Burkina Faso
International call connectivity	Namibia
Radio channel signal level	Tanzania
Radio channel signal quality (C/I)	Tanzania
Radio channel assignment attempts, success and failure rate	Tanzania
Cell downtime	Benin, Estwatini, Sudan, Burkina Faso

Source: GSMA Regulator and Operator QoS Survey 2020

Table A2

Examples of current QoS KPIs and targets in Sub-Saharan Africa

Country	KPI and target
Ghana	• **Call setup time –** Measures how long it takes to hear a ring back tone after initiating a call. The threshold for compliance is over 95% of call setup time measurements being less than 10 seconds. • **Voice quality (mean opinion score) –** Measures the perception of the audio quality of the conversation on a call. The mean opinion score scale ranges from 1 to 5, with 1 being poor audio quality and 5 being excellent. The threshold for compliance is an average of all voice quality (mean opinion score) measurements being greater than 3.5. • **SMS/MMS delivery time –** Measures the time of service delivered to destination number minus the time of service sent from originating number. It is set at less than or equal to five seconds. • **Data throughput –** Measures the rate of data transfer. It measures how fast data is transferred from a file transfer protocol (FTP) server to a mobile device. It is measured in kilobits per second (kbps). The threshold for compliance is over 90% of all data throughput measurements being equal to or greater than 256 kbps. • **3G coverage –** Assesses whether a mobile operator has 3G presence in a district capital or not. This is done by measuring the downlink signal level, received signal code power (RSCP). The unit of measurement is the decibel-milliwatt (dBm) and threshold for compliance is an average of all measured RSCP levels being equal to or greater than -105 dBm.
Nigeria	• **Call setup success rate –** Calculated by taking the number of unblocked call attempts divided by the total number of call attempts. The call setup success rate should be equal to or greater than 98%. • **Dropped call rate –** A dropped call is a call that is prematurely terminated before being released normally by either the caller or called party. The dropped call rate is calculated by dividing the number of dropped calls by the total number of call attempts and should be less than or equal to 1%. • **Standalone dedicated control channel congestion rate –** The probability of failure of accessing a standalone dedicated control channel (SDCCH) during call setup. The SDCCH congestion rate should be less than or equal to 0.2%. • **Traffic control channel congestion rate –** The probability of failure of accessing a traffic channel during call setup. Traffic control channels (TCCH) are responsible for transferring control information between mobiles and the BTS. The TCCH congestion rate should be less than or equal to 2%.
Uganda	• **Blocked call rate –** The maximum proportion of call attempts on the network that should be blocked. The target is 2%. • **Dropped call rate –** The maximum proportion of successful call attempts on the network that should be dropped. The target is 2%. • **Success call rate –** The minimum proportion of calls attempts on the network that should be successful. The target is 98%. • **Data throughput –** How much data (number of data packets) that gets transferred from one point on the network to another in a given amount of time. It is measured in bits per second (bps).

Source: GSMA Intelligence, NRAs

Country	KPI and target
Chad	• **Call setup success rate –** 98% • **Call drop rate –** 2% • **Call success rate –** 97% • **PS call setup success rate –** 99% • **Voice call drop rate –** 2% • **PS call drop rate –** 2% • **Service RRC setup success rate –** 99% • **RRC drop rate –** 3% • **ERAB drop rate –** 3% • **Cell availability –** 99% • **CS fall back –** 98%
South Africa	**Voice** • **Call setup success ratio –** Average call setup success ratio must be greater than 98%. • **Call setup time ratio –** Average call setup time must take less than 20 seconds. • **Drop call ratio –** Average drop call ratio must be less than 3%. • **Speech quality –** Average speech quality of mean opinion score must be greater than 3.

Table A3

Examples of sanctions for QoS breaches in Sub-Saharan Africa, 2014–2019

Date	Market	Sanction	Details
December 2019	Tanzania	**Fine –** TZS5.9 billion ($2.6 million)	The Tanzania Communications Regulatory Authority (TCRA) fined six operators TZS0.45–1.6 billion each for failing to meet QoS standards in Q3 2019.
December 2019	Niger	**Fine –** XOF2.57 billion ($4.5 million)	Arcep fined four operators 1–1.5% of their annual turnovers in 2018 for failing to meet QoS standards.
November 2018	Ghana	**Fine –** GHS34.1 million ($7 million)	The NCA fined four operators GHS4.5-11.6 million each for breaching various QoS requirements. Operators were given three months to rectify network issues, but could not meet KPI thresholds once the deadline was reached.
June 2018	Zambia	**Fine –** ZMW12.6 million ($692,000)	The Zambia Information and Communications Technology Authority (ZICTA) fined three operators ZMW3.6–4.8 million each for failures related to mean opinion score, HTTP log-in success and SMS success rate over two quarters.
January 2018	Kenya	**Fine –** KES311 million ($3 million)	The Communications Authority of Kenya (CA) fined three operators for missing the 80% minimum standard for eight KPIs for the 2015/2016 financial year.

October 2017	Niger	**Fine –** XOF3.5 billion ($6.3 million)	Arcep fined four operators for failing to improve their network coverage and QoS indicators.
September 2017	Cote d'Ivoire	**Fine –** XOF5 billion ($9 million)	The Telecommunications Regulatory Agency of Cote d'Ivoire (ARTCI) fined three operators following its audit of QoS for 2016, where it found a number of infringements when measuring voice quality, call setup times, failed calls and other criteria.
September 2017	Sierra Leone	**Fine and customer redress –** $1.35 million, plus three consecutive days of free calls in compensation to subscribers.	The National Telecommunications Commission (NATCOM) fined three operators for failing to meet the requirements for KPIs.
July 2017	Benin	**Fine –** XOF523.49 million ($920,000)	Arcep fined two operators 0.3% of their 2016 turnover for breaching their QoS obligations.
April 2017	Tanzania	**Fine –** $310,000	In April 2017, six operators were collectively fined following an audit that found all operators had fallen short of delivering on provisions included in their QoS agreements.
July 2016	Benin	**Fine –** XOF176.17 million ($298,000)	Arcep ordered two operators to repay their customers in phone credit as compensation for poor quality of services.
November 2015	Senegal	**Difficult negotiations for licence renewal**	Members of Parliament asked the government not to renew the licence of a mobile operator until it made a commitment to provide assurances that it will improve its QoS.
June 2014	Ghana	**Suspension of marketing activities**	NCA temporarily barred a mobile operator from signing up new customers because of disruptions to its networks. It also banned the operator from introducing new services, promotions and offers after it failed QoS tests.
May 2014	Ghana	**Suspension of marketing activities**	NCA temporarily banned a mobile operator from implementing sales or marketing promotions after it failed QoS tests.
April 2014	Republic of the Congo	**Fine –** 1% of respective annual revenues	The Postal and Electronic Communications Regulatory Agency (ARPCE) fined two operators for failing to adhere to legal and regulatory obligations relating to performance, quality and availability of their networks.
February 2014	Nigeria	**Fine and suspension of marketing activities –** NGN647.5 million ($4 million)	The Nigerian Communications Commission (NCC) fined three operators for failing to meet QoS targets. The operators were also temporarily banned from selling new SIM cards, deleting inactive SIMs from their networks, supplying new SIM cards from their warehouses to dealers or third parties, and offering promotions until the KPIs were met.

Source: GSMA Intelligence

A.2 Research methodology

This report utilised secondary research and data from GSMA Intelligence and other trusted third parties. We also surveyed mobile operators and regulators across Sub-Saharan through a questionnaire. This has enabled the GSMA to gather comprehensive information, insights and views on mobile QoS across several perspectives.

Questions to mobile operator groups

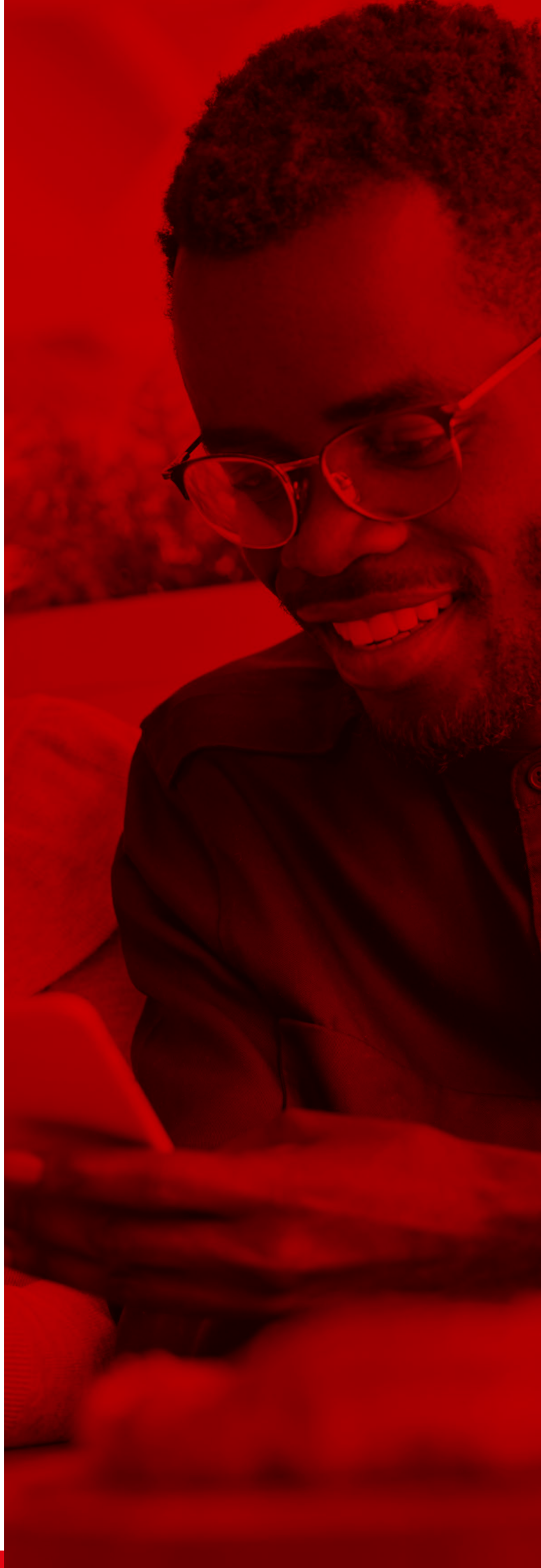
1. In the context of your business, what do you understand by quality of service (QoS) and quality of experience (QoE)?
2. For the market(s) in which you operate, what is your view on the current QoS legal and regulatory framework?
3. What are the parameters against which you measure and report QoS?
4. For each of the markets in which you operate, how does the regulator monitor QoS? Have you been consulted during the process to set the KPIs by which QoS will be measured?
5. Do you face any challenges in meeting the QoS requirements in your market(s)? If yes, what are the main challenges you face?
6. Are there any external factors that contribute to failure in meeting QoS requirements? What kind of support do you think is required in order to address these challenges and improve QoS?
7. Since 2010, for each market in which you operate, have you been fined for not meeting QoS requirements? Could you share the total amount of fines you have faced and the relevant legal reference(s)?
8. Does the implementation of 4G have an impact on the QoS of your network, mostly for voice service?
9. For the market(s) in which you operate, what has been the most significant change in the QoS framework? What other changes would you recommend to regulators in your market(s)?

Questions to regulators

1. In the context of the telecoms sector, what do you understand by quality of service (QoS) and quality of experience (QoE)?
2. Please outline the QoS legal and regulatory framework in your market.
3. What are the motivations behind the QoS regulation currently in place?
4. What QoS/QoE obligations and reporting measures are imposed on mobile operators?
5. Are the KPIs described in your answer to question 3 based on the standards of a third-party organisation (e.g. the ITU, FRATEL etc.)? Alternatively, are the KPIs you measure influenced by a number of different benchmarks?
6. Does your organisation currently own or have plans to invest in QoS measurement and audit tools? If yes, what are the objectives of that tool?
7. Have you imposed sanctions on operators for not meeting a given requirement?
   a. If yes, have the sanctions allowed the operators to implement corrective measures efficiently and successfully? What was the nature of these sanctions?
   b. If no, what was the motivation for not imposing sanctions?
8. In your view, what are the factors that contribute to failure in meeting QoS requirements?
9. In future, do you expect QoS regulations to evolve in your market? If so, how?

A.3 Defining Sub-Saharan Africa

Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Chad, Congo, Cote d'Ivoire, DRC, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia and Zimbabwe.



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