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Where do we start?

Robert Shepherd,
editor, African Wireless Communications Yearbook 2021

I've written several leaders in my time, but I can honestly say that this is the first time I had to think very seriously about where to begin.

Since the world got struck down with Covid-19 coming up to two-years-ago, five million have died with or from the disease, companies have gone bust, the cost of living continues to spiral and we're in a climate crisis. However, it's now time to look forward to better times and so welcome to the African Wireless Communications Yearbook 2021 – where the leading players come to share their views on the past year and share their thoughts and dreams for the future.

The effects of Covid-19 are being keenly felt around the world and are having a significant impact on the telecom sector. As many countries continue to impose restrictions on movement, people are spending more time at home for work and leisure, and using vastly higher amounts of data. Telcos are focused on increasing network resiliency and looking at how Covid-19 impacts their planned investments, particularly in 5G. Operators are also making changes to benefit customers, who during this time need networking services more than ever. In some countries, data is being used as a tool to track and contain the spread of the virus.

Network usage in Africa is skyrocketing, with many telcos reporting large spikes. In some countries, the volume of voice calls is also increasing exponentially. Of course, network reliability is an ongoing issue but it's a long game.

Indeed, we have introduced a new section called country by country, in which we take a close look at six nations, with the help of our partners.

The good news is the African telecom sector witnessed huge revenues in Africa. MTN, Vodacom and Safaricom dominate the sector

on the continent with huge revenues of up to 6 billion US dollars. There are numerous reasons behind this. One of which was, in a way, "thanks" to Covid.

Nigeria had always been a cash economy – in stark contrast to Kenya and other parts of east Africa that have made mobile money a way of life – but the country's central bank broke with tradition to introduce its own digital currency called the e-naira. One of the reasons behind the move is said to be the spread of coronavirus through bacteria-ridden banknotes. Another factor behind the introduction of the currency is concerns about the impact of cryptocurrencies on its economy, believing that they are being used for money laundering and terrorist financing.

It will facilitate transactions, so Nigerians will be able to download the e-naira application and fund their mobile wallets using their bank accounts.

Moreover, telecom and tech companies in Africa are reaching new milestones, capitalizing on renewed international investor interest to pour money into infrastructure development, finance the roll-out of 5G, propel fibre connectivity to new areas, and deploy new mobile networks in key markets.

Thoroughbreds like pan-African fibre internet and cloud computing company, Liquid Intelligent Technologies (formerly Liquid Telecom), cross-regional mobile operator Africell and mobile operator Safaricom are the most notable African tech and telecom operators that have recently secured international financing rounds. Kenya's Safaricom, backed by a US$500m investment from the United States' Development Finance Corporation (DFC), is fronting a consortium that will build a new mobile network in Ethiopia, the most populous country in east Africa.

US-owned Africell, which has 12 million mobile subscribers in countries such as Gambia, Uganda, DRC and Sierra Leone, recently secured a US$105 million loan facility from a group of financiers led by Gemcorp. Part of this capital is expected to be used to build its new mobile network in Angola, a key African market that is keen to build up its FinTech sector.

Liquid's 100,000km pan-African network now covers 14 countries in the region and the firm recently closed a US$620m bond issue. This has brought cheap fibre broadband to about 2.7 million people in the DRC, also seen as a key cog in further roll-out of the network into West Africa as well as East Africa.

From reading the interviews inside you learn how the fixed wireless access (FWA) space continued apace as they provided a great opportunity for communications service providers (CSPs) that are open for innovation with private LTEs, 5G or CBRS.

Indeed, FWA has proved to be a serious contender within fixed broadband technologies and service adoption is beyond the tipping point, according to the Africa Digital Infrastructure Market Analysis 2021 report, compiled by Digitalthings on behalf of Digital Council Africa.

The report highlights that FWA is, in many cases, the quickest alternative to meet growing broadband service demand, particularly in the areas outside fibre coverage.

Additionally, the highest growth during the first half of 2021 has been in regions with the lowest fixed broadband penetration, namely Middle East and Africa, Central and Eastern Europe, Asia Pacific, and Central and Latin America.

Satcoms also continued to thrive as governments and the public at large had to rely heavily on e-medicine and e-learning. In fact, Martin Jarrold, vice president international

programme development, GVF explains how "over17,000 students globally, including thousands across Africa, have taken advantage of over thirty courses and over a dozen certifications covering VSAT installation and other equipment training".

The technology also played and continues to play a key role in the critical communications space as the emergency services uses it – along with TETRA digital radio products – to tend to triage and tend to medical emergencies. Ken Rehbehn, principal analyst, CritComm Insights explains in his chapter opener how Africa's "stark differences in economic development and geography create unique challenges for national governments and civil authorities."

As mission-critical LTE deployments emerge in Asia, Europe, and North America, Africa remains a land where analog radio support dominates. But times change, and government officials across the region recognize the value of digital critical communications capabilities based technologies such as TETRA, DMR, or even LTE mobile broadband. The challenge, however, is finding the right approach that works within the context of each nation's unique geographic and economic situation.

As the United States, the United Kingdom, and South Korea moved towards deployment of mission-critical broadband networks based on LTE, a vision of a single converged infrastructure supporting group voice communications and data-rich applications took shape. In Africa, that vision has failed to become a reality. Early adoption of Huawei's eLTE architecture in Kenya has not spread more broadly across the continent. Thoughts of a technology leap-frog that takes public safety agencies from aging analog infrastructure to cutting-edge mission-critical never gained traction in the face of the realities of spectrum availability, regulatory constraints, and the physics-based limitations of LTE propagation.

When it comes to affordable long-distance coverage solutions across the African continent, few options have historically beat simple analog voice transmission. And while that may remain the case for enterprise deployments, public safety officials understand the advantages of upgrading the aging analog systems with secure TETRA networks as funding permits. TETRA offers public safety authorities a rigorous security feature set along with a competitive and interoperable device ecosystem.

As one interviewee explains, those sectors and companies that have adapted over the last year will continue to thrive.

Reading through the programme for the AfricaCom virtual event, it's pleasing to see that connecting Africa's next billion, green and sustainable development as well as police, governance and leadership through change will be addressed and no doubt heavily-debated going into 2022.

Having started my musings with an unhealthy dose of cynicism, I suddenly feel very optimistic. What is now clear is that digitisation and wireless connectivity have gone forward from the impact of Covid.

As we come to the end of this year and wait to welcome the next, may I take this opportunity to thank all those who have contributed to our publications over the years and particularly 2021, when the landscape was very different and many of you no doubt harboured understandable fears about the future.

Northern and Southern African Wireless Communications could not have flourished if it wasn't for your support and I welcome more editorial from you in 2022. ■

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chapter 1 State of the Market

The cloud of uncertainty that covered Africa's telecom space as result of the Covid-19 pandemic, along with other ongoing political situations, left the continent in a state of flux over the past 18 months. Now, as we (hopefully) begin to emerge from the other side, analysts, researchers and other writers have compiled a raft of content that updates us on the current state of the market.

The International Telecommunication Union (ITU) is the United Nations specialised agency for information and communication technologies – ICTs.

It prides itself on a commitment to connecting all the world's people – wherever they live and whatever their means. Through our work, we protect and support everyone's right to communicate.

ITU Regional Office for Africa frequently publishes reports on the region - two of which we have sampled below.

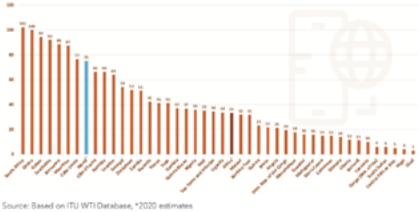
Digital trends in Africa 2021

Mobile market developments

The African mobile market is very diverse, with mobile cellular subscriptions far in excess of 100 per 100 inhabitants in 12 out of 44 countries, namely Seychelles, South Africa, Botswana, Mauritius, Côte d'Ivoire, Gambia, Gabon, Ghana, Mali, Namibia, Senegal, Cabo Verde and Kenya. Twenty countries have subscription rates per 100 inhabitants below the African average of 82.3, while 12 other countries have less than 50 subscriptions per 100 inhabitants (Figure 4). In

Source: Based on the ITU WTI Database, December 2020 edition

Figure 4: Mobile cellular subscriptions, African countries, 2019 and CAGR (%), 2015-2019



Source: Based on ITU WTI Database, *2020 estimates

Figure 5: Active mobile broadband subscriptions per 100 inhabitants, 42 African countries, 2019

most countries, mobile cellular subscription rates have increased over the time-period 2015-2019 (see CAGR in Figure 4).

African active mobile broadband subscriptions per 100 inhabitants reached 33.1 in 2019, trailing far behind the world average of 75 per 100 inhabitants. While just over one sixth of countries in the Africa region, including South Africa, Ghana, Gabon, Seychelles, Botswana, Mauritius and Cabo Verde, had active mobile broadband subscription rates per 100 inhabitants above the world average, almost half of all countries for which data were available had subscription rates below the African average of 33.1 per 100 inhabitants (Figure 5).

Fixed broadband market

Compared with other regions, Africa has one of the lowest fixed broadband subscription rates, given the absence of legacy infrastructure and the relatively lower costs of deploying wireless broadband infrastructure. ITU estimated a fixed broadband subscription rate of 0.5 per 100 inhabitants for Africa in 2020, a figure that is well below the global average of 15.2 subscriptions per 100 inhabitants. Yet fixed broadband subscriptions per 100 inhabitants have increased across most countries for which data were available. Within the region, two-thirds of the countries slightly increased their fixed broadband subscription rates in the period 2018-2019. Just under one-third of countries show declining subscription rates for the same period. Seychelles and Mauritius are two significant outliers, with fixed broadband subscription rates per 100 inhabitants well above the world average, recording sizable increases for the period 2018-2019 (Figure 6).

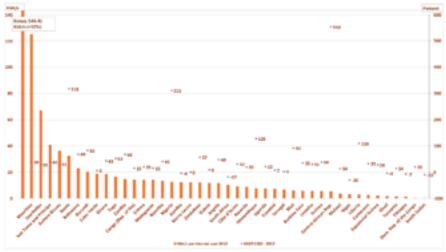
The availability of international bandwidth continues to be an important area for policy and investment, especially given the rising amount of data-intensive applications, cloud-based services and the increasing numbers of Internet users desiring better international connectivity. The Africa region is lagging far behind other regions with regard to international bandwidth at the aggregate and individual levels. Although the total international bandwidth across the region has more than doubled over the last four years from 5 Tbit/s in 2017 to 11 Tbit/s in 2020, it represents only 1.5% of the total world international bandwidth. At the individual user level, there were 30.8 kbit/s per Internet user in the Africa region in 2019, compared with 131.3 kbit/s per Internet user globally (see Box 1 for an overview of international capacity in the Africa region).

At the country level, international bandwidth per Internet user has increased across almost all the countries in the region, where data were available. Kenya had the highest international bandwidth per Internet user, with 566.41 kbit/s and a CAGR of 52% for the period 2015- 2019. Just over one-third of the countries shown in Figure 7 had CAGRs in excess of 40%, including Sao Tome and Principe, Benin, Botswana, Burundi, Ghana, Togo, Zambia, Namibia, Nigeria, Zimbabwe, Angola, Mozambique, Mali, the Central African Republic and Liberia.

Over the same period, just under one-third of countries grew their international bandwidth per

Source: ITU, based on ITU WTI Database

Figure 6: Fixed broadband subscriptions per 100 inhabitants, Africa region, 2019



Source: ITU, based on the ITU WTI Database

Figure 7: International bandwidth in selected African countries in kbit/s per Internet user, 2019 and CAGR (%) for the period 2015-2019

Internet user between 20 and 40%. Few countries, including South Sudan, Ethiopia, Niger, Senegal, Eswatini, South Africa, Gabon, Sierra Leone, Gambia and Cabo Verde (Figure 7) experienced small or no growth (CAGR below 10% or negative).

International capacity in the Africa region

To ensure that the Africa region, as one of the most important future global growth markets, is embracing digital transformation and that it has adequate connectivity, expanding international connectivity via submarine cables, international fibre and satellite is key. The figure below shows that by the end of 2019, 28 African ITU Member States had, at least, one submarine cable landing(1). Fifteen ITU Member States in the region are landlocked and have to rely on either satellite or international fibre link capacity. The figure also shows that approximately 45% of Africa's population is more than 10 km away from fibre network infrastructure.(2)

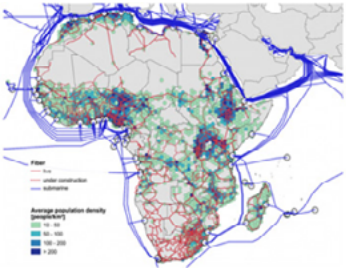
Satellite broadband connectivity offers a good alternative, with the possibility to provide coverage everywhere, including the remote parts of the region. It therefore may offer an effective means to close the digital divide and address remaining connectivity gaps. While progress has been made, challenges persist with regard to the cost of infrastructure.(3) ITU data for satellite broadband subscriptions (4) were only available for 19 countries, with the biggest markets including Tanzania, Zimbabwe, Nigeria, South Africa and Kenya.

Internet access, use, skills and gender

ITU estimated that 14.3% of households in the Africa region had Internet access in 2019, compared with 57.4% globally. The proportion of individuals using the Internet in 2019 totalled 28.6% in Africa10 and 51.4% globally (Figure 8), highlighting the need to bring more people in Africa online.

ITU data show that the%age of individuals using the Internet greatly varies across the Africa region (Figure 9). In four countries, namely Mauritius, Cabo Verde, Seychelles and South Africa, the proportion of individual Internet users (for the most recent year) was above the world average of 51.4%. In most countries, individual Internet use is below 30 per cent (Figure 9).

According to GSMA, lack of infrastructure is not the main reason for the relatively low numbers of individuals using the Internet. The much bigger



1 submarine cable	2 submarine cables	3 submarine cables	4 submarine cables	5 submarine cables	6 submarine cables	11 submarine cables
Republic of Congo	Benin	Cape Verde	Angola	Ghana	Nigeria	South Africa
Togo	Equatorial Guinea	Libya	Senegal		Kenya	
Liberia	Gabon	Tanzania	Côte d'Ivoire		Cameroon	
Sierra Leone	Dem. Rep. of the Congo		Mauritius			
Guinea	Namibia		Madagascar			
Guinea-Bissau	Mozambique					
Gambia	Seychelles					
Sao Tome and Principe	Comoros					

gap is associated with individuals living in areas covered by a mobile network, but not using the Internet. At the end of 2019, 272 million people were connected to the mobile Internet across sub-Saharan Africa, while 800 million were still offline, mainly because of the high cost of smartphones, relative to average income levels, and limited digital skills among rural and less literate populations.(11) In addition, the Alliance of Affordable Internet (A4AI) has identified lack of quality of access, which it has termed "meaningful connectivity" (12), as one key reason why people are not using the Internet. While the GSMA Mobile Connectivity Index shows that infrastructure has seen the biggest improvement in sub-Saharan Africa, alongside modest increases across all other categories over the period 2016-2019 (Figure 10), more needs to be done to ensure that access to meaningful connectivity can be achieved to close the usage gap.

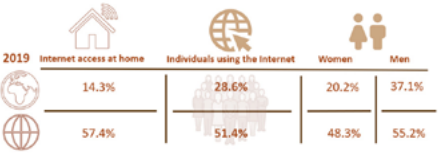


Figure 8: Household access, individuals using the Internet, total and by gender, Africa region and the world

Michael Minges,
ITU expert

Connectivity in the Least Developed Countries: Status report 2021

Mobile phones and rapid Covid-19 surveys

National household surveys in most LDCs are generally carried out face-to-face. Covid-19 has had a major impact on household and individual surveys, due to the need to socially distance and self-quarantine. Many development partners want to know about the impact of Covid-19 and the kinds of emergency interventions that might be needed. Most developed countries use telephone surveys, due to the prevalence of mobile phones. This has now spread to developing nations, given that many have reached a high level of cellphone ownership. Rapid surveys using calls to respondents with mobile telephones have emerged to meet this need. Rapid surveys have been carried out in LDCs such as Afghanistan and Myanmar (World Bank, 2020). A roster of mobile telephone numbers in the country is used, with random calls made to a subset of the numbers. One drawback is that, while mobile telephone ownership may be high, it is not universal, and therefore some people will be left out. These are likely the most vulnerable, lacking the income to own and pay for mobile services, or out of 2G coverage range. However, the rapid surveys do not adjust for this or indicate what proportion of the population they believe they are covering.

Basic mobile networks have enhanced economic and social welfare in LDCs in many areas, particularly banking, agriculture and health. Mobile money reduces transaction costs, increases privacy and reduces the risk of theft, among other benefits (Hamdan, 2019). Financial inclusion has expanded among many LDCs, due to mobile money. According to the World Bank's Financial Inclusion (Findex) survey, the LDC country average of those 15 years of age and older with a mobile money account almost tripled between 2011 and 2017 (the last available survey), from 7% to 19%. Mobile money transactions have expanded rapidly due to Covid-19. For instance, in Rwanda, mobile money transactions increased by 85% in 2020, due to measures taken to encourage digital payments and slow down progression of the Covid-19 pandemic (MTN Rwanda, 2021). Mobile money

services have additionally opened up innovative ways to transfer cash and pay for products. Development agencies can make conditional cash transfers to mobile money accounts, saving costs and increasing security (Aker and others, 2016). Mobile money is also facilitating the deployment of off-grid solar energy, by allowing users to make micropayments for repaying the solar panel (McKibben, 2017).

In agriculture, mobile phones have had an impact in LDCs by reducing information asymmetries. For instance, in Niger, grain traders use them to check price information, improving consumer and trader welfare (Aker, 2010). An SMS alert system in Bangladesh has reduced diseases among poultry farmers (FAO, 2017).

Health is another area where mobile services have had a significant development impact, notably during the Covid-19 pandemic, where many telecom operators have waived fees for access to health information, and health officials have used mobile networks to spread safety messages (WHO, 2020). Mobile networks are also being used to remind people to take medication, such as in Senegal, where people with diabetes are sent text messages (Wargny and others, 2018). Mobile call records can be aggregated to estimate the spread of diseases and identify population movement after natural disasters such as earthquakes. This helps with relief efforts and distribution of cash to affected populations. Call records have been used in Haiti and the Republic of Nepal to follow population movement during earthquakes, and in Sierra Leone during the Ebola outbreak (Maxmen, 2019).

What the most successful mobile services and applications have in common is that they are basic, often using voice or SMS services, affordable, easy to use, require little bandwidth, and work with feature phones and over the 2G network. Although the Internet can be accessed over 2G networks, it is at narrowband speeds (less than 256 kbps). It also requires an Internet-enabled phone. However – given the relatively high coverage of 2G networks and fairly widespread diffusion of basic mobile phones, combined with useful services, ranging from mobile money to health – many people in LDCs may not feel a critical need to move to broadband services.

Percentage of households with a mobile telephone

Country	Survey	Total	Urban	Rural	Location Parity Index score
Afghanistan	2015 DHS	87	94	85	0.91
Angola	2015-2016 DHS	63	83	31	0.38
Bangladesh	2017-2018 DHS	94	97	94	0.97
Benin	2017-2018 DHS	84	89	80	0.90
Bhutan	2017 Census	97			
Burkina Faso	2017-2018 MIS	94	99	92	0.93
Burundi	2016-2017 DHS	47	83	43	0.51
Cambodia	2019-2020 CSES	93	95	91	0.96
Central African Rep.	2019 MICS	36	74	18	0.24
Chad	2019 MICS	71	89	67	0.75
Dem. Rep. of the Congo	2018 MICS	52	84	30	0.35
Ethiopia	2019 DHS	68	87	59	0.68
Gambia	2018 MICS	98	99	97	0.97
Guinea	2018 DHS	89	97	85	0.87
Guinea-Bissau	2018-2019 MICS	94	98	92	0.94
Haiti	2016-2017 DHS	76	90	67	0.74
Kiribati	2021 MICS	73	85	62	0.73
Lao P.D.R.	2017 LSIS	92	98	89	0.91
Lesotho	2018 MICS	92	97	88	0.90
Liberia	2019-2020 DHS	70	84	50	0.59
Madagascar	2016 MIS	34	73	29	0.40
Malawi	2017 DHS	51	84	44	0.52
Mali	2018 DHS	89	96	87	0.90
Mozambique	2018 MIS	63	84	53	0.63
Myanmar	2017 MLCS	82	93	77	0.82
Nepal (Republic of)	2020 MICS	96	97	94	0.97
Niger	2018 ENTIC	79			
Rwanda	2017 MIS	63	88	56	0.64
Sao Tome and Principe	2019 MICS	87	89	83	0.93
Senegal	2019 DHS	97	99	95	0.96
Sierra Leone	2019 DHS	73	93	58	0.62
Tanzania	2017 MIS	82	93	76	0.81
Timor-Leste	2016 DHS	84	96	81	0.84
Togo	2017 MIS	84	95	76	0.80
Uganda	2018-2019 MIS	77	90	72	0.80
Zambia	2018 DHS	74	90	62	0.69
Average		**78**	**91**	**70**	**0.76**
Median		**82**	**92**	**76**	**0.81**

Note: Location Parity Index = Rural households with a mobile phone/urban households with a mobile phone. CSES= Cambodia Socio-Economic Survey, LSIS = Lao Social Indicator Survey, MLCS= Myanmar Living Conditions Survey, MIS = Malaria Indicator Survey and ENTIC = Enquête Nationale sur L'accès et L'utilisation des TIC.
Source: DHS, MICS and national surveys.

Alan Hadden,
Telecoms consultant

Approximately every 10 years a new mobile technology is introduced. The first generation (1G) comprised several incompatible analogue systems for voice. 2G marked a step change with the commercial introduction of GSM from 1991, a digital system developed as a harmonised mobile voice and messaging system in a common spectrum band (900 MHz) initially for Europe's "single market". Its attractive features, performance and scale subsequently led to mass adoption by markets globally.

Global systems need global standards. Cooperation across industry intensified to bring together regional and national standards bodies and stakeholders in major market sectors under the umbrella of a newly formed cooperative organisation, 3GPP. Each generation of mobile technology represents an evolutionary step. 3GPP took over maintenance of the 2G/GSM specifications that formed the basis for 3G development. 3G (WCDMA·HSPA) from the early 2000s brought new features and capabilities including enhanced data rates that built on, and were backwards-compatible with, earlier 2G/GSM systems. 3GPP later instigated development of specifications for the 4th generation of mobile, specifying LTE and LTE-Advanced systems, followed by 5G.

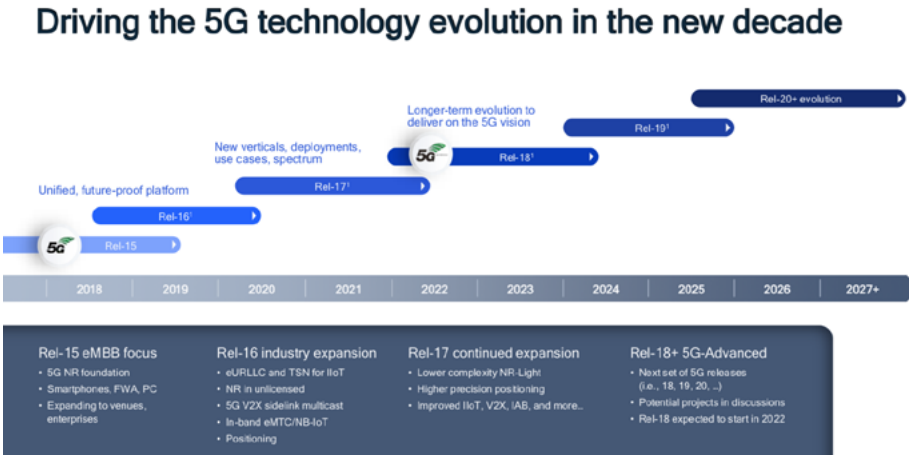
4G/Long Term evolution (and LTE-Advanced) is an evolution of 3G systems, 5G is an evolution from 4G, and so on. Each generation delivers increased scale, capabilities, economies, efficiencies, potential for enhanced and new services, and revenue growth. 5G will achieve the same, critically addressing new markets with new service and business models, not only for consumers but increasingly to support the needs of enterprises and business users in new vertical industries. This harmonized and evolutionary approach to mobile systems development is as important for operators in Africa as elsewhere, who benefit from massive global economies of scale, vast technology developments and service experiences, multi-vendor sourcing programs, global ecosystems, and more. It also means operators can deploy 4G/LTE systems and expand coverage, obtain spectrum etc. knowing that investments are safe and future proof as the basis for introducing 5G systems when the timing and conditions are right for them in their market.

Looking to the future, and following this well-proven model, detailed discussions have begun on "6G" in anticipation of its market introduction in the 2030s. Operators and other stakeholders in Africa should follow and participate in the international discussions about 6G to ensure the specifications are fully inclusive of their needs.

The results of 3GPP's work are submitted for review and adoption to the ITU, which plays a leading international role in managing radio spectrum and developing standards for mobile cellular systems, to ensure stable international regulations, sufficient and harmonized spectrum availability, as well as internationally agreed Sustainable Development Goals.

Currently 4G/LTE (including LTE-Advanced) is the key cellular platform globally for data and broadband connectivity, revenues and growth. Many 3G systems and some 2G/GSM systems in all regions are being retired and their spectrum refarmed for use by more efficient and feature-rich 4G and early 5G systems.

The International Telecommunication Union (ITU) defines the following main usage scenarios for 5G systems:



Source: Qualcomm

- Enhanced Mobile Broadband (eMBB) to deliver vastly increased data rates, high user density and very high traffic capacity for hotspot scenarios as well as seamless coverage and high mobility scenarios with still improved used data rates
- Massive Machine-type Communications (mMTC) for the IoT, requiring low power consumption and low data rates for very large numbers of connected devices
- Ultra-reliable and low latency communications (URLLC) for safety-critical and mission-critical applications

5G provides the opportunity to boost the current broadband and services experience, particularly when using increasingly media-rich mobile apps, across the whole network including at the cell edge. 5G can also enhance the video experience to support HD, 4K, 8K, 3D and 360 degrees content. Advanced gaming enabled by streaming over 5G direct to mobile terminals represents an exciting opportunity for new services and revenue growth. Higher capacity enabled by 5G networks supports many more users – even when in crowded places. Thinking about advanced technological synergies, AR and VR glasses can be paired with 5G terminals for a truly immersive experience for the mobile user.

For the fixed wireless customer today using 3G or 4G networks, 5G delivers a fiber-like performance, which is particularly appropriate to deploy in difficult-to-serve rural areas where FTTH and FTTP costs are prohibitive.

New spectrum is needed to secure the full potential for 5G. Key outcomes from WRC-19 included identification of significant extra spectrum for 5G. High capacity spectrum in millimeter bands in the 26 GHz, 40 GHz and 60 GHz ranges was also successfully identified.

Many of today's 5G systems are deployed within the C band, particularly in the range 3.3 – 4.2 GHz, and future international discussions including at WRC-23 will aim to secure yet more of this mid-band spectrum for mobile systems. Availability of more spectrum below 1 GHz would also greatly help in addressing rural 5G coverage. However the 6GHz band may become the next spectrum 'battleground' within the ITU forum as a number of different technologies and users seek access to this range. The challenge will be keeping the balance of 5G, WiFi users and existing services in the band. Some initial

positions have emerged. For example, North America supports unlicensed use for the whole band, Europe seeks unlicensed use in the lower part only, while China seeks the whole 6GHz band exclusively for licensed 5G systems.

The transition to 5G is mainstream and global. According to my independent research (July 2021) 461 network operators are investing in 5G technology in 147 countries/territories. Investments embrace, technology studies, testing, license submissions, trials, network deployments or commercial launches.

Within these totals, 174 network operators launched 5G commercial service in 71 countries (end 2020: 156 operators in 65 countries) offering eMBB and/or fixed wireless access (FWA) services. Private 5G networks are excluded. 5G service areas vary significantly; some operators offer broad, even nationwide 5G coverage, others have a limited footprint.

The majority of the initial systems were deployed in the Non-Standalone (NSA) configuration. NSA and "Standalone" (SA) are the standardised paths for operators in transitioning from 4G/LTE to 5G. The first deployments broadly were in NSA mode and focused on the eMBB use case for mobile and/or fixed users. It means the 5G radio (New Radio i.e. NR) is supported by the 4G/LTE network infrastructure. Note that 5G use cases needing URLLC and much higher capacity only become feasible with SA 5G NR and 5G core network architecture, independent of the 4G/LTE network anchor.

"According to my independent research (July 2021) 461 network operators are investing in 5G technology in 147 countries/territories. Investments embrace, technology studies, testing, license submissions, trials, network deployments or commercial launches"

Operators can choose a fast start into 5G by deploying new 5G radio on existing 4G architecture (i.e. NSA). But operators who go directly to the standalone model can test or offer solution for many new cases which may be of special interest for enterprises, e.g. to enable smart factories. Private networks represent an exciting new opportunity; dozens of networks are deployed or planned, encompassing - but not limited - to car manufacturers, consumer electronics and other manufacturing plants, ports, airports, mining and process industries, offshore and power utilities, etc. which is driving Industry 4.0 and the digital transformation of numerous industrial sectors and practices. 5G SA is essential for supporting advanced "network-slicing" capabilities. Operators can set out the precise characteristics of a slice including speed, latency, reliability, and security, and delivered in service level agreements agreed with individual enterprise customers.

Interest is now high in Standalone (5G SA). Referring again to my research, 87 operators are evolving their 5G networks to the 5G SA configuration. At least 12 have commercially launched 5G SA services, including in South Africa.

5G will continue to evolve, as we saw with all previous technology generations. 5G, AI, VR, edge and cloud computing technologies are synergistic; each reinforces the impact of the other to propel 5G into new markets and settings. 3GPP will start detailed work on specifications for the next step i.e. "5G Advanced" (3GPP Release 18 and beyond) from Q2 2022 and is expected to be finalised by December 2023. ■

Witney Schneidman,
non-residential fellow Brookings Institution – global economy and development, Africa Growth Initiative

Continuing troubles in the Tigray region of Ethiopia are occupying the thoughts of President Biden's administration, with a call to end "large-scale human rights abuses" and for the withdrawal of Eritrean and Amarah forces from Tigray.

Biden's administration is in the tough position of considering sanctions that would cut off funding from the US and its allies with potential to further destabilise Ethiopia.

Nonetheless, imposing visa restrictions on Ethiopian and Eritrean officials who are responsible for the atrocities in Tigray is an appropriate action, and a watershed given Ethiopia's long-standing role as a key regional ally. There is clearly scope for ratcheting up sanctions if Prime Minister Abiy Ahmed, who won the Nobel Peace prize in 2019, doesn't deescalate conflict and follow through on his commitments to senior American officials, including Senator Chris Coons and Special Envoy Jeffery Feltman.

A next step could be along the lines recently advocated during Congressional testimony by John Prendergast, the human rights activist and co-founder of the Sentry, in which he called for carefully targeted Magnitsky sanctions. Such sanctions would include asset freezes on Ethiopian and Eritrean officials and their national and international networks through which they perpetuate the conflict and benefit personally.

"The principal dilemma for the Biden administration is how to mobilise pressure on prime minister Abiy Ahmed to induce him to end the conflict and the suffering without turning Ethiopia—the largest recipient of American development assistance in sub-Saharan Africa—into a pariah nation"

A pariah nation?

The principal dilemma for the Biden administration is how to mobilise pressure on Prime Minister Abiy Ahmed to induce him to end the conflict and the suffering without turning Ethiopia—the largest recipient of American development assistance in sub-Saharan Africa—into a pariah nation.

In addition to visa sanctions, the administration has shown a willingness to progress a diplomatic path of pressuring the Ahmed government, reportedly imposing cuts in security and economic assistance and extending US$350 million in food aid in hopes of fending off starvation in Tigray.

Perhaps the most difficult decision facing the administration is whether it should cancel a US$500 million investment that the board of the US Development Finance Corporation (USDFC) approved in January that enabled the Vodafone Group Plc. to win a new mobile-phone license issued by the Ethiopian government last month. It would be a mistake for the Biden administration to cancel this financing.

The award of the first telecoms license for US$850m is the largest direct foreign investment in the country's history, according to a tweet by prime minister Abiy Ahmed. The winning

consortium, led by Kenya's Safaricom along with Vodafone and South Africa's Vodacom, plans to invest US$8.5bn in its network over 10years. They have also committed to creating 1.1 million jobs in the same period and covering the country with a 4G service by 2023. The UK development finance institution CDC and Sumitomo Corporation will also provide financial support, in addition to the USDFC.

A bid of US$600 million for a second telecoms license was rejected by the Ethiopian government for being too low. This bid was made by the MTN Group Ltd. of South Africa and a Chinese state investment group, the Silk Road Fund. Apparently, the license will be retendered. The government also plans to privatise 45% of state monopoly, Ethio Telecom.

Opening of the economy

A key question surrounding the tender of the licenses was whether the government would permit the cellphone companies to offer mobile money services. The state-owned Commercial Bank of Ethiopia controls about half of the country's banking sector, which limits the prospect for the development of mobile financial services. This would obviously impact the commercial viability of the investment. Mobile services are projected to contribute to nearly 10% of Africa's GDP by 2023. Mobile will inevitably be a growth sector in Ethiopia's economy. Another uncertainty was whether the cell companies could build their own infrastructure or whether they would be required to lease it from Ethio Telecom. On both issues, the consortium apparently received assurances that gave them confidence to move forward.

"In addition to driving skills development and job creation among Ethiopia's large youth population, the internet will be a vital tool for enhancing transparency and accountability, especially as it concerns elections and human rights"

Internet access will be another spinoff of the successful tender. Even though the country is the second-most populous in Africa, its 110 million people are among the most digitally isolated on the continent. The country's internet penetration of 18% is just below Guinea and above the Democratic Republic of the Congo—a remarkable contrast to neighbouring Kenya where the internet penetration rate is 85% and in Nigeria, where it is 73%.

In addition to driving skills development and job creation among Ethiopia's large youth population, the internet will be a vital tool for enhancing transparency and accountability, especially as it concerns elections and human rights. Recent instances where the Ethiopian government has tried to block internet usage, not only related to violence in Tigray but also in 2020 after the killing of the activist singer Hachalu Hundessa and in 2019 following an alleged coup attempt in the Amhara region, underscore importance of networks not being state controlled.

The region saw the downsides of such control earlier this month when, after Twitter took down a tweet of President Buhari, the government suspended the company in response. Activists and civil society members continued to use virtual private networks to circumvent restrictions in an effort to make the government accountable, as they previously did during the EndSARS campaign.

Biden's administration should stay fully engaged in Ethiopia not only to end the conflict in Tigray but to help the country recover from the pandemic and to ensure that Ethiopia's June 21 elections will be as successful as possible. There's a role for both American pressure and investment in ensuring that the Ethiopian government meets its many challenges. ■

The following information and data was sourced from GSMA'S The Mobile Economy sub-Saharan Africa 2021 report

The mobile industry in sub-Saharan Africa continues to play a crucial role in the response to Covid-19. Mobile operators have implemented measures to support vulnerable communities including offering discounts to mobile tariffs and providing digital content and tools to help people and businesses get online.

By the end of 2020, 495 million people subscribed to mobile services in sub-Saharan Africa, representing 46% of the region's population – an increase of almost 20 million on 2019. With more than 40% of the region's population under the age of 15, young consumers owning a mobile phone for the first time will remain, for the foreseeable future, the primary source of growth.

Over the period to 2025, 4G adoption in sub-Saharan Africa will double to 28%, compared to a global average of 57%. We are still in the early stages of the journey to 5G in sub-Saharan Africa; as of June 2021, there were seven commercial 5G networks in five markets across the region. By the end of 2025, 5G will account for 3% of total mobile connections in the region.

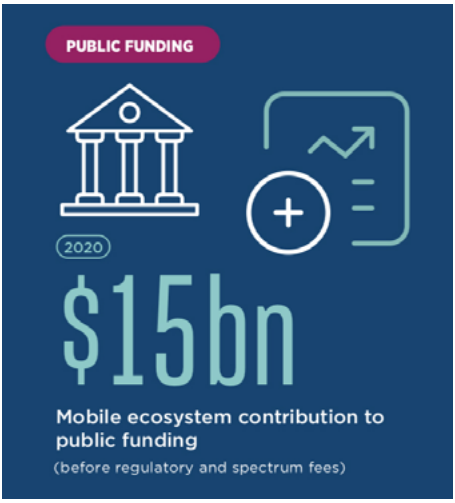
As economies recover and restrictions ease, mobile technology will be even more integral to how people live and how businesses operate. It will enable new digital solutions for small and large enterprises and support the growing use of online channels by consumers. Strong investor confidence and consumer interest in digital platforms point to a digital-centric future for sub-Saharan Africa, with mobile at the centre of the creation and consumption of innovative solutions.

Policies should look to engender inclusive digital development

The pandemic has highlighted the increasing importance of digital technology to responding effectively to crises and planning for recovery. At the same time, the crisis has the potential to accelerate the continent's digital transformation and create resilient digital jobs in sub-Saharan Africa. The continued rollout of 4G and the first stages of the move to 5G open up opportunities in areas such as healthcare, digital commerce, industrial automation and smart city infrastructure.

Realising this potential requires policy measures to support network investments and improve the affordability of digital services for consumers. Governments and regulators in the region should therefore adopt forward-looking spectrum management and fiscal policies, including the following:

- Creating a spectrum roadmap to ensure there is enough spectrum to meet surging demand for mobile services in both the short and long term.
- In particular ensuring access to mid-band spectrum 3.5 GHz, given its importance to the future of 5G.
- Accelerating access to sub-1 GHz spectrum to provide widespread rural mobile broadband services.
- Applying best-practice principles of taxation as recommended by international organisations such as the World Bank and the International Monetary Fund.



Revenue growth remains strong in the pandemic

Revenue growth is benefitting from the recovery of economic activities, following disruptions caused by the pandemic in 2020. Data and mobile money remain the prime revenue growth drivers, with adoption and use of both services continuing to rise rapidly. Beyond this, operators are seeing strong demand for a wider range of digital services, reflecting a shift in consumer behaviour triggered by the pandemic.

The pandemic has underscored the value of mobile networks, which remain the only form of internet access for many in sub-Saharan Africa. Mobile networks have remained resilient as operators implemented various measures, including investments in network capacity, to cope with the surge in data traffic. With the use of digital services likely to continue rising, operators' investments will only become more important. 5G will be a major part of this investment as commercial services are deployed in new parts of the region.

Also in its report, under the sub-heading Telco of the future: open RAN gains ground, GSMA made the following prediction:

The mobile industry is experiencing a paradigm shift in network infrastructure models, with operators large and small increasingly considering open RAN solutions for network deployment and operation. Although open RAN is still in its infancy, with vendors competing to build out their solutions, operator commitments, trials and deployments indicate growing momentum behind the technology. As of July 2021, 38 countries around the world had active open RAN trials, deployments or commitments.

Open RAN has become the native approach to 5G networks for a number of high-profile operators, notably Rakuten in Japan and Dish in the US. Meanwhile, operators are taking a collaborative approach to the development of open RAN technology. In May 2021, Deutsche Telekom, Orange, Telefónica, TIM and Vodafone issued a white paper outlining their technical requirements for the open, disaggregated RAN products they want to roll out in significant deployments from 2022. In July 2021, Etisalat Group, Mobily, STC, Zain Group and du signed an MoU to progress the implementation of open RAN solutions across their footprints.

Every new technology faces challenges to its deployment and adoption; open RAN is no different. GSMA Intelligence research, based on a survey of 100 operators globally, revealed that the top challenges include uncertainty around internal ownership, the integration of solutions in a multi-vendor scenario and limitations in terms of supplier diversity. Vendors should seek to address these challenges to drive greater scale of open RAN deployments. ■

Nathaniel Allen,
assistant professor with the Africa Center for Strategic Studies at National Defense University and a term member of the Council on Foreign Relations

The rapid spread of the internet across the African continent has been heralded as a key driver of prosperity and a sign of the continent's technological coming of age. Today, at least a quarter of the population has internet access, a nearly fifty-fold increase in internet usage since the turn of the millennium. By 2030, the continent could achieve rough parity with the rest of the world when three quarters of Africans are projected to become internet users. The economic potential is enormous: mobile technologies alone have already generated 1.7 million jobs and contribute US$144bn to the continent's economy, or roughly 8.5% of GDP.

Some African countries have taken advantage of rapid increases in internet penetration to make concrete improvements in the lives of citizens. Led by the rise of platforms such as Kenya's M-PESA, Africa has leapt ahead of other regions to become a centre of mobile, peer-to-peer finance. The continent registers close to half of the world's mobile money accounts. Sierra Leone, one of the world's poorest countries, recently established a Directorate of Science, Innovation and Technology (DST). Its initiatives include a "national financial data architecture with embedded automated financial tools" intended to improve service delivery and reduce corruption. These are just two examples of how digitization can provide a cheap, secure source of finance to populations in need and improve government transparency in countries where official graft is a universal concern.

Nevertheless, the rapid spread of the internet across Africa has downsides. For one, without affordable internet and reliable power, broadband internet access will remain out of reach for many low-income Africans living in rural areas. The relationship between internet access and household welfare in Africa is strong: One study from Senegal associated 3G internet coverage with a 14% increase in consumption and a 10% decline in poverty. Thus, countries that do not address internet access issues risk limiting the opportunities of their citizens, exacerbating already-substantial inequality, and inflaming regional, political, and ethnic divides.

More broadly, digitization brings with it vulnerabilities that expose countries to cyber espionage, critical infrastructure sabotage, and crime. Until recently, Africa was responsible for such a negligible portion of overall internet traffic that its systems were not particularly vulnerable to sophisticated cyberattacks. That could change in the coming decade, as African states, criminal enterprises, and threat groups become increasingly prominent cyber actors. Four African states with comparatively high levels of internet penetration—Algeria, Morocco, Kenya, and Nigeria—already rank among the top ten countries by share of users attacked by mobile malware.

Covid-19 and its aftermath

The effect of the Covid-19 pandemic is likely to act as an accelerant for the spread of emerging technology. The pandemic has already led to remarkable innovation. According to a study by the World Health Organization, 13% of all new or modified technology developed to respond to Covid-19 is African. In Ghana, authorities launched a Covid-19 tracker app, citizens invented solar-powered hand-washing stations, and private sector Zipline drones delivered tests. In Tunisia, the Interior Ministry deployed a robot to help enforce a lockdown. When confronted by a man attempting to buy cigarettes, the robot relents: "OK buy your tobacco, but be quick and go home."

But as life has moved increasingly online, opportunities for malicious actors to exploit digital technology have grown. Cyberattacks in countries across Africa have risen, with threat actors adopting techniques designed to exploit shifts to less secure home office work environments and other Covid-related fears. In Zimbabwe, cyberattacks increased by as much as fivefold during the pandemic, driven by phishing attacks that impersonate organizations working on pandemic response or use Covid as a lure to get unwitting individuals to download malicious software.

Moreover, Africa's economies are expected to take significant time to recover from a pandemic-induced shock, leading to increases in poverty and declines in GDP that stand in sharp contrast to the first two decades of the twentieth century. As connectivity continues to rise, increases in poverty and inequality could herald an increase in the growth of cybercrime, as tech-savvy and college-educated Africans find opportunities for legitimate forms of employment limited. For example, SilverTerrier, a major cybercriminal actor based in Nigeria, is made up of individuals in their late teens through to early forties, based in urban areas, and possessing some level of post-secondary education, according to a study of the group.

The economic, political and technological shocks of Covid-19 could also accelerate unsettling trends of digital repression and conflict. Prior to the pandemic, conflict in Africa was already on the rise and democracy in retreat. Facing declining revenues and rising social unrest, it is probable that regimes will double down on surveillance, censorship, and disinformation rather than compromise or address the grievances of disaffected groups. In Uganda's recent election, authorities hacked the encrypted communications of opposition leader Bobi Wine, ran a sophisticated online influence operation, and shut down the internet, efforts that helped to elect incumbent Yoweri Museveni to a sixth term.

A protean legacy

Most likely, African governments will continue to exhibit tremendous variation in their ability to adapt to this period of geopolitical uncertainty and technological change. Some of the more innovative countries may surf the spread of digital technology to prosperity and stability. Mauritius, Rwanda, and Kenya, for example, possess dynamic, tech-driven economies and are the only African countries to rank in the top 50 of the International Telecommunications Union's global cybersecurity commitment index.

More countries, however, risk being destabilised or limited in their ability to harvest the fruits of the digital revolution. Nigeria has more tech hubs than any other country in Africa, but has also become a global centre for cybercrime. Libya's information environment experienced a brief renaissance in the aftermath of the fall of Muammar Ghaddafi in 2011, but has since become a "fragmented vacuum," controlled largely by armed groups and foreign actors. Internet connectivity is a basic prerequisite for technology-driven growth and innovation, yet in fifteen countries, penetration rates are 10% or less.

For Africa's digital revolution to yield peace and prosperity, it is not enough for African countries to focus on the rapid, and often reactive, adoption of emerging technology. It is equally crucial to consider risks and externalities. Increasing internet connectivity should be prioritized, but so should affordability, cybersecurity, and equitable access. Drones and artificial intelligence offer African countries profound opportunities to innovate, but could be destabilizing without strategies, policies and legal frameworks to govern their use. And, driven in part by the pressures of the Covid-19 pandemic, the question of what African governments should do to respond to the proliferation of emerging technology is no longer a theoretical one, It is urgent.

The signs of Africa's digital revolution are impossible to miss. The destination? Impossible to know. ■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Keoikantse Marungwana,
senior research manager, IDC

The African telecoms and ICT landscape has this year experienced what many may regard as a cautiously optimistic phase. With economies reeling from the days of hard lockdowns, digital transformation, specifically, ICT and telecoms have been further demonstrated to be critical enablers for countries to achieve their national development imperatives. Regulators and policymakers across the continent, for good and sometimes flattering reasons, have been very actively involved in various initiatives and developments which had a bearing on the market outlook of the digital landscape on the continent..

There's still a lot of excitement around 5G deployments and developments, with South African operators lead the charge with 5G deployments. The Independent Communications Authority of South Africa (ICASA) was instructed by the courts to review 5G spectrum allocation plans and licensing of a wholesale mobile network operator, or WOAN (Wholesale Open Access Network). This will delay the market by at least a year from seeing new allocations of highly contested International Mobile Telecommunications ("IMT") spectrum, also called high-demand spectrum ("HDS"). The regulator has promised to expedite spectrum allocation, through a "truncated timetable and roadmap" which will see the auction process starting in March 2022.

The Ethiopian market is set for interesting developments, with the Safaricom consortium having been awarded the first telecoms license to operate a mobile network. The government has gone on tender for the award of the second license, which includes mobile financial services, in a bid to liberalise the economy. There's also a plan to sell 40% of state-owned incumbent.

Kenya's regulator published its Frequency Spectrum Management Guidelines and kicked off 5G network trials with Safaricom. The government published National

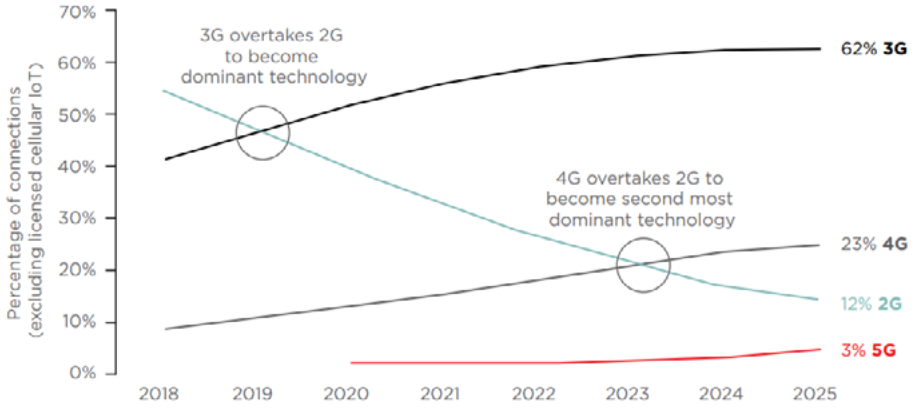


Figure 1: African Mobile Broadband Connections Forecast. Source: GSMA, 2021

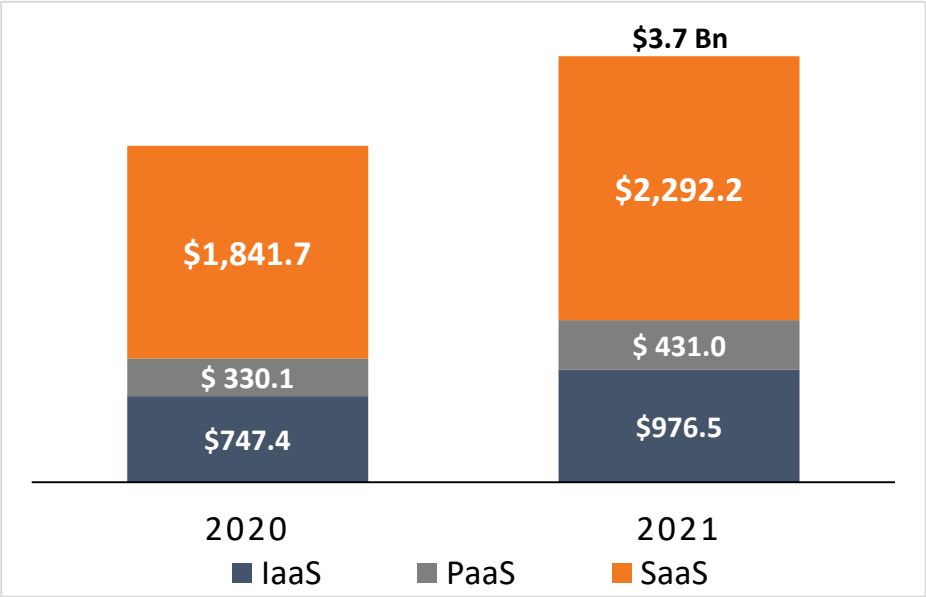


Figure 2: Public Cloud growth momentum to continue beyond 2021 (YoY Growth) – Source: IDC 2020

Broadband Strategy (2018-2023) to accelerate 5G developments.

Regulator, Nigerian Communications Commission (NCC), fast tracked the country's 5G roadmap through a MoU with holder of IMT spectrum, Nigerian Communications Satellite Limited (NigComSat), relocating the NG-1R satellite of NigComSat from previous 400MHz band (3.5GHz – 3.9GHz) to standard C-band 300MHz (3.9GHz – 4.2GHz). NCC set 13 December for Africa's first 5G spectrum auction (two 100MHz blocks in 3.5GHz – 3.6GHz and 3.7GHz – 3.8GHz).

Mauritius, to accelerate 5G deployments, allocated IMT spectrum without auction, allocating three blocks of 100MHz in 2.6GHz and 3.5GHz bands. In lockstep, MyT Mobile, Mauritius Telecom's mobile network, launched 5G services in limited areas.

An increasing number of governments are grappling with managing or keeping up with rapid advancement of digital technologies, particularly over-the-top (OTT) services and other emerging technologies outpacing regulations. Some governments apply a strong approach in managing regulatory or policy gaps exposed by democratisation and globalization of digital services. Social media services are virtually hosted anywhere around the world; and ensuring that OTT providers operate within legal and regulation frameworks for data, financial etc. challenges local regulators. 2021 saw government shutdowns of Internet and social media, while attempts to create or enforce local tax regulations on global OTT players had mixed results.

Cybersecurity breaches haven't abated, with banks and government entities experienced

incidents. The increasing reliance on digital services and global march to 4IR technologies across all industry sectors demands increased focus and cybersecurity investment. The 2020 IDC MEA Security Survey showed that data sovereignty, data leakage and non-compliance to local regulations were top concerns for an average of 50% META (Middle East, Turkey, and Africa) organizations.

To assist African governments and regulators move swiftly on 5G, GSMA published "Roadmaps for 5G Spectrum: Sub-Saharan Africa (2021)" with a roadmap to enable 5G in a structured and efficient manner. This should inform and accelerate 5G spectrum release, and perhaps encourage spectrum harmonization, enabling continent wide, mass and rapid 5G deployments, particularly rural communities.

GSMA expects for 5G to comprise 3% of 1 billion connections by 2025. There's an urgent need for rapid 5G spectrum allocation otherwise, 5G promise for Africa, at 3% in 2025, and likely only accessible in major cities mostly by enterprise customers, will be a dream for most of Africa's population.

Recently African Peer Review Mechanism's conference on, The Future of Governance in the 4IR. highlighted the importance of technology developments, digital transformation, and the direct impact on the continent's progress across all developmental themes of democratic, economic, socio-economic, and corporate governance.

Many African countries have published ICT broadband strategies and updated regulations to encourage digital transformation of their economies, but Africa will need deliberate and more active involvement by governments, policymakers, and regulators to drive this transformation and realise the promise of 4IR.

The Emerging technologies landscape has been very active, many organisations have embraced digital transformation in the wake of the new normal. Organisations have resumed or are planning to increase investments in the cloud, IoT and AI solutions for use cases in healthcare, education, mining and manufacturing, security and retail sectors. IDC predicts by 2024, 28% of IT services opportunities in META region will be digital transformation related.

Many use cases were fast-tracked by learnings from the pandemic. Video analytics solutions using AI for image recognition, a feature used for temperature screening and face mask detection, are becoming standard feature in various surveillance solutions, in malls, airports or in streets. The large CCTV surveillance network being rolled out in Johannesburg with number plate and facial recognition capabilities is an interesting use case of the confluence of high-speed networks, IoT and AI.

Cloud is going mainstream, while Africa accounts for less than 1% of global data centre market, Africa's data centre landscape has been hive of activity. Hyper-scalers and local incumbents have doubled down on expansion plans. Global players entering market through acquisitions and partnerships with local players.

Teraco raised R2.5 billion (US$170 million million) for construction of a new 38 MW hyper-scale facility in South Africa, JB4, scheduled completion in Q1 2022. Africa Data Centres (ADC), Liquid Telecom's data storage arm, raised US$300 million from the US International Development Finance Corporation. The company plans to build hyper-scale data centres in ten African countries. Dimension Data's new JHB1 facility will also come online early 2022.

The Nigerian data centre market, with challenges of reliable electricity, is expected

to grow at a 17% CAGR through 2021-2026. Huawei is driving a trend of modular data centres in the country. These developments will hopefully assist in reducing country's challenge where an estimated 90% of its data is hosted outside the country.

Telecom infrastructure investments and holdings have also raised interest. IHS Towers (29% owned by MTN) which operates in various African countries has announced plans to list on New York Stock Exchange, to unlock value for shareholders. Telkom also announced plans to list its masts and towers business, Gyro, on JSE in March 2022. Mobile operators are emphasizing their new identities of being digital or technology companies more than infrastructure companies. This strategic objective is also being realised on financial statements, with revenue contribution from digital services growing faster than traditional services.

This dynamic continues to create a clear distinction between tower infrastructure providers and telecom companies, a move that should create new opportunities for innovation and new tower company business models. A nationwide infrastructure asset with miniature data centres at the base of mobile network RANs can be useful for various reasons; all sorts of edge cases, however remote or latent the things may be.

The African telecoms landscape has been buzzing, and while there are some missteps on the regulatory front when it comes to ecosystem enablement, there's an enormous opportunity for rapid advancement of the landscape by regulators and governments.

High-speed broadband connectivity continues as operators push for more coverage and ROI on 4G, deploy targeted 5G for specific segments and use cases, and expand their fibre and 'AirFibre' or 'wireless Fibre' deployments into rural markets. The Satellite internet services market will play a key role with Starlink having opened customer applications for African consumers, promising very high internet speeds at competitive prices for satellite services. ■

Looking ahead: The abundance of compute and storage capacity being ushered in by hyper-scale data centres, the maturing IoT and AI solutions landscape, the emergence of edge computing, and the increasing focus by telcos on digital services such as financial services provide a very positive outlook for the market.

The opportunity landscape is wide open for all ecosystem players. For telecom operators, opportunities range from new market expansions, optimisation opportunities in their core and access networks, new propositions in managed cloud and edge services, and launching new digital services. SMMEs with specialised ICT skills in emerging technology (cloud, AI, IoT and RPA), and with industry insights on specific verticals, now have access to virtually unlimited compute, storage, and bandwidth to develop innovative scalable vertical-specific solutions without need for expensive infrastructure investments.

For the African business and consumer markets, the opportunity for increased productivity, and access to services from virtually anywhere, will continue to fuel new ways of working, learning and playing. Cloud-native business models will emerge from all business sectors. 2021 has seen new online-only formal and accredited educational institutions being launched at both high-school and tertiary levels, signaling the maturity of the online learning opportunity beyond the typical MOOCs that led this revolution.

Karim Yaici,
senior analyst and lead analyst for Analysys Mason's The Middle East and Africa regional research programme

We close this section with a report from leading TMT management consulting firm, Analysys Mason.

The company provides detailed 5-year forecasts of the fixed and mobile telecoms market. Its forecasts take into consideration the likely range of economic impacts that the Covid-19 pandemic may have on operators' telecoms service revenue worldwide.

This report, Sub-Saharan Africa telecoms market: trends and forecasts 2020–2025, focuses on operators' core telecoms services in sub- Saharan Africa. It includes discussion of IoT, pay-TV and operator business services. These services are discussed in detail in our other research programmes.

Analysys Mason says its forecasts are informed by on-the-ground, regional market experts from our topic-led research programmes and our consulting division, as well as external interviews. In addition to its robust set of historical data, its forecasts draw on "a unique and in-house modelling tool", which applies a rigorous procedure (reconciling different sources, standard definitions, top-down and bottom-up modelling).

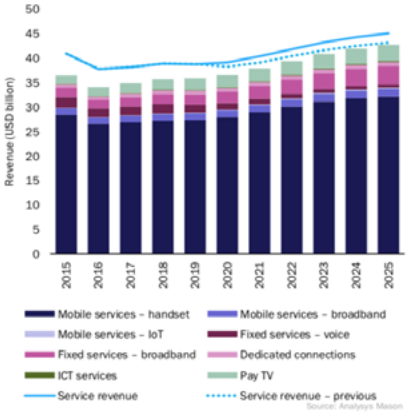
The Sub-Saharan Africa telecoms market: trends and forecasts 2020–2025 was produced by a team* lead by Karim Yaici, senior analyst and lead analyst for Analysys Mason's The Middle East and Africa regional research programme.

REPORT COVERAGE

Geographical	Key performance indicators (around 200)	
Region modelled	**Connections**	**Revenue/ARPU/ASPU**
• Sub-Saharan Africa (SSA)	Mobile	Mobile
Countries modelled individually	• Handset, mobile broadband,[2] IoT[3]	• Service,[4] retail, wholesale
• Cameroon	• Prepaid, contract	• Handset, mobile broadband,[2] IoT[3]
• Côte d'Ivoire	• 2G, 3G, 4G, 5G	• Handset voice, messaging, data
• Ghana	• Smartphone, non-smartphone	• Prepaid, contract
• Kenya	Fixed	• 2G, 3G, 4G, 5G
• Nigeria	• Voice, broadband	Fixed
• Rwanda	• Narrowband voice, VoBB	• Service,[4] retail, wholesale
• South Africa	• DSL, FTTP/B, cable, FWA, 5G, other	• Voice, broadband, dedicated connections
• Sudan	Pay TV	• DSL, FTTP/B, cable, FWA, 5G, other
• Tanzania	**Traffic**	ICT services
• Uganda	Fixed and mobile	Pay TV
• Zambia	• Outgoing voice minutes, MoU	
	Mobile data traffic	

Telecoms revenue in Sub-Saharan Africa will grow in the long term, despite the temporary decline due to the Covid-19 outbreak in 2020

Figure 1: Telecoms and pay-TV retail revenue by type and total service revenue, Sub-Saharan Africa, 2015–2025



The Covid-19 outbreak limited telecoms revenue growth in sub-Saharan Africa (SSA) in 2020.

We estimate that total telecoms and pay-TV service revenue in Sub-Saharan Africa grew by just 1.0% year-on-year in 2020 due to the impact of the Covid-19 pandemic in the region. The lockdown measures had an immediate effect on revenue, and many countries are also beset by macroeconomic difficulties; strong inflation and currency devaluations are common.

We expect that the conditions will start to improve from 2021 thanks to economic

recovery. Nominal GDP for the region is expected to grow at a CAGR of 8.3% during 2020–2025, supported by a 13.3% net expansion in population.

Total telecoms and pay-TV service revenue will grow at a CAGR of 2.9% between 2020 and 2025.

Telecoms markets will also slowly start to recover from 2021. The rising demand for mobile telecoms services will drive most of the growth in telecoms revenue. MNOs will expand and upgrade their mobile networks. This will allow them to reach new customers in unserved areas and to convert non-data users into active data users. The availability of affordable handsets and discounted tariffs for first-time 4G users as well as the launch of new IP- based applications will drive the migration of customers to 4G and result in strong data revenue growth.

Mobile: the mobile SIM population penetration will grow notably, thanks to operators' network expansions and the increasing take-up of mobile data plans

There are opportunities for mobile network operators (MNOs) in the region to grow their subscriber bases.

The mobile SIM population penetration in SSA was 81.6% in 2020. However, multi-SIM usage is very common, so there is still potential for unique subscriber population penetration growth.

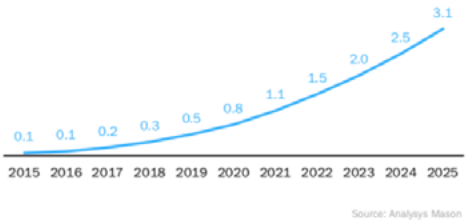
The number of mobile connections in the region is expected to grow by 21% between 2020 and 2025 to reach 1.14 billion. Strong population growth and MNOs' efforts to expand their networks into rural areas will underpin much of this expansion. However, we expect that regulatory interventions on illegal or unregistered SIMs may act to limit the pace of this growth in some countries (such as Ghana, Kenya and Uganda).

The shift towards a data-centric model will accelerate during the forecast period.

The regional average cellular data traffic per handset connection will grow from 0.5GB to over 3.2GB during the forecast period. The lack of fixed infrastructure will enable MNOs to capitalise on consumers' growing appetite for online services. The availability of new feature phones and low-cost smartphones will also drive the take-up of data plans. MNOs are promoting plans with larger data allowances and introducing applications for messaging, music, social media and video services.

Figure 7: Mobile connections by plan and 5G connections, Sub-Saharan Africa (billion), 2015–2025

Figure 8: Cellular data traffic per handset connection, Sub-Saharan Africa (GB per month), 2015–2025



*Alex Boisot (analyst), Ameer Gaili, Charlie Westphal, Emma Brown, Felix Hall and Noor Mohammed Khan (research analysts). ■

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chapter 2 Cellular Networks

Stefano Suardi,
economist, GSMA

Kenechi Okeleke,
senior manager, mobile operators & networks, GSMA

Worldwide the deployment of 5G continues to make progress and in the commercially viable 5G services for consumers, the last 12 months up to June 2021 has seen 90 new commercial enterprise use cases. This includes investment in 5G networks where launched, compared to 69 in the preceding 12 months, this takes the total to date to 169.

Commercial 5G services are now available in every region of the world, making it a truly worldwide technology. By the end of 2021, 5G connections will account for 8% total mobile connections globally, while 5G networks will cover more than a fifth of the world's population.

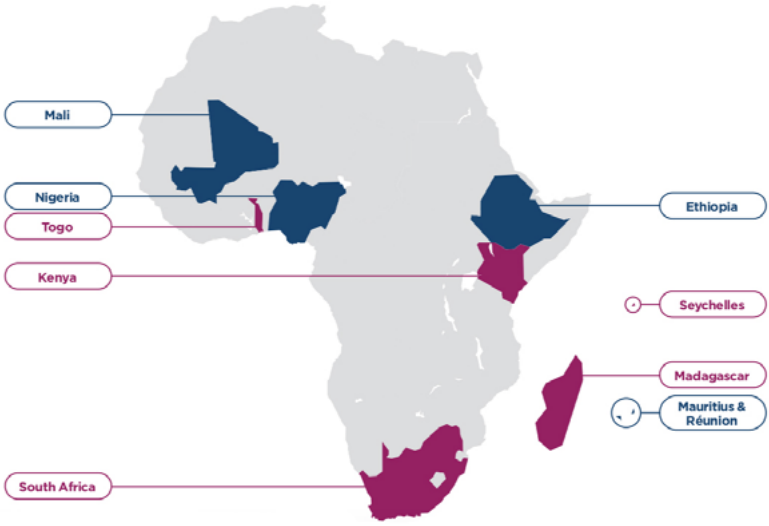
Network rollout is a first step to realising 5G's potential, with the availability of applications an important next stage. As a result, operators and other stakeholders in early adopter 5G markets are increasingly focussing on the development of 5G labs dedicated to co-creating solutions with partners, including start-ups, academia, cloud providers and enterprises, to address specific needs.

In sub-Saharan Africa, the journey to 5G has begun but it is still at the early stage for network deployment and commercialisation. By the end of June 2021, there were seven commercial 5G networks in five markets across the region. In these markets, 5G coverage remains limited to major cities. Enhanced mobile broadband (eMBB) and fixed wireless access (FWA) services are the main use cases.

The cautious approach to 5G in sub-Saharan Africa reflects the greater urgency to maximise the existing capacity of 4G networks. 4G is now available to more than half the region's population – but the technology accounts for just 15% of connections, on average, compared to 57% globally. Furthermore, 5G networks are capital intensive and come with operational complexities. As such, evidence of sufficient demand for enhanced connectivity services to justify investments in large-scale deployments is a vital indicator of 5G market readiness.

The increase in use of broadband for work, learning, entertainment and other activities, as a consequence of Covid-19 pandemic control and lockdown measures, is indicative of the

5G footprint expands across Sub-Saharan Africa, but mass rollout is still some way off



Data as of end of June 2021

potential demand for enhanced connectivity. Given low fixed broadband penetration, particularly in residential locations, most of the increases in data traffic in sub-Saharan Africa were recorded over mobile networks. With digital technologies and online platforms set to become more integral to everyday life post pandemic, 5G networks will be crucial to meeting future demand for enhanced connectivity services by households and businesses.

To this end, operators and other stakeholders in sub-Saharan Africa have begun to prepare for a 5G future, as evidenced by recent developments across the region such as the following:

- **South Africa** – MTN has taken steps to expand its 5G coverage with the deployment of 5G sites in Polokwane in Limpopo and Emalahleni (Witbank) in Mpumalanga. MTN also plans to expand its 5G network in the Eastern Cape province, with deployments in Gqeberha and East London.
- **Nigeria** – The Nigerian Communications Commission (NCC) and Nigerian Communications Satellite (NigComSat) have signed a Memorandum of Understanding (MoU) on the use of C-band spectrum (3.4–3.9 GHz) for 5G services. Most 5G launches globally have so far relied on 3.5 GHz spectrum, which provides a valuable middle ground between capacity and coverage for 5G networks.
- **Mauritius** – MyT Mobile has launched four MyT 5G Experience Zones as part of its transition to commercial 5G services. Customers will be able to register to connect to the 5G network in the cybercity regions of Ebene, Trianon, Bagatelle and Reduit.
- **Mali** – Orange has launched a 5G pilot in Bamako, with customers able to test the network with 5G-capable devices. Orange plans to launch 5G across several markets in the region by 2022.

- **Angola** – New licensee Africell is working with Nokia to deploy the latter's AirScale Single Radio Access Network (S-RAN) across up to 700 sites to concurrently support 2G, 3G and 4G services, and be 5G-ready. Nokia's AirScale platform can be seamlessly upgraded to support 5G networks through a software update.
- **Uganda** – MTN has started the process of automating its network, through a partnership with the Telecom Infra Project (TIP), in preparation for 5G. MTN plans to deploy TIP's Disaggregated Cell Site Gateway technology to build transport products and network capabilities at 2,500 sites across the country to support a smooth transition to 5G.
- **Zambia** – The Zambia Information and Communication Technology Authority (ZICTA) has opened a public consultation inviting stakeholders to provide feedback on its proposals for 5G spectrum bands. The consultation will inform ZICTA's spectrum planning and licensing decisions, including selecting priority bands for 5G; choosing an allocation strategy; identifying bandwidth requirements for operators; creating a planning process to prepare the selected bands for use; setting out a fair and transparent licensing process to suit each available band; gauging market demand; and setting out a 5G roadmap.
- **Cameroon** – MTN Cameroon has disclosed that it has applied for permission to deploy and operate a trial 5G network. Approval from the telecoms regulator Agence de Régulation des Telecommunications (ART) would enable it to test 5G services in the country. ■

Dario Betti,
CEO, Mobile Ecosystem Forum (MEF)

The World Bank and African Development Bank report there are 650 million mobile phone users in Africa, surpassing the number in the United States or those in Europe. In some African countries more people have access to a phone than to clean water, a bank account or electricity. Africa is largely a mobile first continent, bypassing fixed networks.

The level of advancement in mobile fintech in Kenya or Nigeria rivals the rest of the world. The different markets that make Africa have shown a surprising level of innovation and creativity in content, payments, and utilities. But there the nuances between African countries are significant and as such must be understood and respected to ensure success.

Youths are using mobile phones for everything: communicating, listening to the radio, transferring money, shopping, mingling on social media and more. Furthermore, the industry has transcended divides between urban and rural, rich and poor. As Gregory Brophy, the Chief Executive Officer of iTouch Messaging Services explains, "The mobile market

in Africa, powered by youth, has great potential for investors because of the huge numbers." iTouch Messaging Services is one of the very first wireless service solutions that show the potential of this market, starting in 1995 and growing for over 25 years.

There is a great potential in the African mobile market, and it pays to enter in Mobile Africa early on. Gregory points out: "Generally brands who engage early in Africa become household names - the generic for the sector. In South Africa Colgate is toothpaste, OMO is washing powder, Grandma is for headaches. When you're asked for a Grandma, you're being asked for a headache remedy - it could be a tablet, a liquid or a powder. So, the advice is engage early, pay your school fees, and be handsomely rewarded over and over again. Patience is a virtue. Adages manifest their truths."

Projections from the UN suggest that Africa's population of 1.3 billion will quadruple over the next two decades reaching 4.3 billion by the end of the century. While Asia's share of global working-age population would be declining, Africa's would be ascending eventually overtaking Asia by 2100. By the end of 2100, Africa's population would most likely surpass Asia with a middle class exceeding 50% of the population. Economic growth is moving towards Africa. An 80-year forecast is a challenging one, and history has not been kind with regards to the African economic revolution. However, the trajectory of this change is noticeable now. To grow in this market is to position for a historical change.

"Projections from the UN suggest that Africa's population of 1.3 billion will quadruple over the next two decades reaching 4.3 billion by the end of the century"

Mobile Data is changing the opportunities

The market is now enjoying a considerable move to digital channels thanks to the progressive adoption of smartphones.

It is not just fintech that is growing. According to Ali Karaosman from Telecoming, content market is enjoying a boost too, and this mobile monetisation firm has seen a dramatic change "The arrival of online consumption of VOD through mobile phones has converted it into an immediate platform for entertainment consumption." The key in African Innovation is adapting technology to the African reality, using airtime as a wallet, insurance, or money transfer, all is possible. So, the mobile has become the new TV center. Anzelle Robertson from SAM Media reports how even virtual reality is working in Africa. VR has not been a straight success across the globe, but their VR services 'Mobio360' has 700,000 African subscribers enjoying international city tours, extreme sports or exotic locations.

Mobile is the market channel for the content. Taha Jiwaji, the CEO of Mobile Messaging solution specialist Beem Africa says, "Telecoms and omni-channel

"Regulators had to allocate additional spectrum to cater for the increase in digital traffic"

communication continue to thrive and grow across African markets. As consumers move to smart phones and digital channels in droves, businesses are having to follow them to continue to serve them and wow them with new mobile experiences." Operating a Communication platform in West Africa, Alchemy Telco sees the huge business potential. However, Malick Dibba, the CEO and founder believes that both regulation and mindsets have a long way to go to embrace the business model and the benefits wireless networks provide. There are still improvements to be made.

The impact of Covid-19 can be seen in the mobile market. Tracy Molete, from Apprentice Valley confirms that "The pandemic drove agile developments and increase in investment and adoption of digital technologies to enable remote working, remote learning, self-assessment apps, e-commerce platforms and digital cash transfers and payments. The wave has come, it is getting bigger, Network Operators are driving towards acquiring more spectrum and scaling infrastructure to meet the imminent demand brought by the fantastic innovations and adoption thereof across the continent."

Teniola Stuffman, Business Development Director, VAS2Nets Group adds that there are issues with the stronger adoption of data: the 3G and 4G networks are starting to suffer. It is too early to imagine a strong 5G roll out for Africa – more investment in fibre networks to support the mobile delivery is needed. More network-building will be necessary, but the infrastructure is growing.

Regulators had to allocate additional spectrum to cater for the increase in digital traffic. We have also seen a lot of IOT and chatbot technologies emerging. These have become even more prominent recently as they are used, in conjunction with drones and robotics, for remote monitoring and war room dashboards which monitor and respond to societal problems just-in-time.

Changing regulations

Regulations within Africa are tightening up dramatically, and Ryan Louw, the CMO of SMS Portal thinks this is a good thing: "Customer Data Protection policies have been implemented and an Opt-in policy has become the staple for mobile communication in Africa. This becomes paramount in keeping the market customer centric and paves the way for a fruitful future for both marketer and customer." South Africa saw the start of consumer activism in 2008 with the Consumer Protection Act 68 of 2008 laid a foundation for subsequent regulations related to the protection of personal information. Network Operators and Wireless Application service providers had to make drastic changes to align with the consumers' expectations and regulations [1] South Africa has paved the way, but many other countries are now busy establishing frameworks and regulation. Overall, the importance of fighting cyber-crime is intensifying. ■

CELLULAR NETWORKS: INTRODUCTION

Joe Barrett,
president at Global mobile Suppliers Association (GSA)

The Covid-19 pandemic once again demonstrated the importance of ICT for African business and society, with people in many markets reaching for their devices during periods of lock down or when forced to work from home. Operators around the continent reported very rapid growth in data traffic as the pandemic spread from country to country and impacted on peoples' lives, with regulators making extra spectrum available on a temporary basis to help mobile operators meet surging demand.

But it is easy to forget that despite all of this, Africa still has significant gaps in its infrastructure and communications coverage. Many people did not have devices to reach for, or networks to connect to. Gaps are being slowly filled, but there is so much more to do to connect all citizens of Africa to the global society and in doing so to help drive the continent's economic growth. Whilst 2G and 3G services are widely available, it is LTE, LTE-Advanced and 5G services that can really open up new opportunities for the people of Africa.

Over 900 operators worldwide are known to have been investing in LTE, including pre-commercial trials, with dozens of others that have previously indicated their intentions to invest. 796 operators in 243 countries have now commercially launched LTE networks. Africa represents a small but growing and increasingly important part of this ecosystem. In North Africa, 19 operators have launched LTE mobile services, and of these, nine have launched LTE-Advanced, and one operator is in a testing phase. Eleven of those operators in North Africa have also launched LTE fixed wireless access (FWA) services. In the larger sub-Saharan Africa region, 164 operators are investing in LTE, with 136 networks launched and a further 12 operators actively deploying LTE. Thirty-six operators in sub-Saharan Africa have deployed LTE-Advanced, and a further five are deploying, plan to deploy, or are testing the technology. Eighty-five operators in sub-Saharan Africa have deployed/launched LTE FWA networks, with three more deploying or planning to deploy LTE FWA.

As a result of these recent launches, the African region as a whole now accounts for just over 20% of the total number of operators investing in LTE and 19.5% of all the commercially deployed networks. While it remains the case that most of the countries/territories globally that are currently without any LTE at all are either on the continent of Africa or islands in the Pacific and Atlantic Oceans, the number of not-spots in Africa has dwindled significantly. The only African countries/territories with no LTE network known to GSA include Central African Republic, Djibouti, Eritrea, and São Tomé and Príncipe.

In terms of LTE and 5G subscribers, the continent is further behind. According to data supplied by Omdia, the number of mobile subscriptions in Africa totalled 1.185 billion by end March 2021. In absolute terms WCDMA was by far the fastest growing mobile technology in Africa in the twelve months to the end of September 2021, gaining 69.6 million subscribers to reach a total of 605.3 million. GSM which continued to decline, fell from 443.7 million to 373.0 million subscribers.

LTE is now gaining a foothold in Africa. LTE was the fastest growing technology in%age terms and a close second to WCDMA in absolute terms. LTE subscriptions reached 205.1 million by the end of March 2021, up more than 49% over twelve months, to account for slightly more than 17% of all mobile subscribers on the continent. By way of comparison, worldwide, LTE represents nearly 64% of all mobile subscribers. As it becomes the preferred technology in the future, eventually delivering a Gigabit service, GSA expects a migration from 3G to 4G/LTE and then eventually, 5G. But for now, Africa represents

only 3.3% of the world's LTE subscribers, and it is important to note that LTE population penetration in Africa was still only around 16% in March 2021.

New generation technologies

Along with the rise of LTE, we are starting to see increased availability in Africa of LTE-based solutions for voice and IoT services. VoLTE is now commercially available in at least fourteen African networks, with three other operators known to be actively deploying the technology and two planning to do so. NB-IoT, meanwhile, has been launched in Kenya, Tunisia and South Africa, with operators also investing in the technology in Liberia and Nigeria. MTN has been involved in trials of LTE-M in South Africa.

5G is on the horizon. Network vendors and operators worldwide are currently testing and are already deploying 5G networks – in fact over 180 commercial 5G networks have now been launched worldwide. 5G evaluation and deployment has been accelerating in Africa too. GSA is aware of thirty-one African operators from 21 countries that have been investing in 5G networks (including pre-commitment evaluation, testing and trialling all the way through to service launch).

Southern African operators are at the vanguard of the region's 5G development efforts, with 5G network launches by MTN, Rain and Vodacom. GSA has also recorded 5G launches in Madagascar, Mauritius and the Seychelles, a soft launch in Lesotho, pre-commercial deployments in Libya and Kenya and further active deployments under way in Angola and South Africa. GSA has identified other operators with plans to deploy in Cabo Verde, Cameroon, Kenta, Mauritius, Republic of Congo, Seychelles and Tunisia.

5G subscribers numbered slightly more than 66,500 in Africa at March 2021. This means there is potential for tremendous growth of both LTE and 5G. ■

Looking ahead: GSA expects LTE to continue its rise in Africa during 2022. With at least twelve operators known to be deploying new LTE networks as of October 2021 we might expect to reach nearly 170 LTE networks providing either fixed wireless access or full mobile services in Africa by the end of the year.

Whilst it will be a few years before the technology is as widely used as 3G, given the recent increase in the number of commercially launched networks, the anticipated launch of more LTE services during 2022, and the fact that it will be physically available to a larger number of people, and networks will cover wider areas, the technology will attract more and more end users. It would not be unreasonable to expect LTE subscriber numbers in Africa to be well beyond the 300 million mark by the end of 2022.

In addition to the growth in use of LTE, GSA also expects the quality of the LTE infrastructure to improve. We forecast that the number of networks being upgraded from LTE to LTE-Advanced and LTE-Advanced Pro will increase; predominantly through the introduction of carrier aggregation to improve end users speeds, and the launch of 3GPP IoT technologies. At the moment, few networks in Africa can boast maximum (peak theoretical) download speeds of much more than Cat-4. (GSA has identified 20 operators offering Cat-6 or better).

Beyond LTE-Advanced and LTE Advanced Pro services, the launch of 5G networks will help to deliver higher speeds for end users and will additionally open up new opportunities for industry. Although only a few operators have deployed, or are in the process of deploying 5G networks, once governments and regulators make spectrum available - a critical enabler for 5G deployment - we can expect 5G rollout to gather pace over the next few years. At the same time, new technologies designed to improve rural coverage, and ever wider availability of lower cost mobile devices, will bring LTE and 5G within reach of more households.

The biannual Ericsson Mobility Report. Ericsson Mobility Report provides projections and analyses of the latest trends in the mobile industry, including subscription, mobile data traffic and population coverage worldwide. The following is from the June 2021 report.

In 2026, 5G networks will carry more than half of the world's smartphone traffic

The Middle East and North Africa region is expected to have the second highest growth rate during the forecast period, increasing total mobile data traffic by a factor of almost 7 between 2020 and 2026. The average data per smartphone is expected to reach 32GB per month in 2026.

Sub-Saharan Africa also has a very high growth rate, but from a relatively small base, with total mobile data traffic increasing from 0.87EB per month in 2020 to 5.9EB in 2026. Average traffic per smartphone is expected to reach 9GB per month over the forecast period.

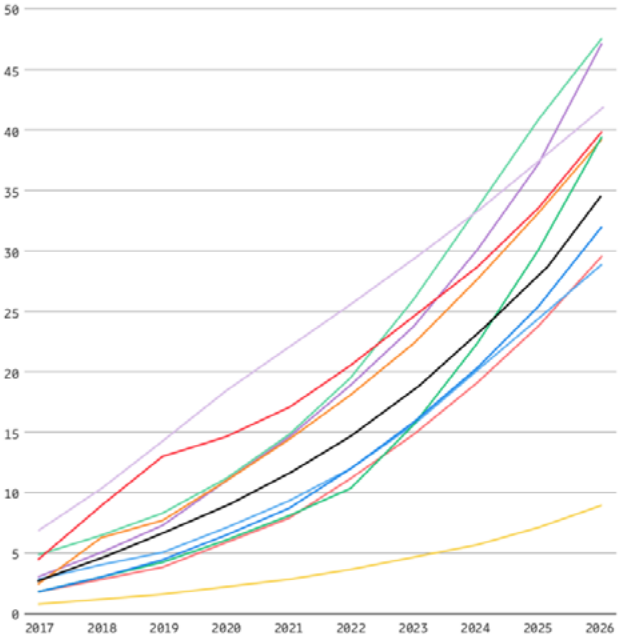
Network sunsets will have no negative impact on global network coverage by technology

Service providers are continuously seeking alternatives to increase coverage and capacity by using newer-generation technologies. One option is to "sunset", or shut down, one legacy technology

– that is, 2G or 3G – which are often deployed in low- to mid-bands that are ideal for creating large network coverage with 4G and 5G.

A further driver of network shutdowns is to reduce network complexity and operational

Figure 14: Mobile data traffic per smartphone (GB per month)



Regions	2020	2026	CAGR 2020–2026
North America	11.1	48	27%
Western Europe	11	47	28%
GCC	18.4	42	15%
India	14.6	40	18%
South East Asia and Oceania	6.2	39	36%
North East Asia	10.9	39	24%
Global average	9	35	25%
Middle East and North Africa	6.5	32	30%
Latin America	5.9	30	31%
Central and Eastern Europe	7.2	29	26%
Sub-Saharan Africa	2.2	9	26%

expenditure. However, there are several considerations to be made, such as device fleet capability and the IoT installed base. There are also regulatory requirements; for instance, as of March 30, 2018, EU regulations require motor vehicles to be fitted with the ability to make 112-based emergency calls. Many of these are limited to 2G and

3G technologies. Sunsetting plans and trends look very different across regions and countries, with shutdowns already taking place in developed countries. This is enabled by the device mix; for instance, in North America, the 2G/3G share of subscriptions is only 7%, compared to sub Saharan Africa, where the share is currently 70–80%.

Coverage and capacity gains in low- to mid-bands can be achieved without, or with gradual, sunsetting – for example with the use of spectrum sharing. Also, if a legacy technology is shut down, the corresponding spectrum band will be used for a newer 3GPP technology and have no negative impact on network coverage. ■

Karim Yaici,
lead analyst, Analysys Mason Middle East and Africa regional research programme

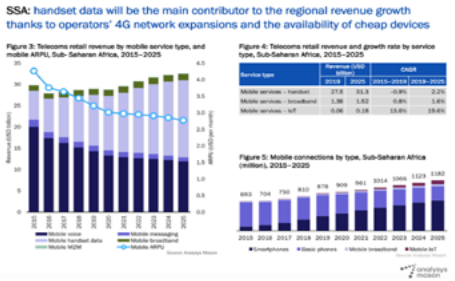
Stefano Porto Bonacci,
analyst, GSMA

The following data was sourced from the Analysys Mason report Mobile services in Sub-Saharan Africa: trends and forecasts 2020-2025

This report provides commentary and trend analysis to support its five-year forecast for mobile services in sub-Saharan Africa. Our forecasts take into consideration the likely range of economic impacts that the Covid-19 pandemic may have on operators' telecoms service revenue worldwide.

Forecasts are based on Analysys Mason's robust set of historical data and draw on a unique and in-house modelling tool that applies a rigorous methodology (reconciliation of different sources, standard definitions, top-down and bottom-up modelling). ■

GEOGRAPHICAL COVERAGE	KEY METRICS
Region modelled ▪ Sub-Saharan Africa (SSA) **Countries modelled individually** ▪ Cameroon ▪ Côte d'Ivoire ▪ Ghana ▪ Kenya ▪ Nigeria ▪ Rwanda ▪ South Africa ▪ Sudan ▪ Tanzania ▪ Uganda ▪ Zambia	**Connections** ▪ Handset, mobile broadband,[2] IoT[3] ▪ Prepaid, contract ▪ 2G, 3G, 4G, 5G ▪ Smartphone, non-smartphone **Revenue/ARPU/ASPU** ▪ Service,[4] retail, wholesale ▪ Handset, mobile broadband,[2] IoT[3] ▪ Handset voice, messaging, data ▪ Prepaid, contract ▪ 2G, 3G, 4G, 5G **Traffic** ▪ Outgoing voice minutes, MoU ▪ Mobile data traffic



Kurt Bagwell,
executive vice president and
president - international, SBA

We chose South Africa as our entry point into the African continent for several reasons. These included our partner's research on the potential for new tower builds and our own research on the country level factors like macroeconomics, real estate rights and law, labour, taxes, population growth, economic maturity and carrier dynamics, amongst others. We felt that the market, at that time, was the ripest for entry and growth, and so far, the number of our multi-tenant sites has supported that decision.

Currently, we have over 1,200 sites in South Africa heading to more than 1,500 by end of year 2022. We have constructed most of our towers rather than purchased towers. Rooftops are part of our numbers, but not to a significant number. Outside of major urban and suburban areas, finding rooftop heights, at suitable locations, that can satisfy multiple customer needs is difficult and lower heights can be problematic for optimum coverage required by our customers. We survey each site and build out what is specifically needed. If we locate a rooftop that is a viable solution for our customers, then we will enter a leasing arrangement to use the rooftop and make it ready for our tenant's equipment. If we need to build stealth towers due to zoning requirements, we build stealth towers, although these of course have physical loading limitations and cost issues, so it is not something we want to do at every location, nor do we think it is necessary at every location. Renting ground space from public or private parties and securing all proper permits is also a key part of our expertise. The structure type is one thing, but we need a suitable location to install a tower and associated equipment.

"We work with major broadband carriers in South Africa - Cell C, MTN, Telkom, Vodacom. We also work with many others who are national and/or regional, including data-only providers (fixed wireless) and providers of many other types of utility, public or safety services"

Hence, after searching and negotiating multiple candidates in a ring, we gain approval on the best candidates and begin the lease negotiations with them. Then we secure all the permissions required. That is our aim, not to just build a facility on a spot that is easy for us but to build at the optimum location for our customer's requirements. It is a basic that such aspects add value to a tower project. We set out to engage the most suitable consultants and we employee the best workers we can to ensure that projects are completed quickly, safely, to customer requirements and as cost effectively as we can.

We work with major broadband carriers in South Africa - Cell C, MTN, Telkom, Vodacom. We also work with many others who are national and/or regional, including data-only providers (fixed wireless) and providers of many other types of utility, public or safety services. Our main long-term target is to

have most of our business with major MNOs, but we will provide our skill and expertise to any customer needing a tower or roof top antenna. That's the advantage of the towerco model – spend extra money up front to build a true multi-tenant structure and facility and rent space to multiple customers that may have varying requirements. That's how we create a win-win model for all of us. In addition, the model in South Africa is where the towerco is completely responsible for the land economics – so our pricing is turnkey or also known as "combo rent", where tower and ground space are included in one flat price. If our land cost increases, that is our expense, not a pass-through, or a pro-rata pass-through, as it is in some countries worldwide. So, this is a cost risk for us, and we need to efficiently manage this expense and longevity of these ground lease contracts, providing our customers with price security that they won't have to face these additional costs. There is a high cost to constantly administer ground leases, but it is a core part of our focused multi-tenant towerco offering, this being an area in which we excel.

We are seeing steady demand and it is typical that carriers over time go through cycles where some years they are busier than others. In a four-carrier market like South Africa, historically you tend to see two to three of them having busy schedules each year for network growth of all types – capacity sites, performance sites, geographic growth sites. That's been our experience in South Africa, and we don't forsee it changing anytime soon. Spectrum is limited right now with the delay in the auctions, so they need to be very focused on existing site performance, and density of sites is a key to keeping up network capacity. When the new spectrum comes, they will need to deploy allocated spectrum, and we will see many modification requests on our sites to add or swap out equipment to implement the new frequencies. ■

"Our main long-term target is to have most of our business with major MNOs, but we will provide our skill and expertise to any customer needing a tower or roof top antenna"

Looking ahead: 3G is still out there and 4G is out there too, but not everywhere, so the phenomena described above is already happening, and with 5G coming, it will be more of the same. Carriers always tend to focus on the high population areas first with new technologies, due to targeting the areas that offer highest return on investment potential. But they all want to provide ubiquitous service in all areas over time, to differentiate themselves as a high quality, well-rounded carrier with good coverage and performance in all areas. This takes different shapes at different carriers, based on their financial positions, network maturity levels, growth plans, etc. At the end of the day, customers look at the number of signal bars and performance of voice and data on their phones and our customers are all still competing with their networks in addition with marketing (phone sale, service pricing, special features, etc.).

Willem Wentzel,
GM of Wireless Division NEC XON

Connectivity, largely wireless, is enabling more than US$180 billion of commercial and social opportunity in Africa and the continent's leading telcos and service providers have already begun to tap the potential with advanced technologies that lead the global arena.

International Finance Corporation, part of the World bank Group, estimated African Internet penetration to be 40% in 2019. That is an increase from 18% in 2014. While it demonstrates growth, the continent's population is growing and rapidly urbanising, offering significant prospects for digitalised societies as an enabler of growth economies.

A 10% improvement to Internet connectivity can generate a 2.5% GDP increase. In Africa's case, the potential in 2019 was 44 million new jobs for every 10% connectivity improvement.

In reality, the actual numbers behind the emerging scope become even more significant in the context of Africa's population growth, with the population expected to reach 2.5 billion people by 2050 and represent more than 39% of the world's total population by the year 2100.

"We see this major shift over the past two years continuing in the next three to four years as African tier 1, 2 and 3 service providers continue optimising flexible, adaptable and capable world-class networks"

However, there are many factors that could impact an optimistic view of the future.

While taking advantage of new open radio access technologies to improve core infrastructure, densification, and access, energy is a crucial element that threatens progress.

That said, there's a powerful argument that recent global events demonstrated how many African organisations were much more innovative than their counterparts in more developed economies.

Adapting to new, distributed work models is easier when infrastructure to support it is widely accessible. Speed, adaptability, agility and innovation have been crucial factors that drove African organisations to rapidly improve and deploy world-class networks in the past 24 months while experiencing severe operational, economic, mobility, and supply chain constraints.

We see this major shift over the past two years continuing in the next three to four years as African tier 1, 2 and 3 service providers continue optimising flexible, adaptable, and capable world-class networks.

For example, the adoption of Open Radio Access Network (O-RAN) technologies to bolster core networks and provide new last-mile opportunities with expanded coverage for better qualities of experience (QoE) into previously under-served markets will massively grow potential customer bases and revenue opportunities.

O-RAN enables networks to shape their own destiny. Free from specific vendor technology roadmaps, they can create more economically sustainable networks that offer flexibility, adaptability and agility. The service delivery platforms they are able to create are much

broader and richer and they are able to overlay services that suit rural and semi-urban customer eco systems.

Many traditional technologies have been adapted to integrate with this emerging environment. Satellite, for example, traditionally had bandwidth costs that exceeded the value proposition. In this new world envisioned and being realised by African service providers, it is cost-effectively repurposed as a backhaul solution in the O-RAN landscape. It also delivers new geographical flexibility to provide economically feasible QoE for people in places that were impossible to serve in the past. Additionally, it has become more affordable and easier to provide peer-to-peer and fibre connectivity.

The capabilities and scale of potential O-RAN solutions is helping to create robust services in Africa. The lessons from global proofs of concept (POC) and deployments, from Japan to Spain and others, are already being put to work in some of Africa's tier 1 networks. They are being used to augment resilience and robustness in existing backbone infrastructures, further develop the network coverage area, and enable new services to meet the evolving needs of end user customers.

The big opportunity that the service provider networks are embracing, is progressively maturing their legacy technologies, from 2G to 3G and 4G. It enables them to provide additional services, grow the coverage umbrella to bring the services to many times more people, and optimise availability and throughput. That enables end user customers to get connectivity that is always on and give them the ability to do the stuff they need, from learning to healthcare, work, ecommerce, entertainment, voice and data communications and more.

O-RAN helps make the service provider's network affordable, accessible everywhere, resilient so that it is always available, and can deliver the bandwidth, latency and throughput required for modern applications in a digitalising world. In non-standalone eco systems, it enables future-proofed 5G options. ■

Looking ahead: African service providers ahead of the curve are using the technology to optimise densification to eliminate network shadows, provide overlays that enable new services, and improve resilience and economic sustainability. This is not least occurring in East Africa, where new markets richly tap next-generation accessibility, connectivity and services.

Amidst the densification, accessibility, service and resilience optimisations, energy has emerged as a crucial factor. Hybrid energy that harnesses grid, diesel, and solar generation with localised storage and delivery being less reliant on long-distance transmission infrastructure has emerged a clear leader.

Intelligent equipment management where energy is in short supply is a critical element to the success of mobile and fixed wireless services throughout Africa. Coupling active and passive intelligence of both communications and energy equipment enables dynamic energy supply scaling to meet real-time requirements. Coupled with digitalised remote monitoring and management, it enables operationally effective, cost-effective service delivery across much wider geographic coverage.

Advanced service providers are continuing to embrace innovative technologies to build out their value propositions, commercial opportunity, and sustainable social value delivery. The search for solutions that leverage world-class open technologies from partners committed to Africa's sustainability by investing in the continent's organisations with steadfast presence, is fiercely contested.

Zoran Lazarevic,
chief technology officer, Ericsson Middle East and Africa

The past year has tasked businesses and organizations to plan and strategize beyond existing models to adapt to challenges Covid-19 has brought the world. Africa has had to navigate pandemic challenges, but the continent's people and businesses have shown their resilience.

African businesses and in particular its telecommunications ecosystem, have proved adaptability to pandemic challenges and commenced a journey to a digital future.

Africa remains the world's fastest growing mobile market, while sub-Saharan Africa continues increasing 4G coverage with 5G planning underway. Driving factors behind this shift include a young and growing population, availability of lower priced smart and feature phones and importance of data in the continent's growth.

Africa has emerged as a strong innovation adopter, with rapid rise in usage of technology and smartphones. See how mobile money was initiated in Africa and is now surging over the continent.

Moreover, Africa has come a long way in its digitization journey – from mobile telephony to broadband, and from connecting to digitizing key economic sectors, jobs, education, healthcare, government and society in general. More still needs to be done given higher dependence on ICT because of Covid-19.

For Ericsson regionally, sub-Saharan Africa has been the company's growing footprint as service providers strengthen their networks to meet growing demand.

In 2020 MTN Benin extended its long-term relationship with Ericsson to provide world-class managed services, including a Network Operations Centre, as well as a Field Services in Radio, Core and Transmission in Benin. Under the agreement, the future capabilities of efficiencies, automation and data will enable MTN Benin and Ericsson to jointly create a world of predictive operations with focus on customer experience, network quality, performance, and automation.

Additionally in 2020, Telma Madagascar switched on its 5G commercial network, powered by Ericsson offering subscribers high-speed services enabled by new generation of mobile connectivity.

In October 2020, Airtel Africa expanded its strategic partnership with Ericsson to enable 4G coverage in Kenya. With Ericsson's Radio Access Network (RAN) and packet core products for 4G, Airtel subscribers will experience enhanced quality of voice and data. The network modernization deal, signed in August 2020, is in line with the 'Kenyan Digital Economy Blueprint Vision 2030' which aims to provide robust connectivity in rural areas and facilitate e-commerce platforms.

Announced in October 2020 that Ericsson's IoT Accelerator will power Telenor Connexion's global connectivity to Wayout's sustainable water treatment micro-factories starting in East Africa.

Wayout has engineered plug-and-play micro-factories for local production of clean, filtered water, with minimal environmental footprint. Powered by solar panels, the micro-factories offer an advanced water purification system.

Ericsson has increased its social responsibility to ensure that end-of-life material is treated and recycled in an environmentally responsible manner.

In 2021 African countries via ATU (Africa Telecommunication Union) endorsed ATU spectrum recommendations, focusing on transforming Africa into a knowledge economy through development of technologies that boost connectivity and innovation.

Mobile communications remain the main platform that connects African citizens and

business, a technology highly dependent on spectrum the availability of which depends on spectrum being licensed for use. The spectrum recommendations outline importance of awarding radio spectrum in countries across Africa in a timely, predictable, and cost-effective fashion to support affordable, high-quality delivery of Information and Communications Technology (ICT) services and spur smart technology initiatives.

The 20th edition of the Ericsson Mobility report (EMR) highlights unique trends in individual markets worldwide, including sub-Saharan Africa and states sub-Saharan African markets where around 15% of mobile subscriptions were for 4G at the end of 2020. Mobile broadband subscriptions in sub-Saharan Africa are predicted to reach 76% of mobile subscriptions by 2026. However, 5G volumes aren't expected to grow in 2021 but may reach around 70 million 5G subscriptions in 2026.

The Global Telecom Market Report (GTM) or "The Future of Urban Reality Report" was launched by the Ericsson ConsumerLab, to assess penetration of 5G and the tremendous potential it holds for worldwide markets. Ericsson ConsumerLab report is Ericsson's largest consumer study, revealing key insights about what sub-Saharan African consumers believe will happen post pandemic, up to 2025, through surveying a sample of 1,000 to 2,000 respondents aged between 15–79.

The report found, when entering the "next normal", African consumers will have added an average of 3.4 online services to their daily online activities, also increasing time they spend online by 10 hours weekly by 2025, compared to pre-pandemic habits.

This move is also expected to bridge the gap between moderate and advanced online users, with the more moderate online users having introduced more online services in their daily life over the course of the pandemic.

Due to the pandemic, the implementation of online education at schools and universities as well as remote working has increased to 87% and 63% respectively. Going forward online education and remote working are collectively expected to remain at 51%.

Pre pandemic, amount of online shopping stood at 28% out of the total number of all shopping events, both online and at physical stores. During pandemic, figure increased to 47%. Consumers anticipate their habits around online shopping will remain around 37% after pandemic has passed. ■

Looking ahead: Ericsson is committed to developing further partnerships with operators and stakeholders to advance infrastructure and technology across Africa. To that end, our partnership with UNICEF's Giga initiative was launched in September 2019 with the aim of connecting every school to the Internet and every young person to information, opportunity, and choice, a prime example of our commitment. Ericsson was founded on the belief that communications is a basic human need, we knew the significance of the initiative and entered a global partnership with UNICEF to help map schools.

There should be much optimism for telecommunications and technology advancements in Africa. However, that requires further partnership and work that fulfils the ambition to bridge the digital divide. 5G is essential to that and while uptake is relatively low, we are committed to demonstrating its importance to the continent's ambitions.

Joachim Wuilmet,
head of customer marketing and communications for Middle East and Africa at Nokia

2020 was a special yet difficult year for all of us across the globe. The global Covid-19 pandemic has rocked nations and negatively impacted economies, forcing organisations to move quickly to enable remote working, and putting pressure on Communications Service Providers (CSPs) to rethink their priorities and ensure that they could deliver on changes in demand, both around peak demand time and the geographical shift of the load of the networks from cities and business centres to residential areas. Here Nokia played a critical role in supporting our customers to keep the networks running, and keep our worldwide communities connected.

The pandemic also highlighted the need to speed up the pace of automation due to limited movement, resulting in a lot of interest in Nokia's network operations automation, such as incident detection, automated troubleshooting, issue resolution, and remote and digital site acceptance.

The other major development is the broader adoption of 5G across the world. As of 31st August 2021, Nokia had 178 commercial 5G deals and 68 live CSP 5G references in key markets worldwide, including Vodacom South Africa, Safaricom Kenya and Togocom live 5G networks in Africa. We see a growing interest and trials for 5G technology across the continent.

"As of 31st August 2021, Nokia had 178 commercial 5G deals and 68 live CSP 5G references in key markets worldwide, including Vodacom South Africa, Safaricom Kenya and Togocom live 5G networks in Africa"

Nokia has achieved many successes across Africa in different technology domains by securing several key deals from customers to modernize and expand their networks with the latest Nokia technologies from the Nokia radio, IP/Optical and fixed network, software and professional services portfolios. Some of the key highlights in 2020 include:

- Nokia and Togocom deployed the first 5G network in West Africa in a three-year deal to roll out the 5G services across the country. Part of the deal included enhancing 2G, 3G, and 4G networks to strengthen Togocom's market-leading position and future-proof its infrastructure to provide next-generation services to Togolese citizens.

- Nokia and Airtel Kenya laid the foundations for 5G in Nairobi, to modernise the city with high-speed 4G and 5G-ready hardware from its comprehensive AirScale portfolio. The deal included upgrading existing 2G, 3G, and 4G radio access network (RAN) coverage in urban, semi-urban, highways, tourist spots, and central business districts in Nairobi and the rest of Kenya.

- Nokia announced enabling 5G services for Vodacom South Africa customers with 5G radio, core, and Fixed Wireless Access (FWA). At the time, 5G mobile broadband and FWA services were already live in four cities and were being deployed to other areas across South Africa, bringing the Nokia and Vodacom 26-year relationship into the 5G era.

- Nokia provided Tizeti with a LTE FWA solution for high-speed internet services, enabling Tizeti to introduce new services, provide better customer service to subscribers and pave the way for easier migration to 5G FWA in the future.

- In South Africa, Nokia joined hands with Forge Academy to provide theoretical, laboratory and on-the-job training to seize opportunities in the Fourth Industrial Revolution (IR 4.0) economy.

Mobile penetration remains a challenge on the African continent, with the current penetration rate sitting at 50%. This means that hundreds of millions of people remain unconnected in Africa. That said, according to the International Data Corporation (IDC) Worldwide Quarterly Mobile Phone Tracker, the continent's smartphone market posted a strong recovery in the first quarter of 2021, growing by 16.8%. IDC expects this growth trajectory to continue and forecasts a 5.6% year-on-year growth for the rest of 2021. ■

Looking ahead: Spectrum availability and pricing remain two key challenges in Africa. According to the GSM, governments across the continent must put spectrum roadmaps in place to ensure there is enough spectrum available to meet demand and reconsider their approach to spectrum pricing. Access to the mid-band spectrum will also be critical to the future of 5G. For policymakers, this means that they need to plan to meet short, medium and long-term demand, while also speeding up the digital switchover to free up spectrum in the sub-1 GHz band.

Connecting the unconnected remains a key priority on the continent to deliver on the promise of the impact of ubiquitous connectivity to stimulate economic growth as countries in Africa look to drive growth that was impeded by the Covid -19 pandemic. Nokia continues to work with and support its partners to overcome the challenges facing the continent and identify the best solutions to meet their requirements.

At Nokia, we create the technology that helps the world act together. Our focus during 2021 and beyond has been to continue to work with our partners across Africa to connect people and communities using the most appropriate technologies, giving them access to valuable critical services.

As more 5G spectrum gets allocated, we will see an increase in 5G networks going live, and new use cases will emerge exploiting the 5G end-to-end architecture.

5G goes beyond data connectivity for handsets and enables real-time machine-to-machine communications. Going forward, 5G is going to revolutionize various industries, such as manufacturing, and paves the way for the 4th Industrial Revolution (4IR). We also expect an increase in 5G networks utilising 5G Standalone (5G SA) architecture, bringing more enterprise use cases.

Africa refuses to be left behind when it comes to adopting new technologies and exploring new 5G use cases. We have already seen the progress achieved in South Africa, Kenya as well as Togo, and we expect more to come in 2021 and beyond. The most important aspect is to proceed with the discussions to reach answers for those vital questions such as how to benefit from 5G, what the right time to market is, which spectrum should be used and, most importantly, what the use cases are.

Segun Ogunsanya,
CEO, Airtel Africa

Airtel Africa is a leading provider of telecommunications and mobile money services, with a presence in 14 countries across the continent, primarily in east Africa and central and west Africa.

Airtel Africa offers an integrated suite of telecommunications solutions to its subscribers, including mobile voice and data services as well as mobile money services both nationally and internationally.

It aims to continue providing a simple and intuitive customer experience through streamlined customer journeys.

In October, Airtel Africa launched a comprehensive sustainability strategy, which sets out its detailed plans to improve the lives of millions of people across Africa through digital and financial inclusion and access to education. The strategy includes specific goals around environmental protection and the ongoing development of a rewarding, diverse and inclusive workplace.

The strategy is delivered through four sustainability pillars: 'Our business' which reflects the firm's operations and the expansion of its network, 'Our people' which sets commitments around employee engagement, development, diversity and inclusion, 'Our community' which details our dedication to improving access to education, and 'Our environment' which is focused on reducing the environmental impact of our operations. We have identified six of the United Nations Sustainable Development Goals to which we believe our work will make a genuine and tangible contribution· they are SDG 4: Quality education, SDG 5: Gender equality, SDG 8: Decent work and economic growth, SDG 9: Industry, innovation and infrastructure, SDG 10: Reduced inequalities, and SDG 12: Responsible consumption and production.

Segun Ogunsanya, CEO, Airtel Africa, explains how the move is a significant milestone in the firm's journey. "Our new strategy provides a solid foundation for us to accelerate change for the communities we serve and the environment in which we operate," he says. "We have worked closely with our stakeholders to ensure that this strategy is ambitious, robust and credible. This partnership approach underpins all the work we will deliver through our strategy. We will look to collaborate across the industry, recognising that by working together, we will be able to drive a more significant impact for the people who need it most. We are more committed than ever to ensuring open and honest communication on our progress as Airtel Africa embarks on its long journey towards a more sustainable future. ■

Looking ahead: Airtel Africa has set itself a major challenge, made up of a sustainability strategy. It includes nine goals and commitments, with corresponding programmes that address the business' material topics (identified through an extensive consultation at the beginning of the year) and enable the group to continue delivering sustainable growth and uphold the best governance standards. They include data security, service, supply chain goals and "commitments to our people". Other goals include digital inclusion, financial inclusion goal, access to education, greenhouse gas emissions reduction and environmental stewardship. The latter, it is hoped, will eliminate hazardous waste from Airtel Africa's operations, significantly reduce its non-hazardous waste and minimise its water consumption with programmes to replace damaging materials, expand recycling schemes and build employees' awareness around the protection of natural resources.

Ashish J. Thakkar,
CEO, Mara

Worldwide the Covid-19 pandemic has disrupted economies to an extent not previously experienced in recent times. Restrictions such as Lockdowns have impacted businesses and this impact is ongoing to a greater or lesser extent depending on country. Regardless of the size or history of the organisation concerned, changes have had to be implemented to cope with the pandemic. Despite the pandemic, Africa has true digital acceleration potential that is yet to be realised. The statement that "Africa is the next big growth market", a description that has persisted for some time, remains valid. In recent years, the accelerated growth experienced within Africa's technology ecosystems has been a great motivator for Mara Phones to open two state-of-the-art smartphone manufacturing facilities in Kigali, Rwanda and Durban, South Africa – the first of their kind anywhere in Africa. A proudly African company and brand, Mara Phones is a subsidiary of Mara Corporation, a trusted company that has been working on the continent for over two decades.

Local manufacturing of smartphones and other tech products is critical for the African economy, especially in the backdrop of Covid-19, to reactivate economies and stimulate the job markets. There is a heightened need for African countries to invest in their own capacity to supply critical goods and services, including smartphones. Covid-19 and the Suez Canal blockage have perfectly demonstrated the fragility of international trade and the overreliance on a few global suppliers. We have seen how global manufacturing powerhouses have threatened local manufacturing in most countries and how supply chain interruptions can affect local economies and cause catastrophic losses.

The global supply chains have also learnt that dependency on any one geography is unsustainable. That is why governments are now encouraging businesses to diversify their industrial bases from China, making Africa a more relevant and perfect alternative destination. The sentiment across Africa, is now to support and buy more African brands, which are proudly "Made in Africa". And we hope that other parts of the world will also come to favour Made in Africa products as reliable and cost competitive. More government support is needed and will result in local companies being enabled to assert dominance in the smartphone and tech sector, further driving innovation and creating local supplier networks, which will increase the number of players within the value chain. ■

Looking ahead: As Africa becomes mobile phone enabled, the development of the digital infrastructure will be an enabler to Africa being self-sufficient, as the continent increasingly becomes a major consumption market. With the focus on improving smartphone growth in Africa, Mara Phones is a firm believer that Africa should not only be a consumer but also a value-added producer of high-tech goods.

The digital ecosystem is crucial for economic growth because access to smartphones puts transformational tools and services in the hands of Africans. Mara Phones is a digital enabler for financial inclusion, agricultural efficiencies, business tools and services, digital health and education. Our devices enhance consumer access to information, networking, job creation and critical tech skills transfer to the continent. Mara Phones is proactively committed to working towards the United Nations' Sustainable Development Goals (SDGs), providing digital inclusiveness to all and creating opportunities, particularly for Africa's women, youth and unemployed. The production of smartphones on the continent offers value added solutions, which will enable a thriving and digitally inclusive Africa.

John Baker,
SVP business development, Mavenir

Wireless communications networks are vital to future prosperity and security of African countries. 4G/5G will support numerous new applications, including critical services provision, benefiting African economies. Data increase on 5G networks will further interconnect economies throughout the world, facilitating cross-border services and commerce. Protecting communications networks from disruption or manipulation will ensure privacy and liberties.

latest Open RAN technology, built on Cloud platforms which leverage industry standard compute and storage infrastructure, the power and scalability of rapid software innovation, offers a means to improve supply and deployment of multi-generation virtualised wireless networks.

Open RAN can simplify 2G/3G migration to 4G and 5G making upgrading as straightforward as software updates. The technology also brings significant opportunity for Africa: it will be a catalyst for new eco-system creation of innovative suppliers in which indigenous African companies compete. In doing so, Open RAN can help Africa diversify its mobile network supply chain, speed deployments, generating significant economic benefits.

Mavenir as an end-to-end cloud-native network software provider, is committed to reducing entry barriers for new hardware suppliers. In 2021, Mavenir was named a group member of disruptive network vendors working with MTN helping the operator group test and deploy 4G and 5G Open RAN across its multi-country footprint. MTN's initiative has ambition and scale needed to boost the supply, support, training and employment of local staff replacing traditional network suppliers.

Traditionally, mobile networks have been built with closed, proprietary software and purpose-built hardware. Although the 3GPP standards underpinning Africa's current mobile networks were supposed to be open, in reality key interfaces are proprietary. This has led to vendor lock-in stifling innovation, inhibited competition and, most critically, slowing deployment in Africa.

While 5G has been specified as a more modular, disaggregated, virtualised architecture, critical network elements from incumbent vendors still incorporate proprietary interfaces. Through tighter, more explicit, publicly accessible specifications for these critical interfaces, Open RAN seeks to rectify this and offer fully programmable software-defined radio access network running on commercial, off-the-shelf (COTS) hardware. As well as offering increased flexibility, Open RAN is more efficient technically and operationally.

GSMA has illustrated that mobile networks deliver immense economic benefits. Providing 4G or 5G mobile broadband to communities currently lacking internet access will deliver further significant benefits by bridging the digital divide and supporting governmental "levelling-up" ambitions.

Through standardized open interfaces, Open RAN ensures interoperability between different suppliers, lowering barriers for new innovators entry: new entrants can compete at the level of discrete network elements rather than having to develop complete end-to-end solutions supporting multiple mobile generations.

Entrants prospering from Open RAN adoption could create skilled African jobs. Increased local R&D and manufacturing of Open RAN solutions would also support productivity growth.

Before Open RAN, there were three cellular radio vendors. Today, there are 15 and increasing. Vendor competition is delivering increasingly diverse high quality Open RAN radio offerings to meet specific coverage requirements or customer needs.

Diversification of the supply chain will also drive network capex and opex costs down. These lower costs will allow faster rollout over larger coverage footprints. Furthermore, diversification minimizes the risk of delays if an incumbent vendor can't cope with a spike in global demand from operators.

Diversification in the supply chain can contribute to enhancing security according to the US National Cyber Security Centre, NCSC. The ability to have a more modular design, with different suppliers providing different network components via open interfaces, can improve - not diminish - security and vendor accountability.

Open interfaces allow multiple independent operators to continuously security test network elements and the whole system, giving quicker detection, reaction to replace or address suspect vulnerabilities. Operator exposure can be limited if one of their vendor's solutions is compromised. Open RAN encourages suppliers to compete on their security credentials.

Open architecture allows operators to apply up-to-date security patches available for the COTS components in their networks - operating systems, Network Function Virtualization infrastructure, BIOS, firmware, etc. Security vulnerabilities can be addressed pro-actively: operators don't become dependent on their incumbent vendor(s) to keep their networks secure.

The shift to cloud-based solutions enabled by virtualisation of network elements also allows new security controls such as sandboxing, containerization and network slicing. These controls make networks more resilient and stable even at large scale, as proved by the experience of Rakuten in Japan and other operators using virtualised elements such as Deutsche Telecoms and T-Mobile.

Open RAN facilitates the opportunity for Africa as an incubator for next generation wireless communications and associated current and emerging downstream markets if government's regulatory regimes are right.

Through strategic partnerships with industry, governments can facilitate development of vibrant innovative technology eco-system in the mobile space. ■

Looking ahead: Governments can play a key role by signalling support for market-based, open, interoperable standards; funding industry and academic R&D and its commercialisation; and supporting deployment through Memoranda of Understanding with regional neighbours to promote interoperable open standards for 5G, while avoiding technology mandates or overly prescriptive solutions. They can also set strategic objectives to secure access speeds to a large%age of their populations within defined timescales and introduce spectrum policies supporting innovation and trials while providing sufficient bandwidth for both local-area use-cases and national coverage.

Taking all these issues together, Open RAN can bring much-needed competition and product innovation to mobile services while accelerating 4G and 5G roll-out, lowering costs to operators and making services more affordable for consumers.

When announcing its Open RAN roll-out, MTN was working towards starting deployment by end of 2021. MTN acknowledged diversifying the vendor landscape, disrupting the cost base and removing dependencies on proprietary suppliers as important benefits. By modernising networks, MTN also saw opportunities for power consumption and emissions reduction, important elements of its Project Zero sustainability programme. As 4G and 5G Open RAN deployments progress in 2022, MTN will start to realise these benefits.

Open RAN will be a catalyst for Africa's involvement in this mobile telecommunication eco-system facilitating investment and jobs and boosting the high-tech sector with benefits it can bring for wider economy.

Shanks Kulam,
co-founder, x-Mobility

The era of mass cloud communications seems to have finally dawned. While the word 'Zoom' no longer just means to rush about but has become known as a communications brand – and even a verb – at x-Mobility the Digital MVNO has seen similar growth over the last twelve months. The natural maturing of the market was speeded up by the global pandemic and we saw a lot more interest for our AppVNO solution.

One of the key trends we witnessed was that of large, established African MNOs looking to try something new and doing that through a sub-brand. Sometimes these sub-brands were wholly owned, sometimes joint ventures and at other times they were kept at arms' length. But they were all developed to explore new opportunities quickly and nimbly in the market.

For MNOs, quick and nimble sub-brands also required quick and nimble solutions – so they turned to a Digital MVNO. There are almost as many different use cases for a new Digital MVNO as there are solutions on the market, but some of the ones x-Mobility has helped launch or prepared for imminent launch, or just discussed at an enquiry level include:

- an immediate gap in the market that can be filled quickly – possibly a demographic or user group that is being underserved elsewhere;
- a defensive move against a competitor targeting a particular user group
- launching into a new market or country without the need to build expensive infrastructure
- reaching out across multiple markets to a global diaspora

"Beyond the return to the old normal, we also see a new normal developing for the Digital MVNO market"

Despite financial pressures the pandemic has put on many businesses, we've witnessed the fact that many businesses have seen it as an opportunity for their future planning and investment.

There are other trends that have developed over the last twelve months. One of which is like existing MNOs creating sub-brands and that is existing, African fixed line players looking to create a mobile solution.

Fixed line operators have client bases that can easily be targeted for a mobile solution. However, traditionally extending into mobile was too expensive as it would be necessary to buy or build a network. The Digital MVNO model changes that and we've seen growth in that sector.

Another example of extending a brands initial offering into mobile has been the rise of technology or media companies exploring the Digital MVNO model.

With a well-engaged consumer audience that has bought into the brand, brand extension seems like an obvious business tactic. Mobile is an exciting area for any brand to be involved in, it can benefit from existing loyalty and also creates further loyalty.

African brands were often locked out of the mobile world. In many territories the traditional MVNO model isn't well developed, but also not appropriate for reaching their audience. If you are, for example, a radio

brand or an online news brand, then trying to send out a physical SIM card to your audience to get them to engage in your mobile network is a non-starter.

Digital businesses need a digital solution for their extension into mobile. A Digital MVNO provides that, and we have seen dramatically increased interest from this sector over the last twelve months.

One new business model we've seen recently in Africa, is from utility companies. For many utility companies in Africa, they are targeting a rural community, which relies on both power and communications to stay connected. In fact, the two are often linked as one of the biggest uses of power is keeping mobile devices recharged. Being able to connect the two business concepts and tie the audience in is a great business model. And one only possible through a Digital MVNO.

Finally, tying all these different trends together, has been a huge surge is usage over the last twelve months.

The increase is partly due to the pandemic and people confined to homes and unable to communicate face-to-face as pre Covid-19. Phones have become even more important tools for users during the pandemic. We are seeing that the phone has become more important again for traditional communications, calls and messages.

This increase in consumer usage has spurred some of the MNOs, fixed line operators and brands to reconsider mobile and realise that the Digital MVNO option is now available to them.

Over the next twelve months we expect the Digital MVNO market to mature further and become a mainstream business tactic that most consumer brands will need to be aware of in business planning.

"Despite financial pressures the pandemic has put on many businesses, we've witnessed the fact that many businesses have seen it as an opportunity for their future planning and investment"

Some of that will be due to new services that we will announce as a business. We are looking forward to expanding on our AppVNO solution and creating more opportunities for African MNOs, fixed line operators and brands.

However, beyond what we are doing we think that the next twelve months will see two other interesting trends.

Firstly a return of international travel. Although there are a few people still travelling, level of mass travel still has a long way to go to reach pre-pandemic days, but we are expecting it to increase gradually over the next year.

Travel has always been one of the driving use cases for Digital MVNOs – the ability to have a calling app on your device that offers a 'local' number and eliminates the fear of roaming charges is a very powerful tool for holiday makers, business travellers or even emigrants.

Beyond the return to the old normal, we also see a new normal developing for the Digital MVNO market. A trend we have seen start this year, we expect to grow and grow next year – hybrid business models that incorporate mobile to make something brand new.

Some brands we are speaking to are seeing mobile not as an add-on to their core business model, but as an integral part of their business. In ways we can't yet foresee, mobile and Digital MVNOs - will become an integral business tool to new businesses of the future. And that future starts now. ■

Justin Head,
CEO, PowerX

With only 46% of sub-Saharan Africa connected to mobile services, tower operators in Africa are under pressure to deliver more reliable, faster and greener mobile connectivity. PowerX is a critical player helping tower teams deliver reliable, faster and greener widespread mobile coverage Africa needs.

Widespread tower networks provide the backbone of mobile connectivity. Throughout Africa, MNOs and TowerCos must meet the increased demand for smartphone connectivity. They need low cost, efficient hybrid solutions to connect the unconnected across remote, rural or ultra-rural areas despite bad or no-grid conditions. They need resilient solutions to expand 4G, and 5G rollouts in growing urban areas with high demand for fin tech and digital services. Tower teams are under pressure to make decisions faster for CAPEX and OPEX to be spent with clear returns.

Agile, highly skilled regional tower management teams have successfully managed large-scale complex networks, most often reliant on manual processes. PowerX's regional work over the year is proof that the best human-optimised towers can be enhanced with AI-driven technology and innovation.

Over the last 12 months, PowerX successfully showed that robust AI solutions at the heart of tower operations delivers efficiencies and optimisations at scale remotely for customers throughout Africa. We proved that with AI, tower teams can harness data intelligence to build infrastructure resilience, optimise tower operations and maintenance efficiency, whilst reducing costs and carbon emissions across networks in a sustainable and scalable way.

Bringing AI to the tower industry in Africa has had challenges. Tower teams have often suffered from poor access to granular, site-level data and a lack of large-scale or automated analytics. Customers need more granular visibility over their entire network in real-time. Africa's vast geographical span and poor infrastructure such as roads, utilities and access, providing and maintaining tower uptime and reaching rural and ultra-rural areas are major challenges.

Tower management teams recognise they can't keep doing more with fewer resources. Yet new ways of working can be unsettling for an industry requiring resilience and measures its success in high network uptime. Therefore, building trust in AI-driven technologies with tangible financial results at scale is a pre-condition to region wide adoption.

Automation's importance has increased due to pandemic. Remote, AI-driven insights have allowed tower teams to deploy much-needed hybrid solutions with lower operational costs, optimise inefficient infrastructure, reduce reliance on diesel and better manage site assets remotely. Last year proves our AI can work remotely and deliver solutions in harsh operating conditions without downtime.

GSMA, State of the Industry Report, indicates 1.2 million mobile money accounts exist in sub-Saharan Africa. In coming years, many African countries will look to mobile infrastructure for GDP growth. Big operators across Africa are implementing mobile payment and financial services, delivering financial inclusion to millions, and enhancing government services and tracking. Mobile connectivity will be vital to deliver growth for Africa.

Mobile infrastructure underpinning new mobile banking services across Africa must be reliable, secure and fundamentally supported by

high availability, low latency mobile connectivity.

New 4G and 5G services continue to drive increase in data traffic putting tower teams under pressure to stay ahead of the curve. This drives the need for high availability SLAs, better power solutions, fast infrastructure upgrade and back-up options in a dynamically changing environment.

With our customers, we have proven how critical AI-driven insights are to proactively detect incremental tower upgrade requirements and act much faster on SLA risks, at scale, in real-time across thousands of sites.

Africa's mobile connectivity heavily relies on diesel, giving the opportunity for energy optimisation and wastage reduction. When PowerX exhibited at TowerXchange Meetup Africa every agenda centred around plans to drive efficiency and meet sustainability targets.

Our customers are clear: industry growth is a must but cannot be done at the expense of the environment. The industry needs solutions today to enable significant headway towards net zero by 2050.

With our customers, we have outlined ways to support subscriber base growth, increased mobile connectivity and data usage with significant diesel reduction enabled by AI solutions giving greener networks. Customers can further optimise power assets and deliver incremental savings from additional capacity sitting idly in their infrastructure. We even see this with the best manually optimised tower networks. With AI, our customers optimise CAPEX already invested, future CAPEX and OPEX while delivering significant results on ESG agendas.

The changes seen this year will continue to accelerate mobile connectivity as the pandemic acts as a catalyst for change. AI solutions provide tower teams with dynamic remote controls to analyse and optimise infrastructure, across networks in real-time, all the time. With AI support, African TowerCos and MNOs can rapidly increase Africa's mobile connectivity for future demand. ■

Looking ahead: GSMA predicts 120 million more people will subscribe to mobile services in Africa by 2025, adding US$155 billion of economic value added. Africa has the opportunity to meet this demand with next-generation infrastructure for faster, greener connectivity, leapfrogging old technologies as it builds new super-fast sites from scratch or upgrades from 2G straight to 4G and beyond.

Innovations for hybrid tower solutions will continue to be deployed across Africa, including more lithium-ion battery storage, solar sites, fuel cells and wind turbines. With remote smart alerts, tower teams will get the best out of each asset, so that innovations are deployed with the highest efficiency levels possible. Exciting trials are taking place with drone site surveys, which will reduce the need for site visits or better inform scheduled site visits.

We believe that AI-driven real-time data analytics and automation at the heart of tower operations will significantly enhance growth. Without real time intelligence, tower teams risk downtime, disruption to service and unexpected costs when undetected increases in consumer use or more data services lead to increased power load or reduced backup availability. Instead, tower management teams across Africa can leverage AI to make better use of their network assets, provide solutions for greener networks, and help consumers connect to the digital world, driving progress across Africa.

Greater connectivity in Africa will have a positive impact on telehealth, e-learning, education, work and industry across the continent. This offers the population the chance to strengthen career prospects and improve their position on the global stage.

Jerome Perret,
CEO, ITD

IT-Development (ITD), the editor of the "ClickOnSite" telecom infrastructure management software, has always had a strong commitment to the African continent and its peoples. The continent was the core territory for the company's founders.

From its two offices, one located in the Ivory Coast and the other in South Africa, the company works with established and trusted major telecommunications organisations, for example Orange and MTN and has a well founded and long-standing understanding of the challenges that this geographical area poses for telecommunications and IT organisations.

The past year cannot be talked about without mentioning the worldwide and more specifically the African continent and the devastating impact and consequences of the Covid-19 pandemic.

"These operators are now faced with the new reality of home working because of the pandemic. As a consequence of this new reality, homeworking has taken inventory databases and document management systems (DMS) from a 'nice to have' status to 'a must have' one status"

"Worldwide, businesses have had to change and adapt to the new way of doing things and have had to cope with the barriers the pandemic has thrown up to doing business in the old way"

Worldwide businesses have had to change and adapt to the new way of doing things and have had to cope with the barriers the pandemic has thrown up to doing business in the old way. This has been felt no more acutely than on the continent of Africa. The devastating loss of life is acknowledged by all. On a business and company perspective, IT-Development has had to rise to the reality of numerous postponed orders during 2020. Post pandemic we have worked to re-engage with those postponed orders and to the increased demand for IT-Development's ClickOnSite software.

We are seeing in the market numerous telecom operators coming to our solution, as the best way to support their digital transformation.

In previous years African operators have prioritized investments and have not looked favorably on the need to have systems supporting remote and home-based working. These operators are now faced with the new reality of home working because of the pandemic. As a consequence of this new reality, homeworking has taken inventory databases and document management systems (DMS) from a "nice to have" status to "a must have" one status.

Remote working due to the pandemic has had to overcome challenges and these challenges are numerous:

- The collection of information that is complete
- Storage of Data and its associated maintenance to ensure its integrity and reliability
- Data sharing within teams
- Work organization and business processes

Beyond the strategic and data management dimension, adaptation to the situation we are in has occurred. Operationally, now more than ever, dematerialization solutions for work orders and technical inspection reports are now becoming an essential part of the maintenance operation landscape. This is combined with a renewed business interest in the various types of preventative maintenance. This has also been boosted by the emergence of Industry 4.0. Predictive maintenance, for example, is becoming essential to generator management, which in many countries remains the source of electrification for mobile sites.

"The past year cannot be talked about without mentioning the worldwide and more specifically the African continent and the devastating impact and consequences of the Covid-19 pandemic"

"Operationally, now more than ever, dematerialization solutions for work orders and technical inspection reports are now becoming an essential part of the maintenance operation landscape"

This type of maintenance enables the optimisation of the number of interventions on site but also to reinforce their relevance. The same type of calculation allows operators and tower companies to control the fuel consumption of their generators but more importantly to warn when it's time to refill fuel storage at the sites before it is too late (and before they break down). ■

Looking ahead: We also hear in various quarters about data collection by drone. But the costs remain very high for such a relatively low gain. Fortunately, solutions are in the making based on artificial intelligence that will have the potential to offer a total cost of ownership (TCO) more aligned with the African market. That is to say, a large territory with a low ARPU.

There is no doubt that the number of use cases will multiply thanks to the deployment of 5G, which is entering a new era with operators such as Orea in the Ivory Coast, which is expected to be the first very high-speed data operator on the African continent. Orea already benefits from the support of numerous partners in the sector such as Huawei, Inetum, and ITD.

Kyle Whitehill,
CEO, Avanti

Connectivity is increasingly more important in achieving a healthy, safe and productive life, yet 3.7 billion people are not connected. Most of those people live in developing countries and half of the 3.7 billion are female.

Over the past two decades, digital technologies have advanced more rapidly than any innovation in history, reaching around 50% of the developing world's population, and helping to transform societies. We are incredibly proud of the part we have played in enhancing connectivity in some of the world's hardest-to-reach communities. In a post-pandemic world, where reliance on connectivity is evolving, the unconnected become even further removed from the digital world and its socio-economic benefits.

Avanti believes everyone has potential to 'Be More', and connectivity empowers people to achieve their full potential. By helping communities across Africa to become better connected, we have been able to create better access to education, medicine and help provide a safer environment in which to live and work.

"Avanti believes everyone has potential to 'Be More', and connectivity empowers people to achieve their full potential. By helping communities across Africa to become better connected, we have been able to create better access to education, medicine and help provide a safer environment in which to live and work"

Covid-19 has challenged everyone, but for those living in unconnected communities the challenge has been great. At the peak of the pandemic, we realised how much the digital divide was growing. Instead of watching it grow, we proactively identified opportunities to connect even more individuals, businesses, and communities.

This is even more acute in sub-Saharan Africa where the population is growing 2.7% per year. As terrestrial networks here are limited, rural expansion is desperately needed. Partnership is key to helping bring affordable coverage to these remote areas of the world. Over the past year, we have launched several new partnerships to help operators and other partners to expand their networks.

For example, our partnership with Clear Blue Technologies will accelerate the rural rollout of low-cost connectivity solutions in areas where network coverage and broadband services have been limited or non-existent. Everyone is entitled to a more connected life and the benefits that come with it, and this partnership is expected to deliver coverage to 400 million people living in remote areas within 3-5 years.

We have also launched our own service, Avanti EXTEND, a new managed service for rural connectivity, to support partners in their efforts to connect rural Africa. Avanti EXTEND provides high-performance and cost-effective 2G, 3G and 4G solutions to remote and hard-to-reach areas across sub-Saharan Africa. It enables MNOs and other partners to provide reliable cellular service to the 100 million people living in these challenging locations that would otherwise be impossible to reach using traditional terrestrial infrastructure.

Avanti EXTEND's built-in and fully operational

CAPEX solution integrates seamlessly into MNO's terrestrial networks to reduce network complexity and increase efficiency. It offers the opportunity for partners to undertake large deployments quickly and effectively, and scale operations to support long-term rural expansion at no additional CAPEX. This removes the need for them to manage satellite configurations, hub infrastructure or terrestrial networks to deploy a successful satellite cellular backhaul topology.

We are committed to enabling people, countries, and continents to 'Be More'. By helping communities across Africa to become better connected, we have been able to create better access to education, medicine and help provide a safer environment for them to live in. We believe in the power of education, and the transformative impact it can have on individuals and communities. We know connectivity has a key role to play in improving access to quality learning and are determined to use satellite technology to help even more people gain access to this.

We are a Business Avenger – committed to supporting the UN Global Goals for Quality Education in reflection of our wider commitment to improve access to education across Africa. For example, we recently partnered with the Global Partnership for Education (GPE) to help address barriers to girl's education in Kenya through targeted, context-specific awareness and information campaigns. The program aims to enhance and add value to girl's education which will in turn strengthen efforts to support the achievement of SDG 4. We are proud to be working with the GPE to help break down some of the social barriers preventing girls from reaching their full potential.

Continuing our work supporting the UN, this year we also started working with the UNHCR, the UN Refugee Agency, as a corporate partner to donate solar powered satellite broadband connectivity and laptops to seven UNHCR sites in remote and off grid refugee settlements in Uganda. By giving access to technology and helping refugees and the communities that host them to be part of a connected society, we are helping them build a better future for themselves and their families.

We already know the global demand for data outstrips supply, leaving many excluded. In Africa this is even more exaggerated, offering huge scope for future growth in the coming years. Rural network expansion is desperately needed. As a high throughput satellite company in Africa, Avanti is poised to unlock this.

Across our HYLAS fleet, more than 70% of our coverage is over Africa, where we have been providing connectivity services for more than a decade. To help power growth, we have also committed 75% of our total investment to help connect the continent. By continuing to use our strong business model, and partnering with providers across Africa, governments, and charitable entities, we believe we will continue to make significant progress towards worldwide connectivity. ■

Looking ahead: Collective action has the power to ignite real change, and we believe there is a real opportunity for the industry to play a key part in the global economic recovery. Since 2020, 90% of children living in sub-Saharan Africa did not have access to a computer and around 80% did not enjoy a basic internet connection. This emerging digital divide has had huge implications across the continent, which has been highlighted further by the pandemic. The digital inequalities across the globe need levelling out, and the time has come for connectivity to take centre stage. To spearhead an 'accelerated transition' towards a more a connected world and close the digital divide.


RSCC
Russian Satellite
Communications Company
TV
SATELLITES
FOR DIGITAL
ECONOMY
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Mobile Solutions

SAT&BC

IoT

Voice

A1 Telekom Austria Group, listed on the Vienna Stock Exchange, is a leading provider of digital services and communications solutions in Central and Eastern Europe with around 25 million customers, currently operating in seven countries: Austria, Bulgaria, Croatia, Belarus, Slovenia, the Republic of North Macedonia and the Republic of Serbia.

Offering communications, payment, broadcasting and entertainment services as well as integrated solutions for mobile operators, A1 Telekom Austria Group achieved revenues of 4.55 billion Euros by year end 2020. Around 18,000 employees and state of the art broadband infrastructure make digital business and lifestyle possible and enable people, companies and things to connect everywhere anytime. As European unit of América Móvil, one of the largest wireless services provider in the world, A1 Telekom Austria Group is headquartered in Vienna and gives access to global solutions.

Avanti Communications

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Managed service for rural connectivity

Carriers expertise

Satellite backhaul

Avanti Communications

Avanti Communications is the leading KA-band high throughput satellite capacity partner to the communications industry across EMEA focused on driving connectivity across Africa.

Our mission is to work in partnership with the people of Africa to empower growth, protect communities and unlock opportunities for individuals, businesses and governments, by creating better connections across the continent.

Avanti recently launched Avanti EXTEND, a new managed service for rural connectivity. Avanti EXTEND provides high-performance and cost-effective 2G, 3G and 4G solutions to remote and hard-to-reach areas across sub-Saharan Africa. This enables MNOs and Tower Companies to provide reliable cellular service to the 100 million people living in these challenging locations that would otherwise be impossible to reach using traditional terrestrial infrastructure.

BICS

Get In Touch - BICS

As a leading international communications enabler, BICS is at the heart of the communications ecosystem. We enable people, applications and things to connect, wherever they are. We are a global provider of international voice, messaging, mobile data, cloud communications and IoT services. Our solutions, delivered seamlessly and securely, are essential for supporting today's data-hungry consumers and digitally driven enterprises. Headquartered in Brussels, with a strong presence in Africa, Americas, Asia, Europe and Middle East, BICS powers the global communications that connect the world.

Roaming

Global IoT

Business Analytics

Fraud & Security

Cerillion
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Cerillion is a leading provider of billing, charging and customer management systems with more than 20 years' experience delivering its solutions to mobile, fixed, cable and multi-service communications providers worldwide. These are used to price and bill subscriptions and variable usage for wholesale, retail and white label services; B2B and B2C offerings and multi-country service provider portfolios.

With more than 90 customer installations, Cerillion has a proven track record of delivering cost-effective solutions to the billing, charging and CRM challenges of today and tomorrow. We combine leading edge products with highly skilled and experienced staff, to provide long-term solutions to your business challenges. From fully integrated systems to managed services and SaaS, we offer a range of approaches and business models to suit your needs now and in the future.

Enterprise BSS/OSS Suite

Case Studies

White Papers

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Mobile Operators

Digital Merchants

Showcase

Blog

Enkudo is a master aggregator that provides mobile operators a rich global portfolio of premium digital services including games, education, video, music services, and many more on Telenity's telco-grade Digital Services Platform (DSP). We ensure a top-notch mobile experience with a service mix crafted specifically for each market.

Over-the-Top (OTT) players and App Stores have become the main provider of digital services to mobile consumers. With the deployments of 5G networks globally, telcos now have a fresh opportunity to offer a broad variety of digital services that will leverage the high-speed mobile connectivity and better quality of service on a next generation of devices.

Our team will take your digital services business to the next level by providing technical, legal, marketing, reconciliation & settlement support, in the new world of digital services domain. Contact us via info@enkudo.com to learn more about how we can help you grow your business.

IDEMIA

14 Milkyway Avenue, Linbro Business Park, Sandton, Johannesburg, South Africa
info@idemia.com

Subscriber digital identification

Eco Friendly Sim Card Product Range

Smart Connect Subscription Management

IOT Sim

According to GSMA estimates, there will be >600 million mobile subscribers in Africa by 2025. To meet this demand, IDEMIA delivers innovative SIM and associated technology to mobile operators to ensure that consumers get secure mobile access across the continent. With a sub-region headquarters in South Africa, where we achieved BBEEE Level 1, IDEMIA is also present across Africa, including countries such as Ghana, Senegal and Nigeria.

As a testament of their trust in IDEMIA, customers, such as MTN, has awarded us with various honours including Supplier of the Year and Outstanding Quality & Delivery Performance.

IDEMIA, the global leader in Augmented Identity, provides a trusted environment enabling citizens and consumers alike to perform their daily critical activities (such as pay, connect and travel), in the physical as well as digital space. With close to 15,000 employees around the world, IDEMIA serves clients in 180 countries.

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Towers

Rooftops

Indoor DAS

Green Power

Expertise, Resources and a Proven Track Record
At Minara Tanzania, our robust wireless communications infrastructure portfolio, combined with our multi-tenant leasing model, allows us to provide mobile network operators with an array of towers and other assets that help meet their coverage and capacity needs.

We are leading the way in providing wireless communications infrastructure, with wireless service solutions that help carriers meet current and future network demands including:

- Towers – A portfolio of 1,400+ towers with locations and heights to fit your coverage needs
- Rooftops – Our extensive rooftop portfolio at premium sites in major urban areas help you increase network coverage and capacity
- Indoor DAS – Our system enables property owners to install one wireless infrastructure solution supporting all service providers and frequencies
- Green Power – Renewable energy solutions to power telecom towers as an alternative to diesel generators

As a preferred communications infrastructure provider, we are continuously setting the standard for customer satisfaction by "Building Better Wireless."®

minara TANZANIA

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Services

Maintenance & Support

Professional Services

Project Management Office

The organisation delivers integrated Solutions for Society that are aligned with customers' priorities to create new value for people, businesses, and society, with a special focus on safety, security, and efficiency. Our portfolio addresses Africa's modern challenges via solutions for Infrastructure, Safety, Communications, and Digital via managed and professional services, maintenance and support, and our project management office (PMO).

We deliver one of the industry's strongest and most innovative portfolios of communications, analytics, cyber security, biometrics, and technologies that unleash customers' productivity potential. Through these solutions, NEC XON combines its best-in-class portfolio of technologies, leveraging a robust partner ecosystem to solve today's most complex business problems.

NEC XON combines the best people, skills, solutions, and services of XON and NEC Africa. The two organisations partnered in 2015 to ensure that customers get the maximum value from their technology investments. This close association provides deep integration skills and experience with global technology leadership. It also continues a proud association with African businesses that reaches back to 1963.

That rich heritage extends the benefits of longstanding global best practice, African expertise, and regional partnerships and delivery to our customers. In South Africa, they also benefit from our Level 1 B-BBEE certification via Kapela Capital.

NEC XON

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Web: www.sbasite.com

Who we are

Site Leasing

Site Development

Tower Acquisitions

Put Our Capabilities to Work for You

SBA South Africa is a preferred provider for mobile network operators. Our experience, capabilities and resources assist carriers to meet their network coverage, capacity and performance requirements. Working with our experienced team ensures speed to market while helping carriers provide high quality, feature-rich voice and data service.

SBA South Africa is a leader in providing wireless communications infrastructure including towers, buildings and rooftops, with more than 1,000 communications sites throughout the country. We offer wireless service solutions that help carriers meet current and future network demand while remaining flexible with build times and design including:

- Site Leasing – leasing antenna space on our multi-tenant towers under long-term lease contracts.
- Site Development – Constructing towers in strategically chosen locations or at the request of wireless carriers under a build-to-suit arrangement.

As a preferred provider for mobile network operators, we are continuously setting the standard for customer satisfaction by "Building Better Wireless."®

Seamless Distribution Systems
Address: Hangövägen 29 115
41 Stockholm, Sweden
Phone: +46 8 58 63 34 69
Web: www.seamless.se

Guide to Retail Value Management

Digitizing Telecoms with Seamless

Why Customers Trust Us

Smart Sales & Distribution - SDS Analytics

As pioneers of digital reform, Seamless Distribution Systems (SDS) has consistently delivered high-performance solutions to telecom operators and retail distributors for over 30 years and counting. Our solutions enable digitalization of the entire distribution chain, for multiple products and through multiple channels, customized according to a business's unique needs.

Our core expertise lies in helping our customers grow revenue through the power of digitalization. We combine years of experience in understanding our customers' needs, pain points and business goals around sales and distribution and leveraging automation and advanced analytics to help them achieve sales growth and OpEx optimization. We are driven to synergize distribution management for telecoms as we solve a variety of problems that impact different stages of the user journey.

Throughout this time, we have been obsessed with bringing unmatched efficiency across the value chain and helping converge all critical processes around sales and distribution in one integrated solution. Our end-to-end offerings facilitate the launch and growth of both direct and indirect channels while unifying customer experience across the board to ensure that telecoms never fail to deliver.

Seamless
Distribution Systems

Sparkle
sparkle.communication@
tisparkle.com

IP&Data

Mobile

Voice

Enterprise

Sparkle is a leading global service provider offering a full range of ICT solutions, global connectivity, services and capabilities designed to meet the fast-changing needs of Enterprises, Internet Service Providers, OTTs, Media and Content Players, Application Service Providers as well as of Fixed and Mobile operators.

Thanks to a state-of-the-art global backbone of over 600,000 kms of fibre and through an extensive worldwide commercial presence distributed over 32 countries, Sparkle ranks #5 for IP globally and is among the top players for international voice traffic. Through a rich portfolio of services, a cutting edge network based on the latest technologies, a globally distributed sales force and advanced customer care capabilities, Sparkle is able to fulfil its mission of providing customers with top-performing and tailored solutions worldwide.

Enriched by its cultural variety and diversity, Sparkle is always committed to excellent relationships with all its stakeholders and operates with constant attention to maintain a safe environment where Partners, Customers, Suppliers and Employees can live and work better.

Sparkle. The world's communication platform.

Find out more about Sparkle at **tisparkle.com**

SPARKLE
THE WORLD'S COMMUNICATION PLATFORM

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Customized Software Solutions

Digital Services for Telecom Operators

Operator Billing Solutions for Digital Services

Consolidate VAS World with Telco standards

Telenity is an industry-leading provider of cutting-edge services and solutions for worldwide communications service providers. We help our customers leverage the power of their networks with our NFV-enabled, 5G-ready VAS Consolidation Platform and Digital Service Platform.

Our VCP solution helps operators reduce opex and improve service quality. Our DSP solution provides telcos the ultimate platform to thrive in the digital world with its product capabilities, partner ecosystem and managed services capabilities. With our Service Subscription Management and Partner Management platforms, we provide a smooth migration to the Digital BSS ecosystem. Both solutions are offered to operators via revenue sharing and SaaS business models.

Our sister company www.enkudo.com brings together the operator and the 3rd-party digital content & service providers on our DSP platform to provide a first-rate digital experience to subscribers, to the benefit of all parties involved.

telenity

Webb Industries

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Webb Industries was established in 1973. Through the years, the company has earned trust through integrity, inspired innovation through technology and instilled confidence through leadership.

Webb Industries is a leading value-add distributor and manufacturer of products and solutions to enhance connectivity and improve communications. These include telecom masts and structures, site-build kits, in-building coverage and signal enhancement, data cabling infrastructure and a wide range of radio frequency components.

Webb has over forty years' experience in the manufacture of antennas, radio frequency combiners, splitters and multiplexers, as well as cable and connector assemblies. Our work meets the high operating specifications that customers require when deploying demanding communications solutions.

Webb's outstanding relationships with international trading partners were forged over many years. Our partners are world leaders in their fields. These include Telegärtner, Times Microwave Systems, Eupen, Polyphaser, Dehn, SMC Hilomasts, mWave, Laird and Comba.

Webb's Radio Comms Warehouse supplies radio communications accessories and security-related equipment. RCW is the sole African representative for several leading brands including NOVA.

Website

Jasco

RCW

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Inteto Connect offers products that will improve your 3G, 4G/LTE and 5G signal and speed. These include Poynting antennas, Teltonika and HUAWEI routers and Wilsonpro and weBoost cell phone signal boosters.

More from Inteto Connect

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Intracom Telecom is a global telecommunication systems and solutions vendor. The company is the benchmark in fixed wireless access and innovates in the 5G/4G wireless RAN transport and small-cell SON backhaul.

Home & Business Ultra Broadband FWA

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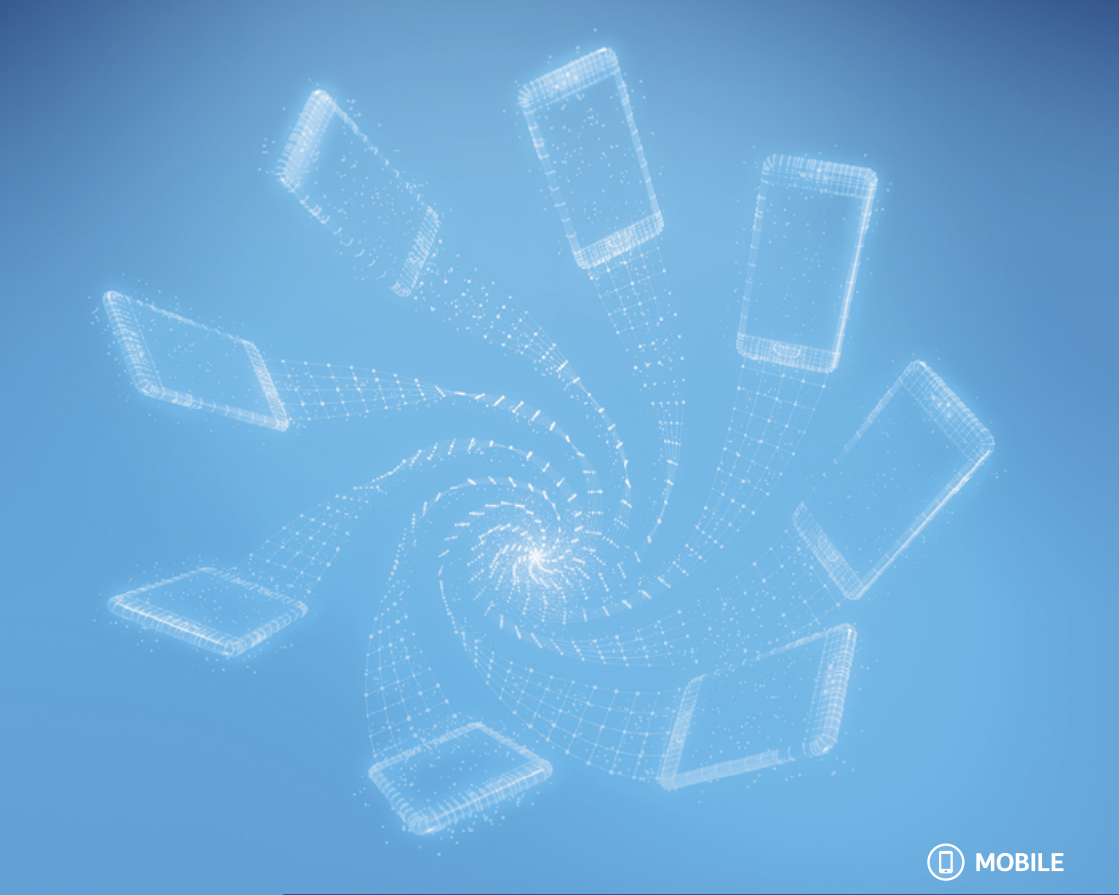
ST Group is a distributor of VertiGIS and Precisely products in Africa. ConnectMaster™ is a software solution for the design, engineering, documentation and operation of tele-communication network infrastructure.

More from ST Group



MOBILE

You move and together we evolve

Sparkle sets itself as the reference A2P SMS provider for the Wholesale and Enterprise markets

Sparkle provides a high quality A2P SMS solution thanks to its proprietary SS7 network which guarantees worldwide delivery.
The solution opens up significant opportunities for mobile operators who need to protect their networks from the grey market using Analytics and Firewall solutions.
Discover Sparkle's Mobile Platform, an interactive ecosystem based on a global communication network in constant evolution. Its governance ensures the creation of value for customers, suppliers and partners, every day, before they even know they need it.
Because we're always looking ahead.

Sparkle. The world's communication platform.

IP&DATA
CLOUD & DATA CENTER
ENTERPRISE
MOBILE
VOICE

SPARKLE

TISPARKLE.COM

chapter 3 Value Added Services

Bulent Unsal,
head of telco, EMEA south
SAP Middle East

5G is the fifth-generation mobile communication standard which promises to deliver twenty times the performance, extend the software defined network, and weave in new capabilities such as edge services and new security features. For the first time, performance intensive and mission-critical applications can be provided through a mobile network.

5G is one of the series of what are called; "transformative technologies". The others include 'artificial intelligence', 'the Cloud', and 'the Internet of Things'. These are said to be shaping tomorrow's world, singly or together.

In the simplest terms, 5G is a collection of tools that should allow 'higher speed' internet to be available by 'wireless' rather than by cables and phone lines brought into the home or office.

For example, a 5G network coupled with SAP software can guarantee a level of connectivity and response time to a robotic arm that's performing a remote surgery, so we can wrap a new business model around this and charge for this as a service. In a similar vein, we can also expand this to remote equipment diagnostics and novel retail experiences as well using 5G as a platform for innovation. As a result, we see 5G as a game changer as we look to the next two to five years.

What could be the general impact of 5G on society?

Basically, 5G networks will bring three important capabilities which are;

1. **Enhanced mobile broadband (eMBB)** – mainly speed but also include coverage, capacity and data rate. eMBB will bring high-speed mobile broadband to crowded areas, enable consumers to enjoy high-speed streaming and will allow enterprise collaboration services to evolve.

2. **Massive machine-type communications (mMTC)** – mainly connecting everything using low data rate and low energy. 5G is expected to drive IoT through the deployment of a considerable number of

low-power sensor networks.

3. **Ultra-reliable and low-latency communications (URLLC)** – mainly low latency. 5G's low latency and safety characteristics will play well in the evolution of intelligent transport systems, enabling smart vehicles to communicate with each other, and creating opportunities for connected, autonomous cars and trucks.

5G is an opportunity to empower citizens and businesses. 5G will play a key role in transforming cities into smart cities, allowing citizens and communities to realize and participate in the socio-economic benefits delivered by an advanced, data- intensive, digital economy.

5G promises to deliver improved end-user experience by offering new applications and services through gigabit speeds, and significantly improved performance and reliability. 5G will build on the successes of 2G, 3G and 4G mobile networks, which have transformed societies, supporting new services and new business models. 5G provides an opportunity for wireless operators to move beyond providing connectivity services, to developing rich solutions and services for consumers and industry across a range of sectors – and at affordable cost.

How is 5G related with the service provider challenges?

Service providers have two main challenges; A. their cost is increasing & B. their ARPU is decreasing. Therefore, by pursuing different strategies, ranging from a consumer focus to expanding into new enterprise opportunities, service providers primarily see benefits in 5G in two areas. The first is as a cost-effective technology to handle the ever-growing data traffic demand from consumers; the second as a possibility to break the declining average revenue per user trend by offering new advanced 5G services.

Service providers may find new sources of revenue in various B2B2X opportunities, given that 5G excels in many key technology areas, such as peak speeds, latency and positioning accuracy to mention a few. Many industry use case applications can be created or enhanced by 5G. A shift in the value chain is therefore possible, with service providers able to address many new vertical use cases driven by the business transformation that new advanced technologies such as 5G, AI and IoT will bring.

The 5G network will drive disruptive change and transformation across all industries by bringing together wireless connectivity, mobility, IoT, cloud computing and big data. At the same time, telecom operators have the opportunity to become the best enablers for industry applications and trustworthy business partners for industry customers; supporting them through continuous technical innovation and industry cooperation.

By taking advantage of the rapid and reliable communication capabilities of 5G networks, as well as the enormous number of connections 5G can support, 5G will enable operators to better serve customers in all industries. Telecom operators will be able to position themselves as the 'best enablers' for industry applications.

What's the impact on SAP?

From a technical perspective, 5G has a significant impact on SAP solutions as we weave edge services, data management, analytics and digital supply chain solutions into the IoT and 5G stacks. This will entail the development of custom APIs and the creation of microservices. More importantly 5G has a critical impact on our ability to spark customer innovation conversations regarding our Intelligent Enterprise story as well as to support hyperscaler adoption.

Service providers are seeking to unlock revenues from these technologies in the enterprise using 5G, but they lack the business process expertise to enable these services without support from partners such as SAP. As we position 5G and our data platform/Intelligent Enterprise story with customers, we have two guiding principles underpinning our sales motion: our **customer driven innovation** and an **ecosystem approach**.

There are significant challenges for enterprises regarding data management and data strategy. SAP's data management platforms will be key components of how we enable 5G adoption for our customers across 25 industries. And with the growth of edge computing, service providers are well positioned to deliver data management as a service and platform as a service, so the value chain for SAP's software stack and telco's infrastructure capabilities will be closely tied together.

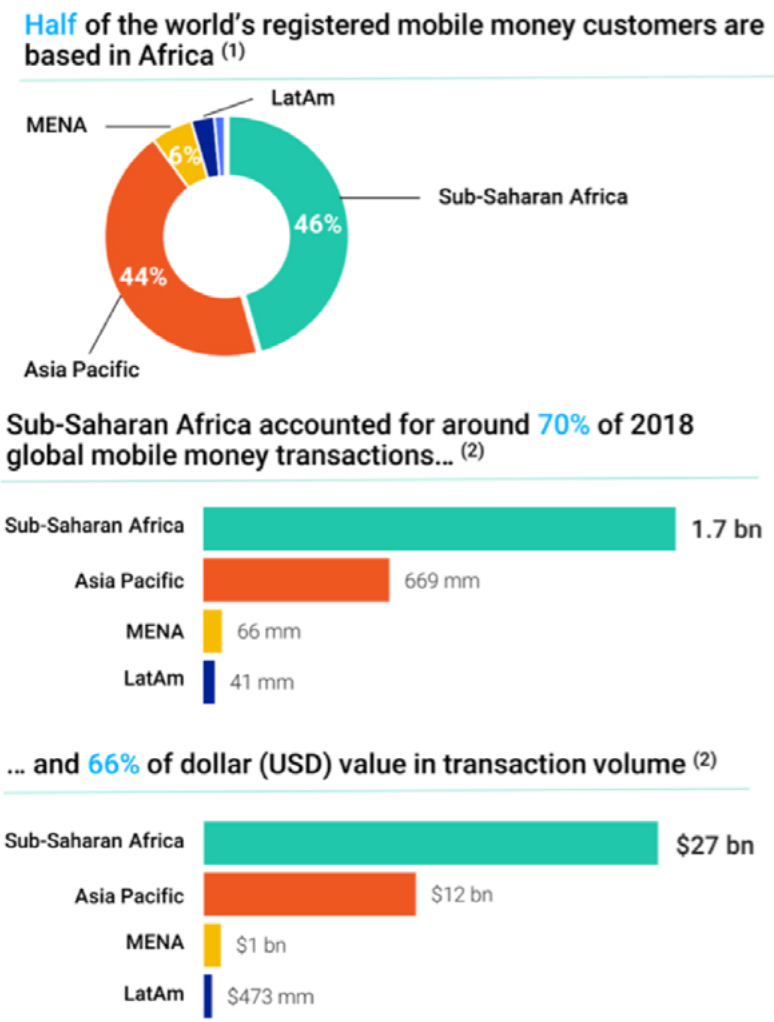
Intelligent connectivity services enable service providers to bundle SAP's data management platform, including edge services, with next-generation connectivity, providing enterprises the technology foundation to scale from on premise and cloud to the edge of the network for data transmission optimization, latency-sensitive use cases, and deterministic performance of business processes. Enterprise customers can make their assets and employees at the edge operate more efficiently by processing business semantics from mission-critical applications such as SAP S/4HANA at the edge for real-time action. For example, a 5G network coupled with intelligent connectivity services from SAP can help ensure the level of connectivity, latency, and coverage that is required for scenarios from remote equipment diagnostics to novel retail experiences. And the service provider can wrap a new business model around this and charge it as a service. ■

Leo Holtz,
research assistant, Africa Growth Initiative – Brookings Institution

Financial technology, or "fintech" as it is widely known as, is accelerating financial inclusion in sub-Saharan Africa—a region that traditionally suffers from limited access to formal financial services, such as credit, insurance, and banking. While in recent years the opportunities made possible by this technology have opened doors for many in the region—especially low-income households—users of fintech are utilizing the tool in more sophisticated ways, as reported in a recent paper by Financial Technology Partners, a boutique investment banking firm, which reveals promising investment trends in the African FinTech industry.

The population of Africa will likely continue to utilize the region's rising cellular and internet penetration and adopt emerging digital payment, banking, insurance, and lending services. As such, the report's authors speculate that Africa's demand for financial services—especially as the population remains largely un- or under-banked while also being the world's second-fastest-growing payments and banking market—will soon bypass traditional banking systems. Importantly, the continent is

Figure 1. Composition of sub-Saharan Africa's mobile money utilization



Source: Financial Technology Partners, "FinTech in Africa: Leapfrogging Legacy Straight to Mobile," 2019.

already the largest adopter of mobile money transfer systems (Figure 1), comprising nearly half of the globe's registered mobile money customers, approximately 70% of global mobile money transactions, and two-thirds of the transaction volume by value. Despite this success, challenges to the use of the tool in new and innovate ways persist: Indeed, the authors contend that lingering low penetration of cellular and internet networks, particularly in rural Africa, suggests mobile money services still have significant growth potential in the region.

The steep influx of capital raised by African fintech start-ups provides evidence of the current and future prominence of digital financial services across the continent (Figure 2). This digital industry has experienced consistent growth since 2016 in terms of both the number of transactions and financing volume.

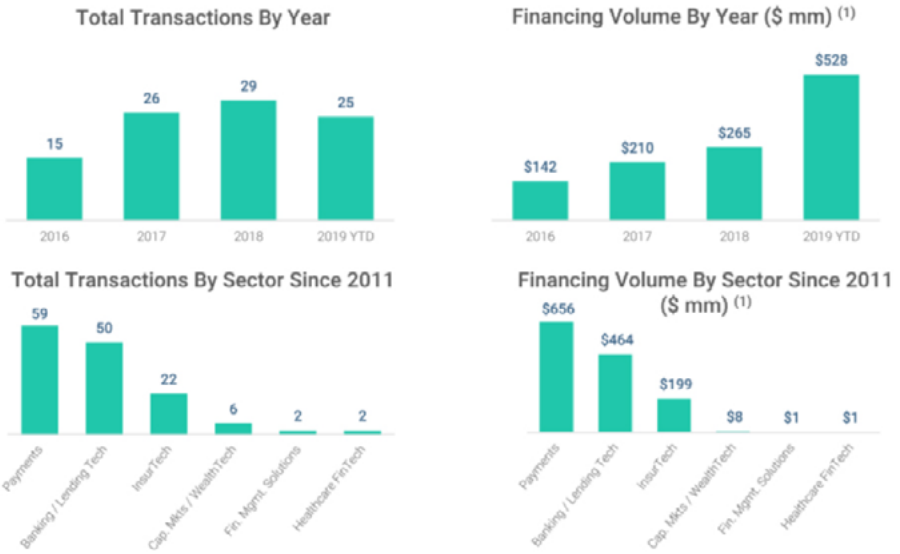
In terms of types of services, FinTech firms specializing in digital payments dominate sub-Saharan Africa's fintech investment landscape by both financing and transactional metrics. Meanwhile, FinTech dedicated to digital banking and lending services follows closely behind in the number of investment transactions, but receives 40% less financing than digital payment services.

Notably, many of the region's local FinTech start-ups are based in sub-Saharan Africa's tech hubs: Nigeria, Kenya, and South Africa. However, due to FinTech's geographic concentration in Africa and its limited, but expanding, access to financing and business scaling, the authors indicate that African FinTech firms predominantly operate within their country of origin or regionally, and, consequently, Africa's digital payment systems are highly fragmented.

The proliferation of mobile financial services, according to the authors, indicates fintech's potential to revolutionize financial inclusion in sub-Saharan Africa. For investors, write the authors, demographic trends in the region, such as a sizable fast-growing population, the expanding middle class, and the significantly underdeveloped financial services industry, signal the region's burgeoning demand for digital financial technologies.

For African consumers, FinTech innovations provide access to vital financial services and so the authors recommend improving the penetration of telecommunications infrastructure, which will continue to enable equitable access to finance for all Africans. ■

Figure 2. African fintech investment flows over time



Source: Financial Technology Partners, "FinTech in Africa: Leapfrogging Legacy Straight to Mobile," 2019.

Jeppe Dorff,
chief product and technology officer, Clickatell

When we celebrated New Year's Day in 2021, the world had already had ten months of dealing with the Covid-19 pandemic. Despite that, companies were still trying to wrap their heads around how best to serve customers and staff in a shifting world. Right after our medical workers, technology was one of the heroes of the pandemic and particularly telcos leaned heavily on tech as entire support teams and contact centres were suddenly forced to work remotely.

2021 was when Clickatell saw telecommunication companies, and MNOs (Mobile Network Operators) in particular, really grasp the immense opportunity of chat. Global statistics painted a clear picture of how consumers wanted to engage with each other and their favourite brands. In fact, by early 2021, the adoption of chat was growing faster than any other digital channel with WhatsApp reporting over 2 billion global users and Facebook Messenger over 1.3 billion users.

"Global statistics painted a clear picture of how consumers wanted to engage with each other and their favourite brands. In fact, by early 2021, the adoption of chat was growing faster than any other digital channel with WhatsApp reporting over 2 billion global users and Facebook Messenger over 1.3 billion users"

With their contact centre agents struggling with the new environments, equipping them with solutions that would allow them to engage with customers on the channels of their choice became mission critical for telcos worldwide.

Clickatell saw a significant spike in our engagement with MNOs in 2021, much of the interest driven by the result we had achieved with MTN. This included helping MTN South Africa become the first global telco to launch chat commerce functionality via WhatsApp in 2019, which would have made a big difference to how they were able to handle the sale of wireless subscription bundles in an environment where on-the-ground sales support was often interrupted by lockdowns and Covid protocols.

When it came to empowering telcos to keep serving customers, we bolstered our contact centre offering and launched our Chat Desk and Chat Flow solutions. Combining the power of live chat with our Chat Desk, a live-agent digital contact centre solution, and unassisted chat with Chat Flow, a chat commerce workflow builder, providing automated chat with drag-and-drop, no-code, functionality, significantly accelerating "time to market" for our partners and customers.

By making customer service accessible with popular chat apps, telcos can eliminate long hold times for agents in contact centres, and meet consumers' needs faster and more conveniently in the chat apps that they already use daily.

Early 2021 saw a material shift in how businesses were thinking about how they were engaging with stakeholders. While many were still speaking about customer experience, Clickatell saw a move toward 'total experience'. This can be thought of as customer experience, user experience and employee experience combined.

Covid rapidly accelerated this evolution and

savvy companies understood that it wasn't just about having good tools for end-users. As workforce dynamics changed during 2020 and into 2021, it became apparent that employees are users as well. They have similar expectations to the brand engagement internally as consumers have. They also want it easy, fast, and frictionless. By adopting a total experience philosophy companies can leverage technologies to help them transition to a more human-centric entity.

Clickatell also saw an acceleration of Robotic Process Automation (RPA). As digital transformation made it onto the executive agenda, the bottleneck most often becomes existing processes and procedures which in many instances are manual and haven't been invested in. RPA, BPA and other automation tools became part of the toolkit that was going to solve the total experience paradigm.

When it comes to MNOs the RPA sub-field of hyper automation (which Gartner describes as "a business-driven, disciplined approach that organizations use to rapidly identify, vet and automate as many business and IT processes as possible.") is blossoming. Total experience relies heavily on this. For instance, if your customer wants to do simple, repetitive transactions, like airtime or data top-ups, why should they have to deal with a human? It wastes their time, MNOs' staff time and adds cost layers of cost. For example, MTN Chat allows their 15.5 million customers who are WhatsApp users to buy bundles within the chat platform and plans to offer additional self-service options.

Additionally, total experience would enable MNOs to automate staff engagement. This would allow them to perform simple administrative tasks and queries without having to engage with colleagues, driving further efficiencies into an already overworked and often diminished workforce.

This year 5G became more a reality in Africa, when Safaricom rolled out a commercial 5G network in Kenya. The technology brings expectation of faster, more robust communications, but also the ability to leverage technologies, like hyper automation and others across the African business network.

Work we are doing in Nigeria shows that adoption of new technologies, like 5G, not only benefits local MNOs' bottom line and spur their further growth, but in turn will have huge knock-on effects on other socio-economic imperatives such as digital inclusion and even financial inclusion. ■

Looking ahead: We believe the opportunity for chat to play a significant role in how local MNOs engage with customers is also encouraging. 2020 data shows 93% of Nigerians aged between 16 to 64 currently use WhatsApp. The growth of chat commerce could change how Nigerians engage with local brands and, with the latest round of mobile banking licences granted, could also change how Nigerians engage with financial service providers.

In conclusion, it's difficult to look back at 2021 without seeing it as being an extremely challenging year faced by all. But we believe the twenty / twenty view of these pandemic years will shine a spotlight on just how beneficial the rapid acceleration of certain philosophies and technologies - like total experience and hyper automation - have been. The Clickatell team is the first to point out Africa never simply follows the trends. We believe the next three to four years could see innovation around these technologies not only allowing companies in Africa to forever change how they engage with customers, but could well result in African businesses, especially those in the telco space, leapfrogging their global counterparts. We are looking forward to playing a pivotal role in helping this happen.

David Lofti,
CEO, Evina

2021 was a year marked by the need for mobile operators to ensure financial security and overcome challenges because of the pandemic, such as the increase in mobile phone based fraud. Worldwide and more acutely in Africa, mobile operators play a significant supportive role to business and daily life. Increasing mobile use, significantly for payments is a growing profit area. Potential for monetisation of customer data exists, presently 1% of the potential is being realised, data that FinTech companies are eager to access. Mobile operators could become the main players in the payment ecosystem, but need to become the users of customer data, rather than just network providers and data sellers.

Fraud currently posses a significant problem for mobile operators and the payments system. 2021 has seen increased fraud, as more people went online and the physical payment system was suspended because of Covid-19.

In 2020 Africa saw US $4 billion in fraud and therefore Evina has championed the fight against mobile payments fraudsters.

Evina estimates that in Africa 19% of mobile phone financial issues were subject to fraud. Commonly attempts are made to make payments without the account holders' authority.

Evina estimates in Egypt 25.5% of transactions were suspect and this was 35.8% in Kenya.

Malware in applications or "malicious apps" is becoming more common and made up 17.6% of all fraudulent attempts across Africa in the period January to June 2021. Evina has detected a series of malicious apps, due to the level of fraud attempts on these apps. These included scanner apps, messaging apps, photo editing apps and even medical apps such as blood pressure apps.

1st half 2021 saw clickjacking account for 62.3% of attempts, also mobile carrier billing fraud and remote-controlled fraud saw 7.6%. Evina has helped mobile operators manage malware that takes control of devices to commit fraud. Fraud is increasing with mobile money and manipulation of individuals to make payment.

The cost to mobile operators in dealing with fraud is hitting their financial margins.

Evina's cutting edge technology is available to operators in the African market to cut fraud.

Evina's DCBprotect, which detects malicious bots and Evina's Eyewitness, which records fraudulent behaviour for payments was implemented by Vodacom allowing its millions of customers security and confidence in using network payments. Mariam Cassim of Vodacom commented, "The protection of our customers against all forms of fraudulent activity is our top priority ... Introducing Evina DCBprotect as the solution is a testament to our efforts to stay ahead of fraudsters and create a fraud-free digital environment ..."

Like Vodacom other mobile operators, merchants and payment aggregators in Africa are taking the initiative to protect mobile payments and make day to day operations,

"Fraud is increasing with mobile money and manipulation of individuals to make payment"

which is resulting in fewer complaints and increasing brand confidence.

Along with Vodacom, many other mobile operators, merchants, and payment aggregators in Africa have taken the initiative to protect their mobile payments and improve their day-to-day operations, resulting in fewer complaints, improved brand image, and increased business opportunities to boost the mobile payments industry in Africa.

Evina has launched a mobile money anti-fraud service this year. Fraud levels are hitting consumer confidence and raising concerns with regulators.

As a cybersecurity company, Evina strives to protect mobile phone transactions and the interests of users, which is why over the last 15 years we have invested in research and development to produce advanced technology with capabilities to identify between malware and a human user and when payments are being made legitimately and not under duress.

It's the only solution able to do so and it is why Evina has been recognized by the mobile ecosystem as the Best Direct Carrier Billing Fraud Solution at the industry-leading Global Carrier Billing Summit two years in a row, and Best Financial Clearing Solution by Juniper Research this year.

Today Evina's anti-fraud technology detects 99.94% of fraudulent transactions in more than 70 countries across the globe and protects more than 16 million transactions a day, with a large portion originating on the African continent. Our aim is to continue to fight mobile fraud with the most precise technology and to give support to mobile operators to assist them in their growth within the market.

Working together, Evina and mobile operators can shape the future of the mobile payment industry, making it more secure for customer's payments and to help operators increase their market size and profitability. Therefore, if there is one main thing we can learn from the mobile industry in 2021, it's that mobile operators need to manage mobile fraud to untap their financial potential and to progress their way to the top. ■

Looking ahead: Along with the increase in cell phone usage, mobile fraud worldwide is on a growth curve for the next few years, at least. Behind these fraud attempts are criminal organizations, and today all of their eyes are on Africa, characterized by many regions that lack adequate protection against mobile fraud and an avid and diverse usage of mobile phones.

According to the MEF's 2021 consumer survey on mobile payments, security is the number one reason users worldwide choose a specific type of payment. In fact, when users get defrauded using a specific payment method, they lose trust in this method and will lean more towards switching to a mobile operator that can offer a more secure method. Many mobile operators in Africa have lost clients due to this exact issue, heavily damaging their reputation, all because of fraud and unprotected payment channels. This phenomenon will be more and more common in the future as the competition between MNOs increases.

To add to the tense competition, international FinTechs and technology giants have noticed the potential to develop their mobile activities in Africa and enter the scene. African mobile operators must not succumb to the pressure, and instead mobilize their resources and set the 2022 battlefield, where trust and security will be the winning factors.

Tommy Eriksson,
CEO of Seamless Distribution Systems

This past decade, the world has fast tracked to technological transformation. The digital world revolves around connecting people and systems enabling them to share data anytime and anywhere through innovative digital solutions.

As we surface from worldwide pandemic restrictions, digital connectivity has become a societal lifeline.

The sharp growth in Mobile Financial Services and digitization of distribution are examples of how telecoms and service providers have catered to the needs of unconnected communities worldwide during Covid-19.

Telecom operators and technology service providers collaborated, bringing unbanked people into the financial system, enabling remote working. Recent years have seen greater push towards digital money and MFS (Mobile Financial System) plus more rapid moving of payment channels to mobile.

Rapid adoption of mobile money is partly due to its ability to enable telecoms to access new revenue streams by:

- Becoming facilitators of third-party retail goods
- Enabling management of all financial transactions through one platform.

In Kenya, payments and transactions facilitated through mobile money solutions now equate to one fifth of kenya's gross domestic profit.

With disruptive technologies like 5G and Cloud native, the telecom industry is in a dawn of new reality instead of incremental evolution. The change induced by these technologies will run significant interference in today's reality. This is signified by the pendulum shift from monolith architecture to cloud computing and microservices for increased flexibility and modularity.

With reliability, increased bandwidth, ultra-low latency 5G has been adopted by telecom operators because of its business benefits and ability to support AI, IoT and cloud. They regard 5G as a significant leap forward, with potential to trigger a series of other disruptive changes. It's evident there's increased emphasis on transformation from service-oriented architecture to cloud native approach, and especially microservices architecture within that. One predominant reason for transformation is a cloud native approach is more geared towards dynamic environment in a constantly evolving landscape. This not only makes scalability easier but also helps decrease their hardware footprint.

Within the digital transformative shift, IoT represents growth opportunity for service providers to become a hub for selling associated hardware, particularly networking and security equipment. The usage and value of IoT for telecom operators is more than just providing better connectivity to consumers. Instead of focusing solely on expanding network connectivity, telecom operators can reposition themselves as IoT access providers.

With this technology solution, telecoms are able to turn unstructured data into actionable insights. By further leveraging data analytics, they are able to extract valuable information from data passing through their system with IoT technology.

Recently, the focus has shifted towards consumer services, and subsequently, data analytics and business intelligence has become the cornerstone of growth. To meet business objectives and digital agendas, more telecoms are making efforts to immerse data analytics into core business operations, not

only enhancing product offerings through personalization but also for data-driven and informed decision making.

With the way the telecom industry is moving, the new paradigm will be more focused on managing end-to-end services, instead of just managing networks. Telecoms need to pivot their digitization and automation efforts towards services instead of networks, which in turn will require disruption of existing business processes and models.

The telecom universe is also challenged in more than one aspect. Tech and automation may be moving at pace, but often, operating companies lag behind. This could be due to lack of right infrastructure, fragmented systems within the company, or their own resistance to the change.

In many cases, telecom companies running on their legacy systems tend to upgrade systems in small, incremental steps. They are disinclined towards complete evolution and make changes within small parts of their system. Additionally, concerns around data privacy hampers the complete transformation to cloud native and a XaaS approach.

Paradigm shift from traditional service-oriented architecture to cloud native approach and microservices architecture is a game changer for Seamless Distribution Systems (SDS). Equipped with microservices and advanced technology stack, SDS is able to achieve cost efficiency, increased scalability, and faster time to market. This approach proved to be more suitable to the unified product suite SDS offers, the plug and play modules that act as separate components instead of a single solution are more easily harboured within this architecture.

Impact of the pandemic has made it evident that there will be emphasis on distributed and remote functionality in the future which highlights the requirement for a consolidated sales and distribution, and convergence of physical and digital product offerings.

The SDS unified platform, with multiple encapsulated modules and solutions has the ability to integrate with all kinds of BSS requirements and third-party platforms. The foundation of cloud native makes the solutions and platforms compatible with any system and facilitates in supporting all kinds of deployments.

Apart from the enhanced performance through data-driven insights, the analytics engine also paves the way for an effective transformation from SaaS to XaaS strategy. ■

Looking ahead: SDS will focus on servicing and expanding within core markets across Africa and the Middle East region, where a strong network of clients and partners is already in place.

SDS's near future business growth strategy will be to envelop data analytics and immerse artificial intelligence across all product categories. The addition of powerful data analytics tools is critical for growth, especially considering that today customer journeys are more immersive than previously.

SDS is also constantly striving for an agile and flexible business model to keep pace with industry trends. SDS has been focused on automating indirect sales channels for telecoms, however, with more subscribers turning to digital apps to communicate, telecom operators, pivoting towards facilitating direct sales will be crucial.

SDS has an unwavering vision to enable higher control and last-mile visibility to telecom operators in an effort to help them monitor distribution chains, optimize processes and ensure smooth sales across all consumer touchpoints. Looking to 2022 only confirms how enhancing digital buying and selling experiences will be make or break for telecoms and that's precisely what we are looking to champion.

Osman Perksoy,
VP of digital Services, Enkudo

Enkudo is a company that enables digital mobile consumers to access globally supplied digital content and services through accessible payment methods such as Direct Carrier Billing (DCB) and mobile wallets. With a young and increasing population, Africa is one of our major target markets due to the relatively limited adoption of conventional banking and credit services.

Throughout 2020, Enkudo moved forward with multiple projects across the continent of Africa. We signed a contract with a major global mobile operator in Ghana, launched our platform with the second largest operator in Algeria, integrated with a leading Payment Services Provider in Nigeria, introduced a streaming video service in Tunisia and pursued qualified leads in various African countries. Overall, it was an effective year for us, and despite the challenges of the pandemic globally, we maintained a high pace of growth in Africa.

The complexity of business processes and the changing regulatory environment was the biggest challenge for Enkudo. For example, due to a Nigerian regulation enforcement, we had to introduce another local partner in the value chain, which added to the integration and the operations costs of our operations and squeezed our margins.

Another challenge was the low predictability of payment timelines and financial risks due to exchange rate fluctuations, as a result of the political volatility in some African countries. With one of our accounts, we experienced significant financial loss due to the sharp increase in exchange rates while we were on hold for delayed payments.

Finding proficient local partners that we can work in alignment with, is still not an easy task in Africa. Most local companies in the telecom space have limited experience in the digital services domain. In our engagements, we spent significant time and effort in the training of our partners regarding the fast-growing digital services domain.

Despite all the challenges, the opportunities in Africa remain attractive for Enkudo. We are still covering a small portion of the region and we plan to replicate our existing business engagements, especially across the local properties of large mobile operator groups.

Our first-ever integration with a Payment Service Provider was realized in Nigeria. We are very excited about this project, as it opens a whole new channel for charging for digital content and services. Digital Services business has potential to grow, not only through mobile operators, but also through Payment Service Providers (PSPs), Internet Service Providers (ISPs) and FTTx companies.

As Africa continues to develop in the coming years, the consumption of digital content and services should grow exponentially. By establishing widespread connections in Africa at this early stage, we aim to build a strong foothold that will enable the expansion of our Enkudo digital services business in this region.

> "Most local companies in the telecom space have limited experience in the digital services domain"

Where digital content and services are concerned, we see that gaming remains as the strong category leader of the industry, followed by education and health and well-being. We believe that all these categories have been positively affected by the pandemic, as individuals changed their habits towards the consumption of personal entertainment, fitness applications and remote training services in the comfort of their homes. Overall, the pandemic has accelerated the digital transformation both at the enterprise and individual levels.

This year we also observed that all mobile operators in Africa have put digital services business in their list of top priorities. Globally speaking, most of the telecom services providers were caught off guard in the last decade, when 4G deployments and smartphones created a fertile ground for Over-the-Top (OTT) service providers to flourish. This paradigm shift jeopardized even the core services of mobile operators, such as voice and messaging, for which significant decreases in revenues were observed. During that period, mobile operators considered OTTs as a threat. That is not the case anymore. We see that the telecom space is more welcoming to digital service providers now and they look for opportunities to leverage the strengths of a partnership with them. We believe we will see this trend getting stronger in the coming years.

Enkudo's strategy for business growth in Africa has three main dimensions: broader coverage with new integrations to mobile operators, wider variety of content and services in our digital catalog and stronger content sales though performance marketing.

While we will continue adding new mobile operators from Africa to our customer base, to grow our pool of digital content and service providers we will utilize a digital marketplace solution that we started building in 2021. We are planning to launch Enkudo Digital Marketplace at the beginning of 2022 as a white-labelled solution, with a rich pool of content in various categories, such as games, streaming video, streaming music, mega promotions, well-being, edutainment, and others.

We believe that through this marketplace digital services will be rolled out to the end user a lot faster. The branding and look-and-feel of Enkudo Digital Marketplace are customizable based on the needs of the telecom operators. This solution will be powered by performance marketing tools that aim to maximize the Customer Lifetime Value (CLTV) for digital services business. ■

Looking ahead: Digital services will dominate our daily routines in the coming years in all aspects of our daily lives. We expect a quantum leap in the number and variety of services, with the support of new technologies in augmented reality (AR), artificial intelligence (AI), cloud gaming and 5G networks. The concept of "digital consumer" will be the focus of almost every business, and service providers will compete in the digital space more aggressively than ever before. The developments around super-apps, meta-universes, crypto-currencies, and internet of things (IoT) will shape the market for many companies, and new services that were not even imagined before will soon become available.

Overall, we expect exponential growth in digital services market with more players jumping in this domain from media, sports, entertainment, healthcare, finance, and government sectors. Our goal is to benefit from this growth by leveraging our robust technology and flexible business operations.

Prianca Ravichander,
director of partnerships and ecosystems at Tecnotree

The telecoms industry is embarking on a new era, with advancements in revolutionary technologies like 5G, artificial intelligence, and edge computing. Digital technologies are changing the world, with smartphones and other devices creating demand for new and personalised experiences. Customers are now 'always connected', and enterprises need to embrace new technologies to create more revenue and value for their services. These new technologies will not only alter how people consume content and interact with the environment but will also change the dynamics of the industry. The traditional telecoms market is transforming, with conventional offerings losing to new digital technologies. The same is true for the African digital market.

Tecnotree has an 18 year association with MTN, Africa'a largest mobile telecommunications services provider. Tecnotree's portfolio of capabilities have assisted MTN to provide leading digital services across Africa. Tecnotree has effectively worked towards implementing digital technologies that drive value for customers, the industry, and society, and seek economic growth by creating opportunities and improving lives. Tecnotree has contributed to bridging the digital divide in Africa through developing and launching new services.

The African market gives several challenges. Some are associated with high costs of mobile and internet, the difficulties in reaching rural populations, and lack of infrastructure for digital expansion. Internet availability in Africa is still low and connectivity costs are among the highest. Although the region represents a large percentage of the global communications market, because of these issues the potential market for digital services decreases.

With combined increasing competition and price pressure and with the regulation of the sector, Tecnotree needed to respond quickly to the industry's challenges. There was a need to find new ways to differentiate and remain relevant in the market. This required not only protecting traditional revenue streams but also developing new offerings and services.

The effects of the pandemic are still impacting – but even during lockdown and the challenges Tecnotree grew stronger in Africa. Tecnotree's strategy in Africa over the last year was to increase its contribution to the economy while growing in the market, with a focus on the following areas:

With the reality of 5G, there is a huge opportunity for the sector to create better customer experiences and engagement. In the last year, the African market has enjoyed growth and profitability, and given the rate of mobile connectivity growing in Africa, MTN chose Tecnotree as their strategic partner for the digital transformation journey across MTN Benin, MTN eSwatini, MTN Zambia, MTN South Sudan, and MTN Cote d'Ivoire.

Connecting the unconnected across Africa is a part of Tecnotree's five-year collaboration with MTN and their 'Ambition 2025 mission'.

Tecnotree believes in driving innovation with next generation products and services. The company constantly endeavours to create platforms that enable flexibility and digital transformation with the help of an agile architecture. This allows operators to launch relevant, market ready products and services. Tecnotree's products and customer management solutions facilitate personalized experiences based on understanding of customer behaviour.

Tecnotree products enable digital experiences across different processes with its leading-edge digital product DCBS (Digital Convergent Billing System), in MTN Ghana. With more than 18 million customer transactions, 2.5 million invoices and 20K master configurations, this was an incredible task delivered remotely, including entire migration, UAT, and end-user training. Another important launch was Tecnotree DLM (Digital Loyalty Manager), which successfully went live in MTN Uganda supporting 9 million users.

Investing in digital technologies is paramount for the telecommunications industry to increase growth and access.

The Leadership e-connect program across various MTN Opcos showcased Tecnotree's financial health along with updates on technology and innovations. Driving the spirit of teamwork and collaboration, the e-connect Program helped enhance the partnership and drive a successful digital transformation journey across various operating companies.

Tecnotree's efforts towards digitization goes beyond enterprise development. Tecnotree and MTN Uganda partnered to support the Christ Vision orphanage and the Love Foundation in Uganda, to create awareness about the rapidly changing digital world and the importance of digital literacy amongst children, which has the potential to improve lifelong opportunities.

One of the most innovative projects undertaken by Tecnotree in Africa was the launch of a unique technology platform that enables the monetization of over-the-top (OTT) services amongst mobile operators and service providers, accelerating growth in emerging markets. The end-to-end B2B2X platform is called Tecnotree Moments, and it's empowering Telcos to onboard pre-integrated partner offerings ranging from sports and gaming to media and entertainment.

The power of 5G is being used here for lifestyle bundling, partner lifecycle management, multiparty settlements, AI chatbot subscription management, identity management, and direct customer billing on a microservices-enabled architecture to convert ecosystem partners into instant revenue generators. The platform is flexible, with a low code/no-code, and one size fits all approach for partners, vendors, and customers. ■

Looking ahead: The fourth quarter of 2021 will see the launch of Moments multi-experience platform in North Africa. The platform offers digital services and products in the areas of sports/esports, gaming, education, and healthcare. With the initial support of eight global content aggregators and their ecosystems, Moments is expected to scale five times the number of partners by the end of 2022. These partner ecosystems are key to unlocking new digital services, accelerating revenue growth, and new experiences for the target market with 65 million consumers and 10,000 enterprises in the operator's target verticals.

Over the past year the telecoms industry across the world, not just in Africa, has highlighted the importance of adapting to technological changes. This means that in the case of uncertainty there is only a short window of opportunity to prepare yourself for disruption and pick up the pace on transformation and changing consumer demands. Telcos need to realign their business strategies to include omnichannel experiences and instant communication services for customers. The growing divide in the market, meanwhile, also suggests how adversity produces both winners and losers, and how the shift in the economy also creates opportunities for those who act bravely and surge ahead.

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Enkudo is a master aggregator that provides mobile operators a rich global portfolio of premium digital services including games, education, video, music services, and many more on Telenity's telco-grade Digital Services Platform (DSP). We ensure a top-notch mobile experience with a service mix crafted specifically for each market.

Over-the-Top (OTT) players and App Stores have become the main provider of digital services to mobile consumers. With the deployments of 5G networks globally, telcos now have a fresh opportunity to offer a broad variety of digital services that will leverage the high-speed mobile connectivity and better quality of service on a next generation of devices.

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According to GSMA estimates, there will be >600 million mobile subscribers in Africa by 2025. To meet this demand, IDEMIA delivers innovative SIM and associated technology to mobile operators to ensure that consumers get secure mobile access across the continent. With a sub-region headquarters in South Africa, where we achieved BBEEE Level 1, IDEMIA is also present across Africa, including countries such as Ghana, Senegal and Nigeria.

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IDEMIA, the global leader in Augmented Identity, provides a trusted environment enabling citizens and consumers alike to perform their daily critical activities (such as pay, connect and travel), in the physical as well as digital space. With close to 15,000 employees around the world, IDEMIA serves clients in 180 countries.

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Guide to Retail Value Management

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Our core expertise lies in helping our customers grow revenue through the power of digitalization. We combine years of experience in understanding our customers' needs, pain points and business goals around sales and distribution and leveraging automation and advanced analytics to help them achieve sales growth and OpEx optimization. We are driven to synergize distribution management for telecoms as we solve a variety of problems that impact different stages of the user journey.

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chapter 4
Critical Communications

Ken Rehbehn,
principal analyst, CritComm Insights

With 54 nations distributed across more than thirty thousand square kilometers, Africa is a sprawling and diverse continent with critical communications opportunities and challenges. Just as other regions of the world continue to leverage a blend of communications technology serving public protection and disaster relief (PPDR) requirements, so too does Africa. But stark differences in economic development and geography create unique challenges for national governments and civil authorities.

As mission-critical LTE deployments emerge in Asia, Europe, and north America, Africa remains a land where analog radio support dominates. But times change, and government officials across the region recognize the value of digital critical communications capabilities based technologies such as TETRA, DMR, or even LTE mobile broadband. The challenge, however, is finding the right approach that works within the context of each nation's unique geographic and economic situation.

"As mission-critical LTE deployments emerge in Asia, Europe, and north America, Africa remains a land where analog radio support dominates"

As the United States, the United Kingdom, and South Korea moved towards deployment of mission-critical broadband networks based on LTE, a vision of a single converged infrastructure supporting group voice communications and data-rich applications took shape. In Africa, that vision has failed to become a reality. Early adoption of Huawei's eLTE architecture in Kenya has not spread more broadly across the continent. Thoughts of a technology leap-frog that takes public safety agencies from aging analog infrastructure to cutting-edge mission-critical never gained traction in the face of the realities of spectrum availability, regulatory constraints, and the physics-based limitations of LTE propagation.

When it comes to affordable long-distance coverage solutions across the African continent, few options have historically beat simple analog voice transmission. And while that may remain the case for enterprise deployments, public safety officials understand the advantages of upgrading the aging analog systems with secure TETRA networks as funding permits. TETRA offers public safety authorities a rigorous security feature set along with a competitive and interoperable device ecosystem.

DMR also has potential for regions that see benefits in digital communications without higher-end TETRA capabilities. Conventional DMR systems, as an example, offer the potential to replace old analog systems with a simple - but modern - digital approach. As a reflection of these trends, Omdia's recent market forecasts for the Middle East and Africa anticipates the analog installed base to decline between 2020 and 2025 at a -20.4% compound annual growth rate (CAGR).

Beyond the extremes of all narrowband or all mobile broadband is the prospect of devices supporting both approaches. There is a growing trend of public safety authorities embracing hybrid mission-critical deployments that blend the best of both narrowband and mobile broadband capabilities. Hytera, for example, supports the Johannesburg public safety agencies with devices operating standardized TETRA radios and LTE. The combination provides increased network resiliency, expanded coverage, and data capacity for information-intensive applications. The options for multi-mode hybrid devices are growing, with Airbus SLC also offering device and network solutions for TETRA customers. Likewise, public safety agencies in the North American market have access to hybrid land mobile radio (LMR)/LTE devices from L3Harris and Motorola Solutions.

"Beyond the extremes of all narrowband or all mobile broadband is the prospect of devices supporting both approaches"

As the future of African critical communications evolves towards a mix of technologies favoring digital narrowband complemented by islands of dense LTE/5G topologies, regulators and mobile network operators (MNOs) must evolve. National communications regulators must provide MNOs with the ability to offer quality-of-service, priority, and preemption (QPP) services. And spectrum policies must ensure sufficient high-capacity LTE and 5G spectrum resources. On the services front, MNOs need to go beyond best-effort consumer-grade mobile broadband services to deliver QPP offerings that public safety can access reliably. Without these moves across the 54 nations of Africa, effective hybrid critical communications deployments will remain crippled. ■

Looking ahead: While the prospect of modernising Africa's critical communications networks is daunting, the results have the potential of driving positive change across the region. New capabilities bolster the delivery of health care, fire protection, and law enforcement. And while the diverse sub-regions of the continent will embrace various approaches, the common goal will remain: protecting people and property.

LTE and 5G Disruption

Though land mobile radio systems have proven valuable tools for group coordination, the data limitations and high deployment costs are forcing enterprises and governments to shift from narrowband to broadband technologies. For enterprises, a variety of push-to-talk over cellular solutions are available that operate over mobile LTE networks. Government users are turning to a standardized mission-critical push-to-talk over cellular technology that incorporates quality of service, priority, and preemption.

Unfortunately, however, a shift to LTE presents a particular challenge to public safety operations. The ability for users to communicate with nearby users, even when the network is not reachable, is paramount but not available with today's LTE devices.

Though the 3GPP standards effort that created mission-critical push-to-talk included the proximity services feature as a direct mode alternative, the capability has not entered the market. This gap means that the shift towards LTE and 5G depends upon hybrid push-to-talk devices that can handle LTE and a legacy LMR radio technology. Most major LMR device suppliers now provide hybrid options.

As the options for land mobile radio expand and users contemplate a future shift towards LTE and 5G communications, the fundamental need for simple group voice communications remains. For many years, and in many parts of the world, narrowband land mobile radio coverage will remain the foundation for enterprises and public safety.

"This gap means that the shift towards LTE and 5G depends upon hybrid push-totalk devices that can handle LTE and a legacy LMR radio technology"

The challenges of geography and economy make analog the dominant land mobile radio technology across northern and southern Africa. Still, modern cost-optimized digital technology such as DMR is becoming popular as systems get refreshed. TETRA also plays a role for security services that require the enhanced security features provided by the technology. ■

Looking ahead: Projections from the Public Safety and Critical Communications division of leading analysts Omdia show that the Middle East & Africa region will continue to adopt digital communications technology, and by 2025 it will be one of the most digitized regions in the world, with 95% of LMR users converting to digital. In 2020, it was one of the LMR shipment markets most affected by the global pandemic and it experienced considerable decline in all the technologies including Cost Optimized Digital technology, TETRA shipments, P25 and TETRAPOL. However, OMDIA projects a recovery from the market and forecasts it to reach above pre-pandemic levels by 2024.

Uwe Niske,
senior sales director, sub-Saharan Africa & United Nations, Motorola Solutions

The complexity of crime associated with the modern technological era poses greater challenge for worldwide public safety organisations and requires greater resource allocation than ever before. To add to this burden, emergency services along with private companies are facing additional new challenges that have arisen over the last eighteen months of the pandemic.

Right now, body-worn cameras and video solutions are at the forefront of public consciousness, and soon, every frontline officer might be wearing a body-worn camera, seeing it as essential as the badge that they wear in establishing trust between the frontline and the communities they serve. Globally, we are witnessing a significant shift towards public safety policing and the realisation of how body-worn cameras can improve the safety and accountability of frontline teams, capture crucial evidence and also promote increased transparency.

Body-worn video solutions are already making a positive impact on public safety agencies globally, with various successful deployments. Recently, Motorola Solutions – a technology company specialising in mission-critical communications, video and analytics – secured a contract to provide French national and military police with 30,000 body-worn video cameras, believed to be one of the largest deployments of the technology anywhere in the world.

According to Uwe Niske, Senior Director sub-Saharan Africa & United Nations at Motorola Solutions, the company has also begun to deploy body-worn cameras to public safety agencies in sub-Saharan Africa and is also in the process of various pilot projects across the continent to prove the effectiveness and value video and analytics solutions can provide for end-users in terms of safety, transparency and judicial processes.

Niske continues that, it was also somewhat unforeseen that body-worn video technology would be deployed by emergency response services, but this has proven to be extremely beneficial especially during the pandemic where frontline personnel faced the challenge with an increasing number of difficult situations.

“As an example, in the Western Cape in South Africa there have been ongoing attacks on paramedics while they are out on call. Body worn cameras assist by capturing interactions between the paramedics, patients and members of the public, helping to identify what transpired. It also protects the paramedic against allegations of malpractice.

“There is no doubt that body worn video radically and incrementally increases officer safety and accountability. The use of video solutions does not fundamentally change the manner in which first responders operate, users soon realise that members of the public conduct themselves differently when they know they’re being recorded. Frontline crews not only feel safer, but as it also records interactions with members of the public, there is irrefutable proof of the interaction.”

Niske says it is key that when body-worn technology is deployed, it is tailored to

local conditions. "There are many variables to consider. For example, you also have to consider whether you automate the technology or permit the user to decide when to switch it on or off. You may decide to automate recording once a firearm is drawn or even have your colleagues' cameras also start recording automatically in sync in order to capture the activities in the background. In many cases this type of evidence simply becomes undeniable!"

"Technology is meant to support the organisation, its processes and its people – and if you don't deploy it correctly, you may not get the results that you're hoping for. This is what separates Motorola Solutions from our competitors"

Local regulations need to come under consideration here. Some countries have fairly complex laws around video, requiring people to be informed when they're being recorded, or their faces blurred out. "In South Africa, one has to be cognisant of General Data protection Regulations (GDPR) and Protection Of Personal Information Act (POPIA) legislation, but we don't have regulations specifically around body-worn cameras, which poses a challenge to deployment. Regulation is required to ensure that the footage captured by body worn technology will stand up in court."

> "The use of video solutions does not fundamentally change the manner in which first responders operate, users soon realise that members of the public conduct themselves differently when they know they're being recorded"

While some local private security firms have already adopted body worn technology, adoption by the police service is pending finalisation of the necessary regulations. These regulations will protect the police as much as they will protect members of the public, concludes Niske.

Motorola Solutions is a global leader in public safety and enterprise security. The company's solutions in land mobile radio mission-critical communications, video security & access control and command center software, bolstered by managed & support services, create the most integrated technology ecosystem to make communities safer and help businesses stay productive and secure. ■

Looking ahead: Demand for mission-critical communications in the South African and pan-African market is growing, particularly as public safety and emergency services increasingly depend on advanced technologies. This trend is supported by recent research which found that 88% of citizens globally now want to see public safety transformed through the use of advanced technology.

As we look towards 2022, there is a consensus for change and a demand to transform safety through the transparent use of advanced technology. Safety is becoming a shared responsibility among service providers, industry and society and these groups need to work together to ensure that safety technology is used in fair and inclusive ways. This will increase trust, collaboration and further improve the way public safety services are delivered.

Marnus Kruger,
sales director for Africa at Rajant Corporation

As the African continent and the rest of the globe continue to recover from the social and economic effects of the Coronavirus pandemic, Rajant Corporation has continued to support its clients across heavy-duty industries, including mining and energy. Handsomely bestowed with mineral and oil deposits, Africa is set to bounce back in 2022, increasing its output to meet the heightened consumption as normal service resumes. The African region has a wealth of valuable and extractable natural resources, highlighting its position as a global mining leader.

With the mining industry deploying more autonomous and semi-autonomous equipment and applications every day, they require mission-critical, high bandwidth, and secure machine-to-machine communications systems. Having access to increased throughput and low latency to overcome any interference, above or below ground, enables all autonomous applications and trackable systems to support worker safety.

One thing is certain in the mining industry, fleet automation and optimisation continue to be key drivers behind the need for resilient and adaptable wireless networks. Africa has been notably behind its counterparts in Europe and the United States, in terms of "legacy" landline infrastructure and high-capacity cellular wireless is largely focused on consumer and enterprise use. Operators are eager to roll out 5G technology deployments and develop new services by investing in existing infrastructure. This focus of African operators on public and private networks for data and commercial uses stresses the growth potential.

However, the likes of LTE or 5G technology may not offer the most robust and reliable connectivity in industrial settings. Traditional wireless networks such as LTE and Wi-Fi with fixed infrastructure, have limited range and coverage, as well as being asymmetric, meaning data upload is slower than download – an issue when streaming high-bandwidth applications such as video. Mines and ports need sufficient resilient, low-latency and symmetrical upload and download bandwidth. By deploying a private network solution, and subsequently owning the industrial network infrastructure, operators can make changes, ensuring maintenance is performed when needed. If it is not privately owned, then the organisation has no control over the network and any initial discounted tariffs are likely to increase to full price later.

As nations and organisations adapt their working practices accordingly, automation has become even more important in the open and underground mining space. The need to be able to operate systems will continue to accelerate remotely. Autonomous technology will no doubt evolve at different speeds across different continents. But African mining operators are planning for the long-term, preparing for the years ahead while simultaneously considering the cost ramifications before taking a shovel to the ground.

Autonomy is essential if operators and their workforces are going to safely navigate hazardous sectors, and autonomy can ensure conditions are significantly safer. By turning to autonomous vehicles and robotics, they can undertake the more dangerous work and keep workforces safe. This can help protect staff from risks inherent with mine sites, ensuring they are not exposed to unnecessary dangers. As location environment and conditions change, autonomy can offer mission-critical scalability to adapt to customer demands and allow assets to operate at maximum efficiency. Taking the most optimal route and offering unparalleled consistency can increase productivity even higher for an operator.

For those mining operators across the continent eager to exploit the potential of automated technology, adopting and embracing this is not always a simple process. A key consideration is the operating costs that will be high when autonomous equipment and

networks are first deployed. Therefore, affordability is a crucial requirement. For those intent on relying on networking technology, it is essential to have a dependable autonomous network. Partnering with the right company is crucial. Deployed in more than 230 of the largest open-pit and underground mines globally, Rajant Corporation thrives in providing global market-leading technology with a local presence and working alongside partners that can ensure its existing customers continue to expand their growth.

Rajant Corporation continues to deliver connectivity to the mining industry in sub-Saharan Africa. The resilient and reliable Rajant Kinetic Mesh® Networks have been deployed at many major open-pit mines with attention now shifting to underground mine deployments. Historically, wireless networks in an underground setting have been achieved using radiating "leaky feeder" cables, with gaps in the insulation that allow RF signals to leak out for data and voice-only communications. Line amplifiers act as an antenna for devices to receive a signal and need to be installed at regular intervals to allow communications between mining staff. However, if the cable were to break, the communications would also cease to operate.

By utilising a Kinetic Mesh network, not only will deployments be enhanced with greater flexibility, but underground mines can experience the multi-radio high-speed connectivity that open-pit mines typically enjoy. Rajant offers a robust and redundant alternative to fibre that is easy to install and maintain and supports real time location services – or tracking of assets and people. With the Kinetic Mesh BreadCrumb® nodes overcoming the mine's continuously changing conditions, it provides resilient communications in adverse and mobile environments. The self-optimising network works via multiple-frequency, peer-to-peer connections and can be deployed on both fixed and mobile assets, helping to make the digitalised mine a reality. Rajant can provide site-wide connectivity and a complete view of operational data regardless of layout and terrain, instilling full confidence for operators.

Rajant recently collaborated with ESG Solutions, an industry-leading micro seismic solutions provider for the oil and gas, mining, and geotechnical industries, for carrying micro seismic data to the surface. Many mines install micro seismic systems for rockburst monitoring and collect data from micro seismic events that can lead to a better understanding of rock mass deformation. However, an issue with certain wireless solutions is the receipt of accurate seismic system timing synchronisation. This is not the case with Rajant. Its wireless network can be used for micro seismic system monitoring in the field for up to 10 kHz sampling rates in micro seismic systems that use geophones and or accelerometers.

As mining operators continue to seek greater levels of efficiency and safety with tele-remote operation for dozing and heavy equipment, NEVIL ELETRO MECANICA worked with Rajant for its iron ore mines in Brazil. Rajant's connectivity in NEVIL's tele-remote operation software and controls allowed an operator to control multiple dozers, excavators, loaders, and trucks.

With mining personnel remotely operating heavy equipment, connectivity enables increased scale, expansion, and profitable exploitation of the mine site. Rajant also recently announced the launch of its own MeshTracer solution, a software-based personnel and asset tracking solution that can provide the location of Rajant BreadCrumbs, other manufacturers' location tags – such as AeroScout, and any Wi-Fi device that uses a static MAC address. Being able to track BreadCrumbs both above and below ground allows a mine to track personnel and assets, providing the ability for enhanced two-way communication in emergencies.

As connectivity demands change, it is vital for organisations to have access to a "living network" that can evolve and adapt in a dynamic network environment. Rajant's Kinetic Mesh technology provides the mobility, ruggedness, and autonomy for companies to build their private wireless networks in the IIoT arena. For mining operators across the African continent, it is essential to introduce and deploy trusted and reliable wireless technology to maximise the full potential that the connected mine has to offer. ■

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Motorola Solutions is a global leader in mission-critical communications. Our technology platforms in mission-critical communications, command center software, video security & analytics, bolstered by managed & support services, make cities safer and help communities and businesses thrive. We have a rich history of firsts, including pioneering mobile communications in the 1930s, making equipment that carried the first words from the moon in 1969 and developing the first commercial handheld cellular phone in 1983. Today, our global employees are committed to designing and delivering the solutions our customers refer to as their lifeline. At Motorola Solutions, we are ushering in a new era in public safety and security.

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Rajant Corporation is the broadband communications technology company that invented Kinetic Mesh® networking, BreadCrumb® wireless nodes, and InstaMesh® networking software. With Rajant, customers can rapidly deploy a highly adaptable and scalable network that leverages the power of real-time data to deliver on-demand, mission-critical business intelligence. A low-latency, high-throughput, and secure solution for a variety of data, voice, video, and autonomous applications, Rajant's Kinetic Mesh networks provide industrial customers with full mobility, allowing them to take their private network applications and data anywhere. With successful deployments in over 70 countries for customers in military, mining, ports, rail, oil & gas, petrochemical plants, municipalities, public safety, agriculture, and warehouse & factory automation. Rajant is headquartered in Malvern, Pennsylvania with additional facilities and offices in Arizona and Kentucky. For more information, visit Rajant.com or follow Rajant on LinkedIn and Twitter.

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Martin Jarrold,
chief of international programme development, GVF

"Space, the Final Frontier…" These opening words from the science fiction of Star Trek have permeated popular culture since the late-1960s. Since then, we have greatly expanded the frontiers of the science reality of our space activities. Now, space agencies – including many new national agencies of developing nations – and commercial organisations are extending further the uses of space. As more nations focus on space, including several across Africa, and as global commercial space activity expands, it is absolutely essential that we do not lose sight of the irreplaceable value of the orbital real estate which enables us to maintain and protect life on Earth at its current, complex, level of civilisation. Space might be the Final Frontier; it is certainly the Essential Frontier.

Whether at geostationary (GEO) altitude, medium Earth (MEO) altitudes, or low Earth (LEO) orbit, we must protect this unique asset. GEO has only two-degree spacing between orbital slots, but we have long-practiced good husbandry of this orbit, ensuring that satellites approaching end-of-life still have sufficient on-board fuel to navigate to a graveyard orbit from which it will take thousands of years for Earth's gravitational attraction to decay their orbit to a plasma-engulfed atmospheric end. In fact, recently, we have gone further to enhance the good management of GEO with the Mission Extension Vehicle programme to re-fuel still functional satellites. This is one of many facets of a rapidly emerging "new space race" wherein established industry players and many new entrants are pushing the boundaries of space logistics.

Many have written about the "new space race", or NewSpace. NewSpace is a big topic, but not in the same way as the now decades-long history of the business of designing, building, and launching satellites to orbit. Before NewSpace, the "big" in satellite related to the size/mass of spacecraft – for communications, Earth observation (EO), weather forecasting, determining military strategy, intelligence gathering, etc. – and to the scale of the commercial sector and government sector budgets which provided funding. NewSpace is multi-facetted and includes the recent successful realisation of fully software defined satellites, featuring programmable payloads. NewSpace is not only about space segment. It is having a multi-faceted impact on ground segment infrastructure too, with innovation

in satellite antenna design, qualification and testing (about which more below); in modem design; in teleport engineering, operation, and deployment.

The business of NewSpace has already engaged around 20 of Africa's nations (with space programmes at various levels of development) and applications using satellites are becoming a more affordable domain populated by many small-scale start-ups and spin-offs from academia leveraging the reducing costs of technology. It is increasingly viable for lower-income nations in Africa to design and manufacture their own small satellites and at least 11 have done so to serve broadband communications, navigation, and EO.

The number of smaller space-active nations is many more than just 10 years ago when, among African nations, Nigeria's space agency (NASRDA) was the continent's leading light in satellite remote sensing with the launch of NigeriaSat-2 and NigeriaSat-X. With payloads of imagers for EO applications such as resource management, mapping and agricultural and disaster management, these two satellites were somewhat precient of today's even greater need for such orbital assets.

The protection needed for MEO, and increasingly populated LEO, is from ourselves, from our actions or inaction. Just as we have realised that we must change our behaviour to preserve Earth's current climate equilibrium (with satellites having a vital role to play in this task) we are realising that we must not abuse orbital space either.

For Africa, satellites – vehicles the size of a double-decker bus in GEO orbit, through to shoebox-sized spacecraft in LEO – play a vital and increasingly important role in enabling broadband communications, expanding access to the internet, and monotoring and measuring innumerable facets of everyday life, gathering, managing, and analysing data generated by the bustling urban mega-connurbations, from industry, from agriculture, and from the remoteness of the rain forests and coastal waters.

Whilst, as noted above, GEO is a comparatively well-managed resource, we are only now learning that we must parallel the growth of our expanding broadband communications and remote sensing business assets in the lower Earth orbits with internationally agreed and implemented policies, protocols and good practice. An estimated 170 million man-made objects are orbiting Earth, threatening humanity's access to useful space. With the density of objects in LEO enough to cause collisions, this could cause a self-sustaining cascade, as each collision generates more debris, leading to

more collisions. This – the Kessler Syndrome – describes rendering impractical the use of satellites in LEO for generations to come.

The world's growing space community – the commercial and national government agency space powers of pre-NewSpace, plus the increasing number of smaller space-active nations in Africa and elsewhere, plus the enterprises of NewSpace from the likes of SpaceX 'Starlink' to small IoT-focused or EO/remote sensing start-ups – must act now to create a regime of protocols to ensure the long-term sustainability of space, to protect the technology we place there and the application of the technology to delivering critical applications. Many of these bring together the sustainability of the space environment with the sustainability of our planet's current climate equilibrium.

The distinction between communications and EO is eroding. Satellite broadband communications work entirely within the IP environment, and EO – visible spectrum, infrared, ultraviolet, or x-ray frequencies – is also a stream of digital data. Both share the same lower orbits, and there are many more of both being launched. Finally, both contribute to what I, and others, have elsewhere described as Actionable Intelligence and the emergence of a Digital Planet. The idea of a Digital Planet extends to the emerging concept of a "global digital ecosystem"; a concept of the United Nations Environment and Development programmes. The 'product' of this "global digital ecosystem" will enable the formulation of Actionable Intelligence, and foster a culture of Sustainable Decision-Making that, in the context of trying to meet the UN Sustainable Development Goals (SDGs) and of trying to stem climate change, will be the indispensable currency of the future Digital Planet.

The merging of satcoms with EO (plus Artifical Intelligence/Machine Learning), the gathering of data and its dissemination as Actionable Intelligence, affects our understanding of our use of Earth's natural resources, of water and food security, and of understanding population demographics, and providing public services, etc. Data helps inform strategic decision-making by governments, international agencies, and the World Economic Forum with its Stakeholder Capitalism Metrics which are designed to show how companies are doing on climate change action and contributing towards the SDGs.

Glasgow, in Scotland, will soon host the COP26 Climate Change Summit which will aim to accelerate action towards the goals of the 2015 Climate Accords agreed at COP21, and the United Nations Framework Convention on Climate Change. The broadcast satellites which bring us news video of such gatherings, as well as of extreme weather events which the scientific community recognise as symptomatic of a changing world climate, are just one element of a greater orbiting infrastructure on which we depend to monitor and evaluate the impact on the Earth of the Anthropocene Epoch.

Space agencies and private EO companies are actively monitoring the Earth as climate change evidences itself, using a wide range of technologies to monitor sea levels and coastline change, track atmospheric carbon dioxide and methane levels, monitor rain forest logging, and measure other (negative) changes impacting the planet's flora and fauna. Utilising space to help tackle the complexities of climate change requires action now to create a binding approach to space sustainability; otherwise, we will lose not only access to the precious resource that is near-space, but an important tool to protect and preserve the Earth we know. But, it isn't only physical collisions between increasing numbers of spacecraft that threatens the security of our satellite real estate. A continuing threat is radio frequency interference arising from various causes.

Some 98% of all radio frequency interference (RFI) is unintentional, caused by one or more of human error, antenna cross polarisation leakage, faulty equipment, or adjacent satellite interference. Unintentional RFI can also be the result of overlap or interference between signals used to communicate

with satellites and those used for terrestrial networks such as mobile phone systems. A complex regulatory framework exists to manage RF spectrum. The ITU recognises the RF spectrum and specific orbital regions as limited resources, providing for efficient and economic use, and equitable access. Allocation of a frequency band designates it for specific space or terrestrial applications. An allocated band can be further divided into allotments or channels, designating its use in particular geographic areas.

ITU Member States and other space stakeholders all have a role in reporting harmful interference using the Satellite Interference Reporting and Resolution System (SIRRS) which enables space stakeholders to report harmful interference affecting space services as well as to receive support from ITU. Through SIRRS, ITU is accumulating an international repository of interference events, making them easier to track, analyse and resolve. The satellite industry has developed RFI mitigation techniques, including Carrier Identification (CID), advanced monitoring and geolocation technologies, and more robust operational training.

Proper training is increasingly recognised as a first line of defence against interference and there is agreement within the industry that training reduces uplink errors and improves equipment maintenance and installation practices. The GVF training programme is building a global force of qualified VSAT installation technicians available in local areas to support expansion of VSAT networks. The training content is focused on interference prevention skills, serving the industry's drive to combat unintentional interference. Over 17,000 students globally, including thousands across Africa, have taken advantage of over thirty courses and over a dozen certifications covering VSAT installation and other equipment training. Students equipped only with Internet terminals can access realistic simulations of the behaviour of real-world equipment through advanced web-based e-learning materials featuring interactive 3-D animations based on numerical simulation algorithms, facilitating grasp of technical concepts and practice of hands-on skills such as dish pointing, polarisation alignment, and uplink signal line-up.

A necessary concommitant to training is satellite equipment quality assurance. Satellite operators

attach a high priority to antenna performance in limiting RFI. In this conection the GVF Mutual Recognition Arrangement Working Group (MRA-WG) was formed to develop a consensus-based framework to improve the efficiency of satellite operators' terminals type-approval procedures .

Using this framework, once a type-approval is provided to a manufacturer by any participating satellite operator, other operators may mutually recognise the results of the tests conducted during the first operator's type-approval process. The MRA-WG procedure defines a set of standard tests that an antenna or earth station manufacturer should perform in order to apply for type approval from any satellite operator, improving the quality and completeness of test data helps reduce the time and cost required to bring new ground-segment technology to market.

In furtherance of the desirability for operators to work with antenna manufacturers to improve the antenna terminal qualification process, GVF and a group of satellite operators (AsiaSat, Eutelsat, Inmarsat, Intelsat and SES, most of which serve the connectivity needs of the African continent) have collaborated to produce guidance for antenna manufacturers regarding expectations for new antenna products, and how to demonstrate compliance with the Satellite Operators' Minimum Antenna Performance specifications (SOMAP). (See https://gvf.org/working-groups/ for more detail.)

GVF member company, QuadSAT, joined GVF to participate in the MRA-WG, and work with the SOMAP group. QuadSAT is developing a novel approach for conducting on-site antenna verification using Unmanned Aerial Systems (UAS), or drones, which avoids the need to transport antennas under test to an outdoor far-field antenna range.

The GVF terminal type-approvals procedures and the SOMAP requirements were identified as directly linked with QuadSAT's UAS-Antenna Performance Evaluation (UAS-APE) system technology development. This inter-relationship of the GVF's already existing framework and QuadSAT's technology/product development objectives signalled the opportunity for a European Space Agency collaboration. The space agency recognised the value of this technology and awarded QuadSAT a contract to develop and validate the technology with support from GVF in the form of technical advice.

GVF's recognition of the importance and innovative significance of QuadSAT's technology and product development potential was, and remains, rooted in its contribution to the satellite communications industry's objective of reducing rising levels of RFI and in improving the effectiveness of type-approvals processes. Antenna testing using traditional methods can be expensive and logistically difficult.

QuadSAT's drone-based measurement method differs significantly from traditional test-range methods by bringing the test range out to the antenna no-matter its location. That satellite antennas can be tested anywhere, easily and effectively, with the quality/reliability of measurements fully comparable with high-end traditional test ranges is a change recognised by satellite operators as better enabling industry growth and innovation.

As alluded to above, Earth's growing "global digital ecosystem" will include an ever more heavily populated LEO, with tens of thousands of satellites, comprising various constellations launching over the next decade. OneWeb is one of those constellations, and the companies have partnered to test ground-based satellite antennas at OneWeb gateway stations using drones. Following antenna installation, operators primarily use on-orbit testing for link calculation diagnostics and calibration to increase operational performance. By using such drone technology instead, on-site testing can be conducted while minimising transmission downtime.

More generally, MEO and LEO megaconstellations bring new challenges to the industry, requiring adaptation of testing methods. New performance requirements inevitably come for a ground segment which must track satellites across Africa's skies. ■

Pieter-Paul Mooijman,
regional VP for Africa, ST Engineering iDirect

Over the past two years, in Africa and worldwide, we've never been more aware of the importance staying connected is for society, healthcare, education and business.

In Africa, particularly sub-Saharan, Mobile connectivity remains vital for keeping people connected and assisting the Covid-19 recovery. MNOs providing access to platforms, applications, digital content and online services are helping people and businesses get online and obtain information. Over-the-top (OTT) content is in increasing demand in Africa and provides a needed entertainment outlet.

Satellite technology is vital in enabling MNO's delivery of services to Africa. ST Engineering iDirect, throughout the past year, continued assisting operators with deploying mobile services regionally.

Satellite cellular backhaul plays an invaluable part in Africa's connectivity profile. The rise of the smart phone – in 2020, with 495 million subscribers to mobile services in sub-Saharan Africa, representing 46% of the region's population an increase of almost 20 million from 2019, resulted in an exponential increase of data demand.

Today High throughput satellites (HTS) are reducing cost-per-bit of satellite connectivity. This is important for lower-income countries, where smartphones operate as phones, TVs, banks, information sources and consequently require increased data access.

Clearly there's a wide range of use cases in Africa dependent on mobile connectivity, for business and entertainment purposes. Assisting Democratic Republic of Congo (DRC)'s MNO, Vodacom, address customer demands, by deploying our Dialog® platform to improve mobile services country wide. Dialog solution enabled Vodacom to migrate its VSAT-based 2G network to 3G across 150 Base Transceiver Stations, (BTS) the Base Station Controller, being in Kinshasa. This replaced traditional SCPC links to deliver increased efficiency to facilitate 3G data traffic. It also accommodates Vodacom's future growth, enabling increased satellite coverage and deliver increased capacity for expansion.

For semi-urban regions, satellite backhaul is used to deliver voice and data, and other services. Consumer broadband, cloud services and Over the Top (OTT) are all served by satellite backhaul.

Content is increasingly important as OTT services pervade networks, worldwide, these networks often become congested. Offloading traffic onto satellite is an important solution in alleviating the issue. Here, hybrid satellite and terrestrial methods are good. Satellite is cost effective for multicasting content to towers or CDNs, and its role will increase.

For rural and ultra-rural regions, the services MNOs facilitate are crucial. Mobile communications enable important applications such as Mobile Money in rural sub-Saharan Africa for the unbanked. Mobile Money can represent 30% or more of MNOs' revenue.

Addressing remote sites not connected via terrestrial networks, Dialog® platform was deployed by ABS, in partnership with iSAT Africa, a satellite solution provider, using the platform to launch new managed data services on ABS-3A satellite.

Platform offers cost-effective, robust, high-speed broadband for general enterprises, oil & gas and NGO users. It addresses locations requiring network infrastructure diversification

and back-up services for fiber links.

The platform offers versatility and supports MF-TDMA and SCPC technologies with advanced bandwidth management features.

We need to work together with the connectivity ecosystem and the communications industry, to better connect Africa, delivering a high quality, seamless, plug-and-play experience enjoyable by all.

In Africa, we see satellite connectivity being a key technology to extend coverage to hard-to-reach populations. Increasingly, this involves satellite being used to provide ultra-rural communities with essential voice and data services.

For much of the African market, cost effectiveness is paramount and there is no one-size-fits-all technology to meet this diverse continent's connectivity requirements. A blend of technologies will enable the most cost-effective communications solutions. Satellite, terrestrial, cellular and wireless will need to work in tandem to create affordable yet reliable and scalable services that can reach the most remote communities.

When it comes to advancing their networks by leveraging satellite connectivity, mobile network operators are looking for efficiency, performance, flexibility, and scalability. They want a reliable service they can use to easily extend connectivity to rural sites and integrate seamlessly within their terrestrial network. Networks need to meet the scale requirements of large point-to-multipoint networks and throughput demands.

ST Engineering iDirect is a leader in satellite ground infrastructure and solutions for the cellular backhaul and trunking market. We've deployed 80+ mobile backhaul networks, we hold the largest network with 1,500 cellular sites, and 12 of the top 25 telcos are ST Engineering iDirect customers. Our leading multiservice platforms, branded under iDirect and Newtec supporting the broadest range of connectivity applications and network requirements across 2G, 3G, 4G/LTE and emerging 5G networks. ■

Looking ahead: We expect the rise of the smartphone to continue next year, and there's already huge demand for services on these devices. At close 2020, 20 million more people subscribed to mobile services in sub-Saharan Africa than in 2019. This trend is expected to continue into the future.

Entertainment is a massive application for smartphone use in Africa, but the smartphone is truly no longer just a phone – now it's also a TV, bank, marketplace and source of information. Thus, demand for data continues to rise, as people access apps and services they rely on as a part of daily life.

As affordable connectivity to facilitate modern smartphone use cases in Africa continues to evolve, we will see more collaboration toward a hybrid solution. Over-the-Top (OTT) services are, crucially, being supported by satellite backhaul and there is no one size fits all solution for these user demands. A mix of technologies is best suited to meet connectivity needs of the continent. Satellite, terrestrial, cellular and wireless need to collaborate in the service landscape to make sure dependable, scalable services are available to support connectivity needs without leaving remote regions behind.

This kind of hybrid approach has the added benefit of working towards a cost-effective solution. For example, HTS satellite is already lowering the cost per bit of satellite connectivity – and antennas are becoming less expensive too. The industry is hard at work innovating to make terminals more affordable and it's safe to say the future is bright for affordable, scalable connectivity and a plug and play experience enjoyable by all.

Alastair Williamson,
CEO, Wyld Networks

By 2050 United Nations predicts world's population at 9.7 billion, necessitating 69% increase in world food production on 2010 level. Population and climate change pressures could pose difficulties for agriculture in Africa. This increases pressure for ways to generate higher yields while facing water shortages, rising temperatures and extreme weather. Increasing yields will require commitment and investment from private and public sector and a quantum leap in harnessing the power of technology.

At Wyld over the past year, we've been helping sow the seeds of this technology transformation by harnessing the power of the satellite-connected Internet of Things (IoT), creating communications and sharing actionable data between people, processes and things. Agriculture is one of the fastest-growing IoT markets and according to the Statista report, 'Worldwide IoT in Agriculture Market Size 2023' it's expected that the global agricultural IoT market will reach almost $30 billion by 2023.

Fundamental to agricultural innovation revolution is the need for more data points to give agronomists and farmers a highly granular picture of food production cycle.

"LPWAN makes communication possible at significantly longer ranges and much lower power consumption than cellular or Wi-Fi options"

Key data sources include soil moisture sensing, weather stations, crop and storage monitoring, livestock and asset tracking, following the complete field to fork journey. For example, knowing soil moisture level at different locations and depths across a farm helps to calculate the best times for sowing and harvesting, while detecting temperature changes in a greenhouse makes it possible to adjust ventilation and irrigation.

This year, Wyld Networks partnered with South African company DFM Technologies to connect soil moisture sensors to low earth orbit satellites. DFM's soil probes are multilevel soil moisture content and temperature-logging devices. Probes measures moisture content and temperature readings at six depths in a soil profile and measure surface temperature.

Probes guarantee accuracy and reliability, as they are temperature compensated and are not adversely influenced by salinity levels. They are affordable, easy to use and have proven reliability in the field. Through continuous soil moisture content logging, farmers are able to prevent over and under watering, reduce unnecessary crop stress, promote root development and improve fertilizer uptake.

Data collected by DFM probes is sent via Wyld Connect to the Eutelsat Low Earth Orbit satellite network and then back to the DFM Probe Utilities Software, a user-friendly package that provides users with an abundance of information.

Deploying sensors and devices needs to be linked with connectivity improvements as the full benefits of the IoT will never be achieved while mobile cellular networks only cover 15% of the earth's surface.

Agricultural IoT devices have specific communications requirements such as low cost, low power, long-range and low data rates,

which have driven the development of new connectivity technologies such as Low Power Wide Area Network (LPWAN), non-cellular standards like LoRa and Sigfox along with cellular standards like NB-IoT and LTE-M.

LPWAN makes communication possible at significantly longer ranges and much lower power consumption than cellular or Wi-Fi options. Also LPWAN networks can be created anywhere, they offer farmers the opportunity for connectivity of sensors even when there is no cellular coverage.

LPWAN and especially LoRaWAN radio technology is low power (think 2 x AA batteries lasting years sending small data packets on an hourly or daily basis) and in contrast to Wi-Fi, LoRaWAN can operate at distances between 10-15Km, as the lower power signals operate at much longer wavelengths.

LoRaWAN is a game changing solution but even with all these benefits, it's limited by scale. On African farms, 10-15Km is no great distance. But with sensor-to-satellite connectivity, it's possible to send data from a sensor on a farm directly to a Low Earth Orbit satellite without maintaining a terrestrial LoRa network. Effectively, the terrestrial gateway is replaced by a gateway in space, freeing up sensors to be placed anywhere on the globe, however remote.

Wyld Networks works with Eutelsat S.A., a world leading satellite operator to develop satellite IoT terminals as part of the Eutelsat ELO programme. Eutelsat's fleet of Low Earth Orbiting (LEO) satellites, called ELO (Eutelsat LEO for Objects), offers global IoT coverage enabling sensors to transmit data, irrespective of location, demonstrating how satellite technology can complement terrestrial networks. ■

Looking ahead: Emergence of sensor-to-satellite connectivity means that areas in Africa will come into range, while access to remote data opens up new applications. For example, a crop requiring a certain soil type, water input and fertiliser may become possible in each environment if true information of the ecosystem is understood, both on a macro level and highly localised way. Specific, granular conditions can alter inputs to improve yield and reduce environmental impacts. The opportunity to blend this data with highly local satellite imagery is a potential game changer.

And with sensor-to-satellite, cost for access to the internet for IoT devices using this technology is expected to be a few dollars per node per year. With sensors able to run off low voltage batteries or small solar cells, this will enable IoT technology to reach everyone.

So, this revolution in satellite IoT technology will overcome two key barriers to universal access in Africa – global coverage and affordability - and as such can truly be termed as technology to democratise the IoT and help to deliver against more demanding future environmental and agricultural targets.

Additionally helping to meet growing demand for food, sensor-to-satellite revolution will also support struggling economies. At circa 23% of Africa's GDP, agriculture is a very important economic sector. In sub-Saharan Africa, it provides work for nearly 60% of the economically active population, while Africa's exports of food and agricultural products are worth between US$35 billion and US$40 billion a year.

In addition to the ongoing work with DFM in South Africa, some of the other satellite-connected applications Wyld is working on include beehive monitoring with Bayer and water level management in wells and reservoirs in Guinea. But these are just the start. With truly global reach, satellite connectivity transforms the future of the IoT and opens exciting opportunities across Africa and the rest of the world.

Brian Jakins,
general manager networks business, Intelsat

WhatsApp Chatbots in South Africa, self-diagnostic tools in Angola, contact tracing apps in Ghana and mobile health information tools in Nigeria: Covid-19 has spurred innovation across the continent with the development of health technology innovations that have been piloted or adopted in Africa. The continent, with its rising youth populations, has proved that, in spite of the pandemic, it was pursuing its transformation with cross-generation entrepreneurs driving it into its next phase of development.

Yet, as countries entered lockdowns and people became even more dependent on connectivity for work but also to access news, health, finance services and education, as well as communicate with friends and family, the Covid-19 pandemic highlighted the digital divide across the continent. Despite submarine cables running up and down Africa's coasts, combined with fibre-optic cables and cellular towers, dramatically improving access to connectivity over the past ten years, 670 million people were not covered by mobile broadband (3G or higher) as of the end of 2019, according to GSMA.

Infrastructure in Africa remains the biggest challenge for telecom operators. Reaching the remote communities, in dire needs of connectivity, is often uneconomical or not feasible due to geographic complexities and the number of remote communities. This is, however, a serious obstacle to the continent's growth and development.

Satellites and space-based communications have been at the heart of the many information and innovation revolutions over the past six decades, and we have witnessed first-hand —especially this year — the power of satellites to connect and the tremendous impact that broadband connectivity can have on a community.

Satellite is typically the only practical way to provide connectivity to areas underserved or un-served by terrestrial networks, where economics do not make sense. Satellites' ubiquitous coverage means that there are no 'last mile' issues, while the scalable and cost-effective space-based solutions can help countries meet connectivity challenges quickly.

At Intelsat, our mission is to help extend coverage to more people across the whole continent and we work on developing solutions, even in the most challenging times such as the past year, to ensure that everyone, regardless of their location, benefits from connectivity.

Intelsat has pioneered innovations in space-based technology for more than five decades and the last year was no exception. We experienced the future of in-space servicing with MEV-1 and MEV-2 that provide the Intelsat 901 and Intelsat 10-02 satellites respectively with five additional years of high-performance life. Space servicing is a valuable tool for Intelsat in extending the high-quality service experience that customers depend upon. Mission-extension services represent a smart and efficient way to maintain our existing fleet and free up even more resources to invest in advanced, next-generation technologies. For customers in Africa that rely on Intelsat 10-02 for media distribution and broadband services, this is the assurance of an uninterrupted experience.

It takes more than just new technology to make broadband services available and affordable – new business models are just as important. Our fully managed service, Intelsat CellBackhaul, is a new service model that helps mobile network operators quickly and cost-effectively expand their coverage into unserved and underserved areas. These include many areas that were previously considered geographically impossible to reach or simply too expensive to connect. The deployment of Intelsat CellBackhaul from Kinshasa in the DRC has made it possible to connect any cell tower, anywhere in the country.

Working with local partners also plays a crucial role in helping close the connectivity gap. Their understanding of local requirements, combined with the power Intelsat's global satellite network, help reaching an increasing number of people – enabling, ultimately,

critical educational opportunities, local business growth and game-changing consumer finance solutions. For example, the partnership between Intelsat and Liquid Telecom has led to the connection of more than 2,000 VSAT terminals in 20 countries in Africa, while AMN, relying on Intelsat's network, operates 2,000 mobile network base stations in rural towns and villages spanning 10 countries, serving around seven million people who were previously unconnected, and processing an average of 1.2 billion phone calls a year. These local partnerships help ensure the continuity of high-speed, reliable satellite connectivity to mobile operators, carriers and enterprises across Africa, while also better serving the growing demand for improved connectivity in rural service areas.

Intelsat has remained as committed as ever to keeping customers, partners and colleagues supported and connected since the crisis started. Our business continuity plans enabled our teams to rapidly execute remote working arrangements and Intelsat's global operations have continued to support the mission-critical services that our customers rely on to provide communications and connectivity services, much of this by leveraging remote-operations applications. Our recently launched Customer Operations Centre, located in Johannesburg in South Africa, has enabled us to work always more closely with our customers and better serve them throughout the continent.

While the Covid-19 crisis has highlighted the crucial role that broadband plays in connecting the world and keeping societies strong and healthy, it has also accentuated the digital divide, as many people in Africa, and around the world, are still without access to reliable connectivity. While we kept businesses, governments and communities connected in these unprecedented times, we also worked on expanding access to broadband services to everyone. An objective that is central to Intelsat's mission and that drives us to develop new innovative solutions, business models and new partnerships. ■

Looking ahead: We believe in a connected Africa where rural Africans will get access to healthcare, education, financial services, for an improved quality of life, and that's why we are working on the infrastructure of the future. This communications infrastructure will be fuelled by Intelsat's investments in standards-based design and integrated, high-throughput and software-defined architecture, which will help us respond to the booming connectivity needs, always more easily and at a lower cost.

Already, Intelsat is leveraging its unparalleled global orbital and spectrum rights, scale, and partnerships to build the world's first global 5G satellite-based, software-defined "network of networks." This will play a crucial role when African telecom operators develop their network to support 5G, helping to realise the technology's full potential, by complementing the capabilities of terrestrial 5G networks, and to bring network connectivity to places where terrestrial networks cannot go. They will also further harden network infrastructure by providing an added layer of resiliency to mobile networks.

Not that we are the only ones to believe in the importance of connectivity for the continent. The recent investment in AMN by independent African private equity fund manager Metier will help AMN expand its reach to more than 5,000 towers across more than 15 countries by the end of 2023. This significant move also shows that there are investment-grade opportunities in connecting the underserved.

A connected Africa will also depend on the next generation of satellite engineers in Africa who know better than anyone else the specificities of the continent. This is why we have paired with XinaBox to deliver space-focused STEM (science, technology, engineering and math) learning tools to teenagers across Africa. The objective of this initiative is to spark a tech interest and inspire them to become the future leaders that will lead the way with new advancements.

Providing connectivity to communities across the most rural parts of Africa can be challenging. Innovative technology, proven business models and experienced people are there, though, to make it simple.

Daniel Losada,
VP international sales, Hughes

Mobile and terrestrial network operators in the Middle East and North Africa (MENA) region are seeing rapid growth in demand for services, driven by both the global pandemic's shift to on-line communications and steady economic development in many countries. A number of cloud storage providers, including Amazon and Microsoft, have opened new facilities in the region to meet the growing demand from both government and enterprise networks. The coming rollout of 5G networks, while expected to be slow in most MENA countries, will yield even greater demand for cellular backhaul links to areas currently unserved and for hybrid networks that blend satellite, fiber and mobile broadband connections.

Network operators are challenged to deploy 4G throughout the entirety of their coverage areas. A recent study by GSMA Intelligence noted that smartphone penetration had reached nearly 60% across the 22 countries that make up the MENA region, well above the global average of around 47%. However, the same report noted that MENA lags other parts of the world in building out 4G networks, with only 29% of MENA customers having access to 4G compared to a global average of 51%. As regulators grant additional spectrum for 5G in urban areas it is increasingly likely that the operators will be required to introduce 4G in currently unserved areas – places where satellite can be cost effective to enable backhaul links.

"Satellite connections will play an important role in supporting these networks as demand for cellular backhaul increases and cloud-based hybrid networks are developed to support a range of enterprise customers"

According to a recent report by Analysys Mason, total telecom revenues in MENA are expected to grow by less than a half-percent per year through 2025. Subsequently, 180 mobile and fixed telecom operators in the region can be expected to turn increasingly to enterprise data customers for growth. The report notes that 5G rollout has just begun but that 5G penetration should reach 23% of all mobile connections by 2025. The forecast estimates that the average mobile data traffic per connection by 2025 will have increased five-fold since 2019.

Satellite connections will play an important role in supporting these networks as demand for cellular backhaul increases and cloud-based hybrid networks are developed to support a range of enterprise customers. Oracle opened a cloud data center in Abu Dhabi in early 2019, its first in the region. Since then, units of Microsoft, Amazon, Orange, Alibaba and IBM have all launched data centers in Middle Eastern countries. In addition, a number of countries are developing data-center infrastructure to support smart city and digital transformation projects.

The global pandemic has sped up the adoption of distributed enterprise networks around the world, as banks, retailers, schools, restaurants, and even government agencies shifted more and more to on-line services for both employees and customers. For locations far from terrestrial cable and fiber, the only links available have been often unreliable cellular connections, making satellite connectivity even more critical for business and government users.

On the horizon

With network use continuing to climb, better network management tools are critical. In a study

of Hughes' customers across the nearly half-million enterprise sites we manage globally and found that bandwidth demand per site is up by 150% over the past three years. In a separate assessment of data from 1,900 sites over a single three-month period, 25% of the branch locations experienced network congestion during daily peak hours (and that was pre-Covid-19).

We are seeing customers in markets around the world adopt software-defined, wide area networking (SD-WAN) as the best solution for managing vastly different broadband access types and infrastructure while supporting the proliferation of cloud-based applications. Wide-area networks typically allow enterprises to connect their remote locations to central data centers or into the cloud. The networks are often a blend of hardware and software from a wide variety of providers, and connections can sometimes involve dozens of Internet service providers across a wide geographic area. Getting everything to work smoothly and reliably can be daunting for network engineers. Network congestion, unacceptable latency and periodic service outages are common problems.

With managed SD-WAN, enterprise users can complement LTE and fiber connections with high-throughput satellite connections to ensure very high availability. A managed SD-WAN solution takes over the task of data routing and overlaying the network with control policies that allow the disparate network connections to run more like dedicated circuits. SD-WAN manages traffic flow by using dynamic load sharing across multiple connections. The approach is carrier agnostic and weaves together wired, cellular and high-throughput satellite connections into a seamless network. Cellular 4G LTE (and soon 5G) can be used for low-latency applications while satellites can carry the bulk capacity data, giving enterprises a dual path for high-availability networking.

Once installed, a managed SD-WAN solution can use integrated machine-learning algorithms to look at capacity trends, network states and other factors to improve overall network performance. The SD-WAN software also looks for network vulnerabilities to ensure the highest level of cyber security, whether the enterprise is protecting customer credit card numbers or the integrity of an electrical grid. ■

Looking ahead: Countries across the MENA region are developing broadband infrastructure at varying rates. Nations like the members of the Gulf Cooperation Council and Israel have 4G penetration at just under 50%, while those in the rest of the region have more customers still on 2G networks than on 4G. This digital divide presents an opportunity for development of community-based Wi-Fi hotspots powered by satellite connections. Throughout the region, YahClick, the Hughes and Yahsat joint venture, offers YahClick Express Wi-Fi, a community Wi-Fi solution that uses the Facebook Connectivity platform and enables local merchants to sell internet access at a low price per megabit, thus sharing the cost of the VSAT. These broadband hotspots bring Internet access to consumers wherever they are – no matter how rural – at markets, truck stops, taxi stands, and food shops.

It's true that a rising tide lifts all boats, and as the broadband revolution gains traction in urban areas and developed markets with 5G and multi-transport SD-WAN networks on the cutting edge, the impact will resonate across rural and hard-to-reach places with 3G, 4G and shared Wi-Fi solutions. As that happens, networks that bring together terrestrial infrastructure and satellites will become more common throughout MENA and other regions, making it more important than ever that network managers have the tools they need to assure the best level of connectivity no matter the transport.

Alexander Mueller-Gastell,
ND Satcom CEO

Pandemic-related challenges continue to reverberate worldwide and industries continue to adapt to external factors ranging from unprecedented supply chain interruptions to the multitude of changing regulations impacting borders and commerce. Additionally, ongoing safety and health measures for employees and customers were universal issues.

The degree of flexibility, agility, and commitment required – under the circumstances – defined companies that will conclude 2021 with an improved bottom line. ND SATCOM was amongst them. With stable leadership, it progressed investment in new technologies and market opportunities. As well as advancing its digitalisation plan by securely connecting its worldwide office network, partners, and customers with its headquarters.

We launched a variety of innovative products aligning with customer expectations and extended our SKYWAN 5G solution with a new and military application. Additionally, we countered the pandemic's impact on traditional B2B interactions (trade fairs and direct customer visits) by introducing new partner and customer communication channels via social media and our own interactive platform, which securely hosts live meetings, demos, and training. ND SATCOM's virtual activities successfully closed the pandemic-driven distance and learning gaps by providing the forum for group meetings and one-on-one sessions customers requested.

Through resilience, dedication, and creativity, the entire ND SATCOM family came together to support our global network and achieve our goals.

In 2021, ND SATCOM's sales volume showed a very positive development, with the defence market as a strong driver. Growth was sustained by the successful installation of SKYWAN 5G solution across multiple governmental customers worldwide as the core component within most projects. Our staff faced the pandemic with our entire team's outstanding experience and customer engagement reflecting brand quality and reliability.

We have been successful in positioning SKYWAN 5G as the standard modem and core element among defence customers.

We extended support for tactical applications for military customers by developing customised and rugged versions of the modem in relation to size and weight but also encryption. With the fast-growing SatCom-On-The-Move market for defence, we are ready and experienced, after completing, with a German research institute, extensive tests with different antennas to serve customer needs.

We continue global growth: in Asia, cooperation with governments was convincing for customers to order complex networks with stringent requirements for resilience and geo-diversity. The combination of mesh network capabilities with additional geo-redundant DVB-S2 out-bounds to interconnect sites was already adopted for several networks with more following. To support growth, we increased our regional expert team in several Asian countries. A "multi-station network in a 4U rack" was used to demonstrate SKYWAN technology in both theoretical courses and real operations.

ND SATCOM not only builds components "Made in Germany", it designs and delivers turnkey solutions that comprise complete networks. 2021 saw ND SATCOM awarded a project in the Americas for SKYWAN 5G modems with release 2.0 that comes with True-

Mesh ACM. Key factors for success included the modem and other components developed in-house and strong local support plus customer's trust in ND SATCOM's service organisation for the solution's lifetime.

At the AFCEA conference in Bonn, ND SATCOM presented the new Multi-band FlyAway Terminal (MFT) family and exhibited the X-band version of the MFT 1500. One advantage that sets the terminal apart is its wind resiliency: it can withstand and function in very high wind speeds and severe storms. Customers value high reliability and security that SKYWAN represents. The bar was raised by integrating pioneering innovation of Adaptive Coding and Modulation (ACM) for Mesh TDMA, permitting transmission during heavy rains with adaptive bandwidth control.

ND SATCOM's SKYWAN 5G modem evolution, was one of the main core tasks of the R&D team. After the SKYWAN release 2.0 launched in 2020, an updated, extended version of the software was released. New features include customisable dashboard for the network management software (NMS) and support of the MFT. Updated software is now available for all platforms featuring backward compatibility with SKYWAN release 2.0.

Other launches occurred in 2021: the HPA 4-Series, the latest version of high power amplifiers, marks the next generation of TWTA with its power and performance. It has improved usability through intuitive WebUI, simplified Automatic Level Control (ALC), enhanced performance through reduced intermodulation and halved warm-up time, easy maintenance through firmware upgrades via LAN, and consistent M&C and dimensions to its legacy series. We launched, the redundancy controller RCU 6000, covering the range from single HPA control up to the management of six active transmission chains. It offers a highly intuitive user interface to manage all functionalities: various base band encoders, modulator to upconverters, and multiple HPAs with all switch elements. The RCU 6000's quality and higher temperature range support failsafe operations.

Usability, performance, and monitoring highlights include 6 waveguide switch interfaces, ultra-fast multi-core CPU and 8 fast Ethernet ports, and dual 1-Gbit/s LAN for remote access. ■

Looking ahead: 2021 brought commencement of activity to enhance the core product SKYWAN 5G by enabling proprietary waveforms for special platforms to integrate with Ku and Ka-band antenna subsystems for high-speed communication links. After many hours of simulations, this new market will be addressed in 2022. Also, we will complete its Multi-band FlyAway Terminal (MFT) to cover the mid-size range from 1.5m to 2.4m with many RF and power combinations. MFTs will be verified to comply the MIL standards. The tight integration of SKYWAN modem will provide an extension of existing VSAT networks any new scenarios or customer problems will be addressed.

Recently launched HPA 4-series and new RCU 6000 controllers, next generation of uplink components have been successfully brought to market continuing the success of ND SATCOM in the field of uplink devices. The next generation of the antenna control units - the ACU 6000 – will be launched in 2022 to complete the portfolio.

October saw ND SATCOM CEO Alexander Mueller-Gastell taking part in a panel at the Satellite Innovation conference, discussing with industry leaders "Terrestrial Infrastructure Enablers for Advanced Space Systems". With more trade shows occurring, we will strengthen existing relations with customers and partners and establish new ones.

Caroline de Vos,
co-founder & chief operations officer, SatADSL

Founded in 2011, SatADSL has grown year on year to become an award winning, worldwide technology and operator agnostic satellite provider. The company is disrupting the existing satellite industry in order to realise the increasing potential of satellite connectivity in the new digital economy.

Specialising in bespoke solutions that best fit client's stated requirements and that provide flexible service plans meeting client's needs, while providing services to satellite operators, teleport and hub operators, governments, enterprises, and internet service providers.

SatADSL's flagship platform, neXat is the first satellite aggregation system that acts as a capacity broker and connects teleports with new markets and customers, while providing cost effective and reliable IP access.

Concentrating on the professional market of enterprises, prosumers, or small office home office to provide quality services. Additionally, customers are from Non-Governmental Organizations, public administration, educational institutions, and churches as well as other clients.

The advantage of SatADSL solution is the dynamics and flexibility that can be achieved, which is why it is flexible enough to be used by all the previously mentioned customers to meet their requirements.

"For many Africans direct and immediate communication within a community is important as a cultural aspect"

Satellite connectivity is of huge importance to Africa for many reasons. Most African countries are still not connected by terrestrial connectivity because fiber arrives in the country starting at the coast. This means that there are large parts of the territory that are not covered simply due to the lack of necessary infrastructure to support it.

In remote areas, it is difficult to implement terrestrial connectivity such as fibre and 4G efficiently and the alternative technologies that do exist, are frequently unreliable. This is one of the reasons why satellite solutions can really shine in the African market, connecting rural or hard to reach areas and providing the reliability that is so badly needed. In fact, this is something we consider to be a real opportunity for SatADSL.

"This is one of the reasons why satellite solutions can really shine in the African market, connecting rural or hard to reach areas and providing the reliability that is so badly needed. In fact, this is something we consider to be a real opportunity for SatADSL"

For many Africans direct and immediate communication within a community is important as a cultural aspect. This is where the contribution SatADSL's solution

"In remote areas, it is difficult to implement terrestrial connectivity such as fibre and 4G efficiently and the alternative technologies that do exist, are frequently unreliable"

in Africa comes into play for the demand within African communities.

As a result, digital communications tools such as social networking apps become necessary for them. Indeed, we know from our data that apps like WhatsApp account for significant portions of data on our networks. This speaks to the cultural value of connectivity for the purposes of direct communications in Africa. Keeping people connected is not only about servicing business goals but also the more human element of connecting families, friends, colleagues, and students who want to be able to engage each other directly.

SatADSL's carrier grade platform has been built with the support of the European Space Agency. As a result, we deliver not just the resilience and redundancy to mitigate network outages, but also security and superior service all come as standard. ■

Looking ahead: SatADSL is currently enhancing neXat security, redundancy, and resiliency features in the frame of a contract with the European Space Agency (ESA). The added security makes it more attractive to large teleports, governments, and large-scale enterprises with stringent safeguarding requirements.

SatADSL has developed an e-commerce feature which will allow customers, ISPs, and teleport and satellite operators to request quotations and place bandwidth orders.

SatADSL is also currently embarking on a new and exciting project in Cameroon that will involve connecting 500 schools with about 60 Mbps VNO capacity for internet access and eLearning.

We believe that the arrival of VSAT connectivity is a vector for development in Africa, one that makes it possible to serve remote regions.

Given that more and more professions are becoming digital (education, medicine, banks, administration), without reliable connectivity accessible to everyone, these professions will not evolve technologically at the correct pace. As such, Africa risks falling behind, relative to other parts of the world.

It is clear that the African market understands this to be true, hence the growing demand for satellite connectivity that we have observed for several years in African Telecoms.

Farhad Khan,
CEO of YahClick

YahClick is a joint venture between Yahsat Group and Hughes, serving consumers, enterprises, mobile network operators (MNOs) and governments, using Ka-band capacity on Al Yah 2 and the Africa payload of Al Yah 3 covering 45 countries, YahClick operating in 34 of them. Providing wholesale capacity to other satellite operators. In 2021, it expanded its reach by joining hands with new partners and entering new market segments.

YahClick's markets typically have gaps in terrestrial broadband coverage, where access for government, enterprise and consumer users to high-speed internet is a critical component of national socio-economic advancement. Bridging this digital divide using terrestrial means is costly or operationally challenging, hence YahClick's affordable satellite-based internet services.

In 2021, we widened the scope of our differentiated go-to-market model in Middle East, Africa and Central Asia. Although these markets provide attractive characteristics for satellite operators, they require capabilities and market presence that many satellite operators haven't developed due to a historical focus on selling raw capacity, with such market facing components being performed by specialised satellite service providers focused on higher-end market needs.

We are proactive in offerings further downstream across the value chain, delivering value added solutions, with deeper partnership or go-to-market models. This creates a differentiation and overall value proposition often difficult for competitors to match, giving limited competition.

YahClick partnered with 3 key service partners, second half of 2021, broadening our distribution network, across Africa and Middle East:

YahClick signed a strategic partnership with Global Communications Extension Services Limited (GCES) to provide satellite connectivity for 9mobile, a leading Nigerian mobile network operator. Partnering with GCES brings satellite connectivity to hundreds of cellular backhauling sites, delivering 9mobile a reliable and robust means of rural connectivity across its Nigerian operations. YahClick's satellite services reach more than 60% of Africa's population, and GCES's agreement extends its reach to more regions within Nigeria.

The tie-up with Universal Satcom Group provisions reliable, high-speed Broadband through Al Yah 2 satellite coverage. Yahsat and Universal introduced a comprehensive value proposition to enterprise customers, offering satellite capacity and hosting services to Universal giving the support and capacity to provide their differentiated services. This collaboration is built from the combination of unique product offerings, with both sides coming together to develop the concept of Cooperative Competition supporting unserved territories throughout the Middle East and Africa.

Working with iSat Africa Ltd. FZC, expands YahClick's enterprise solutions business in Nigeria, Zambia, DRC and East Africa. A Pan-African network operator present in 12 markets, iSAT will deliver connectivity solutions for Mobile Cellular Backhaul (CBH) services, business applications, supervisory control and data acquisition (SCADA) systems, and provide remote site connectivity. Connectivity solutions are provided over YahClick's high-throughput satellite (HTS) Ka-band capacity enabling high-speed broadband solutions, with service plans up to 100 megabits per second (Mbps), reaching and serving remote locations. This should impact sub-Saharan Africa market, especially unlocking high demand flexibility in applications like Backhaul or Community WiFi.

YahClick, signed a partnership with HotSpot

Network Limited to support rural telephony for mobile network operators (MNOs) in Nigeria. The technology enables MNOs to expand their coverage, offering uninterrupted data services and high-speed broadband solutions, up to 100 Mbps to remote communities across Nigeria.

Connecting over 20,000 villages will lead to the enhancement of different sectors and will contribute to Nigeria's economic development. Aligning and enabling our mission to lead Africa's digital transformation through innovative services, YahClick is empowering people and companies by confidently supporting them to increase their efficiency and productivity.

YahClick in partnership with the Ministry of General Education in Zambia announced the beginning of a joint project enhancing the delivery of education through E-Learning Platforms, as YahClick's V-Sat Technology and WiFi solutions are introduced nationally to schools.

launched in May 2021 our V-Sat services at Kabulonga Boys Secondary School, in collaboration with the Zambian Government will implement high-speed broadcast connectivity solutions in 2750 locations, with further expansion opportunities outlined soon. Directly supporting children in their studies through e-learning platforms and their learning programme without limit of boundaries.

Due to the pandemic, students in low and middle-income countries lost nearly four months of learning while their counterparts in high-income countries lost only six weeks, catching up via remote learning. For African students these limitations bite harder because, in sub-Saharan Africa, about a third of the population is beyond 3G coverage. Africans in remote communities neither have access to quality education nor quality internet connectivity for virtual learning. YahClick teamed with Service partners to provide e-learning via its broadband service, activating more than 60 sites.

Partnering with South Africa's Department of Telecommunication & Digital Technologies (DCDT) will equip 480 remote Mission Critical Health Centers, at no cost for six months, with satellite broadband to combat Covid-19. Evidencing our social commitment.

With sparse terrestrial network connection in parts of uMzinyathi district YahClick connected 15 schools to e-learning facilities. So far, this initiative has connected 6 000 learners and 200 teachers. ■

Looking ahead: In recent years there's been broader acceptance of Ka-band reliability for higher-end users and applications, including cellular backhaul provision solutions to mobile network operators, supporting expansion of their 3G, 4G and 5G reach beyond areas connected via fibre. To capture this opportunity, YahClick is implementing several new channel models, to allow it to expand its reach and increase sales across all segments, optimising margins.

YahClick continues to focus on expanding its distribution network in underserved and or growing markets with strong economic and demographic fundamentals, such as Nigeria and South Africa, whilst further penetrating existing markets by developing solutions and services such as: VNO managed capacity service, cost effective internet trunking and backhaul solutions on Ka-band for MNOs and ISPs.

Time limited or data limited, Wi-Fi hotspot service enabling multiple user internet connection, via the same Wi-Fi access point using prepaid vouchers. For example, in Ghana approximately 250 schools have a similar service available. These hotspot solutions are operated in conjunction with the Facebook Express Wi-Fi eco-system and platform, allowing service providers to partner with local communities and local entrepreneurs.

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For more information, please visit www.absatellite.com

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Avanti Communications

Avanti Communications is the leading KA-band high throughput satellite capacity partner to the communications industry across EMEA focused on driving connectivity across Africa.

Our mission is to work in partnership with the people of Africa to empower growth, protect communities and unlock opportunities for individuals, businesses and governments, by creating better connections across the continent.

Avanti recently launched Avanti EXTEND, a new managed service for rural connectivity. Avanti EXTEND provides high-performance and cost-effective 2G, 3G and 4G solutions to remote and hard-to-reach areas across sub-Saharan Africa. This enables MNOs and Tower Companies to provide reliable cellular service to the 100 million people living in these challenging locations that would otherwise be impossible to reach using traditional terrestrial infrastructure.

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About Us

Services

Channels

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Es'hailSat, the Qatar Satellite Company, was established in 2010 to deliver satellite services to broadcasters, telcos, enterprises and governments in the MENA region and beyond.

With a goal to be a truly global satellite operator and service provider, Es'hailSat commenced operations with Es'hail-1 in 2013, supporting key broadcasters, beIN Sports and Al Jazeera Media Network. Es'hail-2, the company's second satellite was launched in 2018 and is co-located with Es'hail-1 at the MENA hotspot of $25.5^0E/26^0E$ orbital location. Es'hailSat's high-powered satellites with Ku-band and Ka-band capabilities, provides the region with advanced and sophisticated services.

Es'hailSat's Teleport in Doha provides satellite Telemetry, Tracking and Command (TT&C) operations and capacity management, along with teleport services such as uplink, downlink, contribution, multiplexing, encoding, playout, VSAT services, hosting services, data centre and other services.

Es'hailSat plans to expand with newer satellites in other prime orbital locations around the globe, offering customers the most flexible and reliable services.

Contacts: sales@eshailsat.qa or info@eshailsat.qa

Hughes Network Systems

Contact details:
GlobalSales@Hughes.com

Broadband

Cellular Backhaul

Community Wi-Fi

Multinational Networks

Hughes Network Systems, LLC (HUGHES), an innovator in satellite and multi-transport technologies and networks since 1971, provides broadband equipment and services; managed services featuring smart, software-defined networking; and end-to-end network operation for millions of consumers, businesses, governments and communities worldwide. The Hughes flagship Internet service, HughesNet®, connects millions of subscribers across the Americas, and the Hughes JUPITER™ System powers Internet access for tens of millions more worldwide. Hughes supplies more than half the global satellite terminal market to leading satellite operators, in-flight service providers, mobile network operators and military customers. A managed network services provider, Hughes supports hundreds of thousands of enterprise sites with its HughesON™ portfolio of wired and wireless solutions. Headquartered in Germantown, Maryland, USA, Hughes is owned by EchoStar. To learn more, visit www.hughes.com or follow HughesConnects on Twitter and LinkedIn.

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Russian Satellite Communication Company (RSCC) is the Russian GEO satellite operator with global coverage. RSCC is one of the ten largest world satellite operators in terms of satellites and orbital slots. RSCC satellites are positioned along the geostationary orbital arc from 14° W up to 140° E, covering the entire territory of Russia, CIS, Europe, Middle East, Africa, Asian-Pacific region, North and South America, and Australia.

RSCC provides a full range of communications and broadcasting services via its own terrestrial telecom facilities and satellite constellation, which consist of modern Express, Express-AM, Express-AT, Express-AMU type satellites; e.g. video distribution and contribution, DTH, DSNG, broadband Internet access, IP trunking and cellular backhaul, maritime mobility, in-flight connectivity, SCADA, enterprise networks connectivity and other. The company operates various regional satellite TV distribution networks and corporate VSAT networks for fixed and mobility customers throughout Africa and in other parts of the world.

RSCC
Russian Satellite Communications Company

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Over the past 24 years, C-COM has been a world-leading provider of high-quality, reliable auto-pointing satellite antenna systems. The company is now in the final stages of development of a potentially revolutionary Ka-band, electronically steerable, modular, conformal, flat panel phased array antenna.

More about C-COM Satellite Systems

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Stratosat Datacom, established in 2002, provides cost effective tailor-made turnkey satellite and microwave communication solutions in Sub-Sahara Africa. We have rendered products and services to the majority of Telco and Satellite Operators in Africa.

Our customer focussed team provide expertise in equipment supply, installation, systems integration, commissioning, handover, training, maintenance, support and network monitoring.

Stratosat's main solution offerings are:

- High-Speed Satellite Managed Broadband Connectivity, Mobility (CoTM & CoTP),
- Managed Services,
- Tailor-made Communication Network Solution Design, Project Management,
- Satellite Equipment Supply & Distribution and Implementation & Management of Large Astronomy Projects (SKA / MeerKAT).

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SatADSL offers satellite services worldwide to operators, teleport & hub operators, government and enterprise bodies, and ISPs. SatADSL, with its neXat platform, is the world's first satellite bandwidth aggregation emarketplace.

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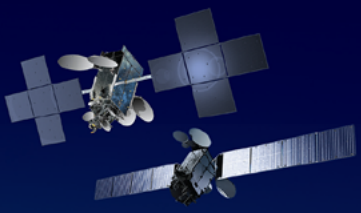

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Space to deliver your vision

chapter 6
Broadband

Danson Njue,
senior research analyst with Omdia

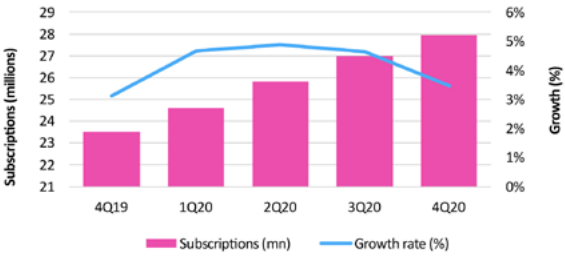
The fixed broadband segment recorded 18.8% YoY growth in active subscriptions, reaching 27.9 million by end-2020 compared to 23.5 million in 2019.

In 2020, a 19.6% YoY growth in fixed broadband revenue was recorded, with strongest growth recorded in 2H20, due to an increase in demand for home and office broadband services to support remote working and home schooling and entertainment.

Overall, Africa continues to see strong growth in the fixed broadband segment, driven by growth in consumer demand and the increase in the deployment of fiber and fixed wireless broadband (FWB) networks across several countries.

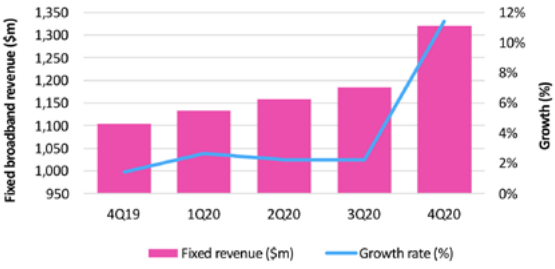
However, Africa's fixed broadband household penetration is significantly lower compared to other regions, hence creating a great investment opportunity for service providers.

Africa fixed broadband subscriptions and YoY growth



Source: Omdia

Africa fixed connectivity revenue and YoY growth



Technology market update

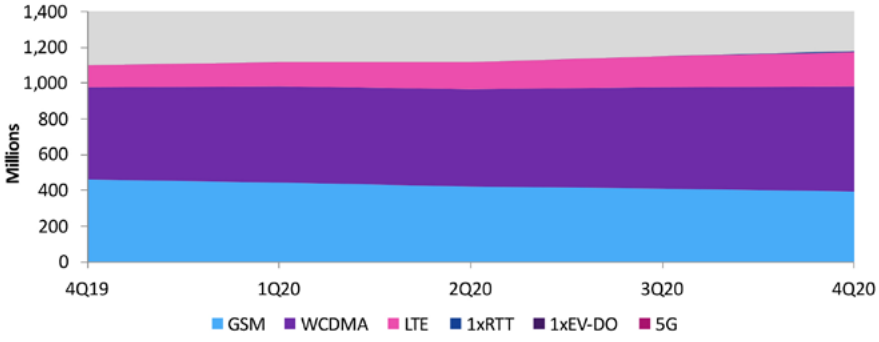
GSM and WCDMA were the dominant mobile technologies in Africa at end-2020, accounting for 33.4% and 50.2%, respectively. Mobile broadband technologies – 3G and beyond – accounted for the largest share (66.5%) of total mobile subscriptions in 2020.

Last year saw an increase in the expansion of mobile broadband networks, particularly 4G, by network operators to meet the capacity demands from consumers. In addition, there was a significant fall in data prices across many markets, which saw an increase in the uptake of data services.

Africa has seen a significant increase in the number of 5G network deployments with South Africa being the leading 5G market in Africa. Some of the mobile operators that have launched commercial 5G services include Vodacom, MTN South Africa, Safaricom Kenya, and Cable & Wireless Seychelles.

In the fixed broadband segment, xDSL, FWB, and FTTx were the dominant technologies, accounting for 57.3%, 34.8%, and 6.3%, respectively, at end-2020. FWB and FTTx are projected to be the dominant fixed broadband technologies in the future due to their convenience in offering high bandwidth to consumers.

Africa mobile subscriptions by technology, 4Q19–4Q20



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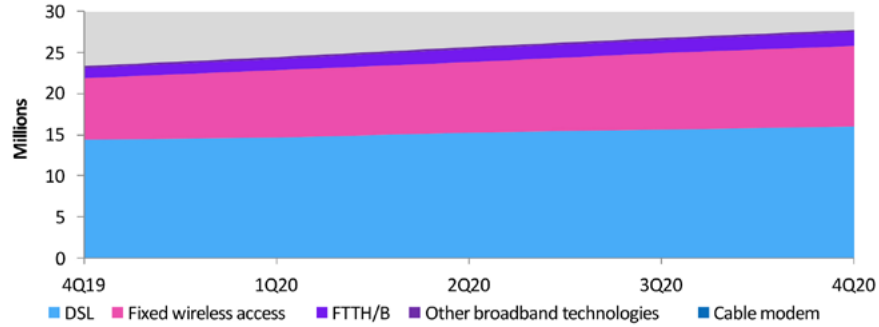
Africa fixed broadband subscriptions by technology, 4Q19–4Q20



Source: Omdia

Fixed broadband subscriptions forecast

Africa's fixed broadband market is projected to record strong growth with active subscriptions increasing from 28.3 million in 2020 to 43.8 million in 2026, a 54.8% growth. The growth will be supported by a strong uptake of FTTx and FWB services.

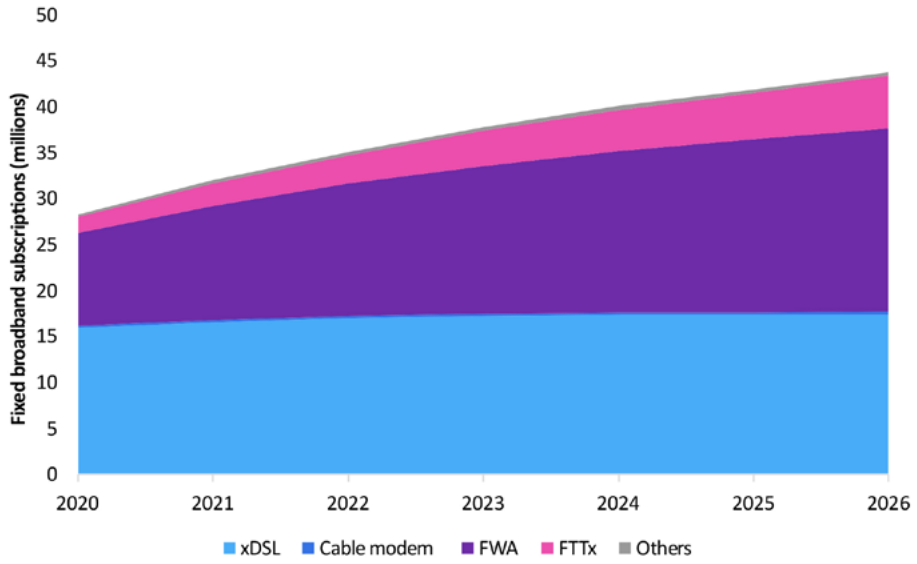
FWA will record 99% growth in active subscriptions over the forecast period, as more service providers choose LTE and 5G over WiMAX to offer wireless broadband services due to their relatively higher bandwidth and low latency.

FTTx subscriptions will grow by 219.8% by 2026 due to strong demand from consumers and an increase in fiber network deployment by service providers.

The fixed broadband market continues to attract new players, hence driving competition and lowering the prices for services.

"Covid-19 may be a blessing in disguise for regional telcos as they have been able to test their resilience during a pandemic. It has also unlocked many opportunities in the digital services segment"

Africa fixed broadband subscriptions forecast, 2020 –26



Source: Omdia

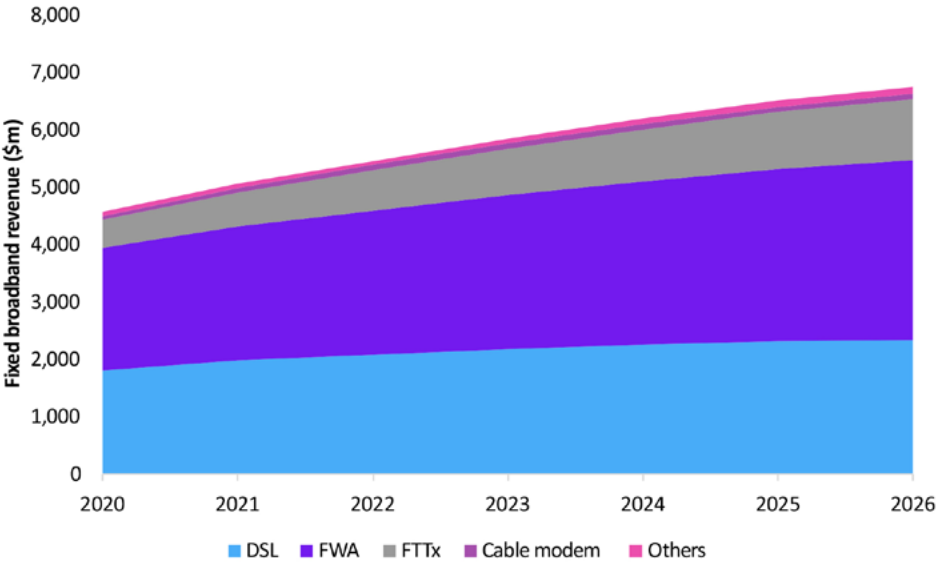
Fixed broadband revenue forecast

The fixed broadband revenue in Africa is projected to grow by 48.1%, increasing from US$4.6bn in 2020 to US$6.8bn in 2026. The growth will be supported by strong service uptake with all the technologies recording double-digit revenue growth over the period.

FTTx will record the highest revenue growth of 122.2% as more consumers and businesses opt for the technology due to the need for higher bandwidth for home and office use. Africa continues to record an increased optical fiber deployment as a key technology to power the region's digital economy.

FWA (which is provided via LTE and 5G) will record 46% revenue over the forecast period. 5G is still a new technology in Africa with only a handful of operators having launched the service. Lack of spectrum is seen as the main inhibitor for increased 5G deployment on the continent.

Africa fixed broadband service revenue forecast, 2020 –26



Source: Omdia

4G will dominate Africa's mobile broadband market as 5G deployment takes shape

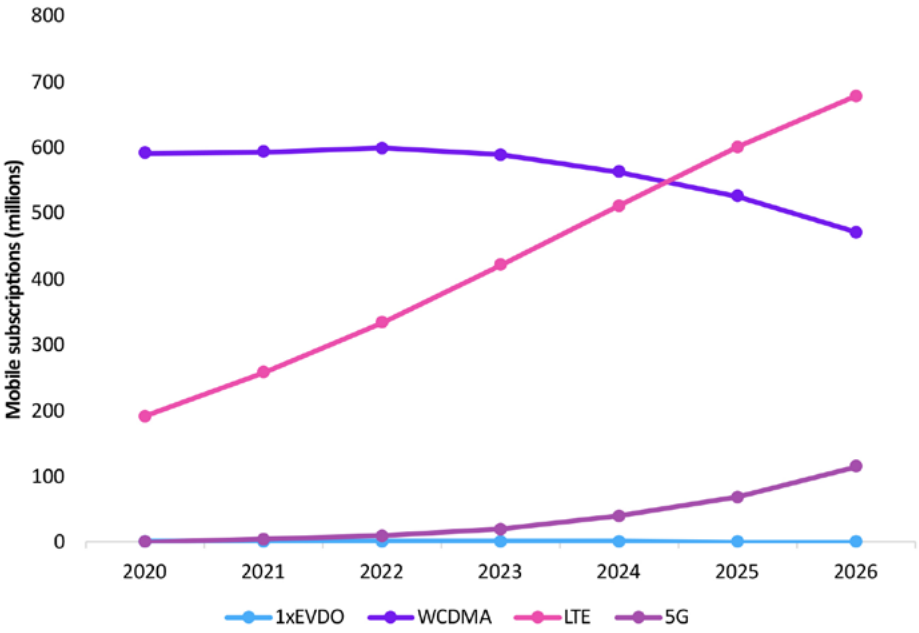
According to Omdia forecasts, 4G LTE will be Africa's most dominant mobile broadband technology by 2026. WCDMA will be popular, but its growth will decline sharply from 2024 as more users will opt for 4G and 5G due to better speeds.

5G will be the fastest growing technology between 2020 and 2026. However, rapid deployment of the technology is still facing a myriad of challenges, including the delay in spectrum auctions and unavailability of affordable 5G devices.

Mauritius is the only country in Africa that has granted 5G licenses and awarded a total of 300MHz of radio spectrum to three main operators – CellPlus Ltd, Emtel, and MTML, in the 2.6GHz and 3.5GHz bands. Operators in other countries including South Africa, Kenya and Seychelles, that have launched commercial services, are using spectrum allocated on a temporary basis.

In Africa, LTE will continue to play a key role through which most users access mobile broadband services. For operators that cannot afford to deploy 5G, LTE will remain the main mobile broadband technology. Consequently, such operators will continue to aggressively expand their LTE networks to meet the data demands from their customers.

Africa's mobile broadband subscriptions forecast, 2020 –26



Source: Omdia

BROADBAND: INTRODUCTION

Martha Suarez,
president of the DSA

In the last year, internet access has provided a lifeline to communities across the World, throughout the global pandemic. Africa is no exception to this, with people turning to the internet for education, information, and communication in a time when normal social interactions have been limited. Continuous review of spectrum allocation is needed, to meet the rising demand for broadband, and to serve communities without access to this vital amenity.

In Africa, fixed broadband penetration tends to be low, an average of just 3.45%, particularly in the residential sector according to Research firm Check Point. Furthermore, in South Africa, according to official statistics, there are a total of 232,108 registered fixed terrestrial wireless subscriptions[1], accounting for 16.92% of the total fixed broadband market. The WISP sector represents a critical contributor to tackling the country's persistent digital divide.

In fact, fixed broadband adoption in South Africa is estimated to have reached 10.05% households[2]. Fortunately, adoption of Wi-Fi (and the value it creates) is growing rapidly not only in South Africa, but also across the continent. Southern Africa's internet penetration rate rose above the global average in 2021, to 62%. Even areas with some of the lower penetration rates such as Eastern and Middle Africa showed a quarter of the population with access to the internet. In 2021, countries such as Kenya showed high internet usage rates of over 85%, with other countries of high penetration rates such as Libya and Nigeria also coming in at over 70%.

Broadband non-adopters are, as expected, concentrated on the lower income population in urban areas and rural geographies. Wireless ISPs tend to have a primary focus on the vulnerable population and part of their deployment is in rural municipalities. In that sense, it is critical to understand the needs of these players. As a result of this rising demand, and especially as an important step towards digital inclusion, regulators must continue to take steps towards effective spectrum utilization, enabling license-exempt access to additional spectrum in the 6 GHz band, that could be used by Wi-Fi, and also by other modern technologies like 5G new radio unlicensed (5G NR-U).

Internet usage is not just on the rise; it's an important aspect of modern life for those living in Africa. In South Africa, smartphone users spend more than half their online time connected to Wi-Fi and in Nigeria, there are an astounding 43 million social media users, which is more than countries like Italy and Canada. For business, education, and healthcare, connectivity is also of the upmost importance. In its National Broadband Strategy 2018-2023, Kenya says it plans to bring fixed broadband connectivity to 100% of tertiary institutions and public health facilities by 2020, and 50% of primary schools by 2022.

Regions like South Africa have also seen a dramatic increase in the number of people working from home thanks to the impacts of the pandemic. In a recent study, it was shown that 46% of people felt even more satisfied with their work while at home, and 50% felt even more motivated while remote working. 63% of respondents even reported that productivity increased. While working from home looks like it might be here to stay for many, it is not possible

[1] Independent Communications Authority of South Africa (2021). *The State if the ICT Sector Report in South Africa*, p. 44.
[2] Calculated by dividing the total number of fixed broadband subscriptions of 1,371,466 by an estimated total households of 13,645,902.

without reliable internet access.

This being said, extreme variations in internet penetration show that the digital divide is still prevalent in the continent. While the regions previously mentioned boast high rates of usage, those like Western Sahara, South Sudan and Eritrea have less than 10% of their population connected to the internet. Particularly in times of difficulty, such as those imposed by the global pandemic, regions without sufficient connectivity are at a major disadvantage.

6 GHz for a digital future in Africa

Wi-Fi is a highly cost-effective wireless access technology due to ease of installation and user control over the network. The global Wi-Fi ecosystem also benefits from enormous economies of scale, enabling manufacturers to produce very cost-effective products. According to Intel, the cost of licensing the necessary intellectual property for cellular 5G alone is 3 times that of a Wi-Fi chipset, and the entire 5G cellular modem cost is 50 times the cost of a Wi-Fi chipset. When trying to deliver affordable connectivity, this means Wi-Fi offers lower cost of coverage for low-population density areas and lower cost of terminals.

The ITU-D Study Group on Broadband development and connectivity solutions for rural and remote areas, in its annual deliverable 2019-2020 has recognized that "Wi-Fi hot spots and local area networks, which can be installed at rural points of community activities, including shopping centres and university campuses, can serve a variety of users. These are also suitable for homes, where all family members can access Wi-Fi connectivity. Wi-Fi technologies are very effective if the backbone landing is not far from the locality and can be used to create a mesh network".[3] According to the report, in India[4], several rural areas have been connected using Wi-Fi, as a last-mile connectivity solution and in Zimbabwe[5] the community information centres constructed by the universal services fund of the country use Wi-Fi technology. Similarly, in the Democratic Republic of Congo (DRC) approximately 52,000 public Wi-Fi hotspots are live in the country, with the installed base set to reach 150,000 by 2025.

Regulators and spectrum authorities are guided by public policy goals focused on providing broadband access to all their citizens, leaving no one behind. They recognize spectrum is the income for wireless access and always try to make the most efficient use of it. In this context, spectrum sharing technologies like Wi-Fi 6E, that make more efficient use of the spectrum, while protecting incumbents and increasing affordable connectivity are being considered by regulators and spectrum authorities worldwide. As countries across the world such as South Korea, Canada, the US, Brazil, Saudi Arabia and others open the 6 GHz band for unlicensed access, countries across Africa should follow their lead. Especially in areas like sub-Saharan Africa, where the average number of people per household is above the global average, the increase in devices sharing a singular hotspot can cause congestion, reducing quality of service.

The African Telecommunications Union (ATU) has this year approved the recommendation by its Emerging Technologies group to enable licence exempt technologies to operate in the lower 6 GHz (5925-6425 MHz) band, and as a

[3] Annual deliverable: "Broadband development and connectivity solutions for rural and remote areas". Question 5/1 Telecommunications/ICTs for rural and remote areas. ITU-D.
[4] Presentation by Mohit Bansal at the workshop on broadband development in rural areas hosted by the Question 5/1 Rapporteur Group,25 September 2019.
[5] Presentation by Batsirayi Mukumba at the workshop on broadband development in rural areas hosted by the Question 5/1 Rapporteur Group, 25 September 2019.

result, some countries in Africa are considering extending licence-exempt access for Wi-Fi and other license exempt technologies to the 6 GHz band. While this is an important step, opening the entire band would provide more economic benefits; for example, the cumulative economic value between 2021 and 2030 associated with allocating the 1200 MHz in the 6 GHz band in in Nigeria amounts to US$ 72.14 billion, broken down by US$ 49.89 billion in GDP contribution, US$ 10.51 billion in producer surplus to Nigerian enterprises, and US$ 11.74 billion in consumer surplus to the Nigerian population. In Kenya it amounts to US$ 20.29 billion and in South Africa amounts to US$ 57.76 billion.

Next year and beyond

Predicted growth by Check Point states that along with the Middle East, growth in fixed broadband subscribers will equal almost 70% by 2030, by far the largest increase when compared to other regions across the globe. As the fastest growing region in the world in this area, regulators should not delay in utilising available spectrum. That is how they will avoid overburdening of spectrum, which is being experienced in regions like North America and Europe where users experience congestion during peak hours.

After the recession in 2020, Africa is expecting a healthy growth in its economy, and countries that recognise the value in spectrum allocation will see their economies benefit. Providing additional spectrum access in the 6 GHz band (5925 – 7125 MHz) to support the deployment of Wi-Fi 6E and 5G NR-U, will offer African citizens one of the most anticipated advancements in affordable broadband connectivity to date. It is time to act now. ■

Craig Thomas,
vice president, strategic marketing & business development, Broadband Forum

Between 2020 and 2021, Internet users in South Africa increased by 1.7 million, a 4.5% increase. This Datareportal report highlights operators' continued efforts to bridge the digital divide and bring connectivity to the unconnected. While Internet penetration in the country has risen to 64%, more work should be done. There's an urgent requirement to connect those left behind and to implement a strategy that will bring about greater change for all inhabitants, now and in the future.

African broadband marketplace is diverse and characterized by limited fixed broadband penetration. Looking back to 2019, regional difference in mobile and fixed broadband penetration was stark. Even in advanced fixed broadband South African market it was 102.22 mobile broadband subscriptions as against 2.14 fixed connection subscriptions. Compared to developed areas outside of Africa, customers have choice of mobile networks such as 4G, 5G, Fixed Wireless Access, fixed access, and satellite technology. Where internet connectivity limit is 3G or 4G, that becomes the expectation of what broadband is. Higher bandwidth, ultra-low latency and reliable connectivity should be the aspiration for all operators.

Leveraging fixed and wireless networks would be critical for South Africa and wider African market as it means operators can

make the most of their limited fixed networks. This means looking to the future and deploying fifth-generation technology to enhance existing service offerings and open new revenue streams.

5G requires highly scalable and future-orientated network architecture to enable deployment of new services and applications. By taking a holistic approach to network management and operation, operators can provide a unified broadband customer experience. This means it's imperative to integrate wireless and wireline convergence at all levels of broadband ecosystem.

Operators must look at utilizing fixed and mobile networks to deliver enhanced customer experience, as a single network will not deliver Quality of Experience that consumers want. For true convergence to occur, a single converged 5G core network must be leveraged regardless of whether they connect via a wireless or wireline technology. Unlocking new revenue streams, fifth-generation technology offers higher bandwidth and lower latency that customers seek. For operators to safely navigate their way past challenges they face while bringing the benefits of 5G to fruition, they must look to leverage key 5G specifications that are already available.

Broadband Forum is providing a global framework for operators to enhance their service offerings. Industry specifications such as Release 16 from 3GPP, and Broadband Forum's Phase 1 document aim to ensure a smooth migration path to 5G and maximize the addressable market for operators. This highlights importance and relevance of standards bodies such as Broadband Forum and 3GPP in jointly developing 5G convergence standards, while bringing together operators and technology providers to help deliver 5G benefits.

Instead of operating two separate, distinct core networks for mobile and fixed access, operators can use the 5G core (5GC) as common core. This enables operators to deliver a unified experience and implement converged and integrated 5GC network capable of handling increases in connected devices. The support of a transformed transport network and standardized interfaces will go a long way in automating away any complexity. As network traffic rises, operators need a competent transport network that seamlessly connects 5G Radio Access Network (RAN) and core networks, as well as delivering enhanced performance and improved Quality of Service.

Previously, the transport network was backhaul-focused and static, whereas high-bandwidth technologies such as 10G PON allow 5G transport network to be utilized for xHaul on a larger scale. For operators across Africa and worldwide, to unlock the range of applications and services of 5G, they need to consider the expenditure required to build out a 5G network. Another key consideration for operators, is whether they migrate their existing networks or fully replace them. When evolving transport networks, undertaking a full migration can reduce disruption to operations and services. This is often the preferred method to enhance current investments and provide greater levels of performance and scalability.

Additionally, with increased activity of new fibre broadband market entrants over the last decade, a new opportunity arises for new operators to offer wholesale fibre services to mobile network providers expanding their 4G and 5G services reach into new territories. Ultimately success of fibre broadband and increasing rollout of 4G and 5G is symbiotic.

5G development within the Broadband Forum is a key focus with many leading players collaborating and developing next steps of fifth generation technology. Broadband Forum's

work is key in allowing carriers to manage all aspects of their services in a more holistic way. This can be achieved by standardizing transport architecture and enabling integration of wireless and wireline at all levels. This provides operators with confidence to deploy standardized technology that's been certified and approved by Broadband Forum. Operators can then effortlessly evolve networks and make sure fixed access is supported by a common unified core network.

Broadband Forum's work in cooperation with 3GPP on Fixed Mobile Convergence (FMC) has resulted in a set of specifications which allow full convergence to take place, with operators able to leverage 5G networks while integrating existing fixed access deployments. FMC helps extend geographical reach of 4G/5G core networks, both from a traditional cellular device and for Fixed Wireless Access. Investing in a single fibre access network that also leverages a complimentary single edge and core architecture whilst offering a migration path from existing network investments is exactly what is motivating operators globally to drive industry wide standards and best practices.

Broadband Forum has released three specifications that will reduce development time and expenditure from the traditionally disparate fixed broadband and 4G/5G networks. Importantly, they will deliver a common and managed broadband experience to customers whatever the final connectivity technology.

Standardization allows operators to build out 5G networks with open, cloud-native platforms that utilize software and hardware components from different vendors, eliminating vendor lock-in. 5G services can be deployed quicker, more securely and more flexibly. Broadband Forum's 'TR-470: 5G Wireless Wireline Convergence Architecture, which was produced in conjunction with 3GPP, describes 5G FMC architecture and provides high-level guidance for network architects and planners. This specification enables fixed and mobile functions to coexist over shared infrastructure and facilitates multi-access connectivity with customers having an access-independent service experience. Network operations are streamlined for operators with common technology, on-boarding, services and subscriber management between fixed and mobile divisions achieved.

Looking ahead

In 2022 and beyond, by leveraging 4G/5G convergence standards, operators across South Africa can take a unified and holistic approach to help deliver high-quality fixed broadband connectivity the country deserves. There is a clear argument to invest once and look at the broadband access network holistically to deliver next-generation access. One unified access network can integrate all technologies, with the final access technology the only variable in a network which can accommodate all broadband access technologies. ■

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Obehi Okosun,
MD Cambridge Broadband Networks (Africa)

The last 18 months Covid-19 rapidly and significantly impacted human interaction. Africans faced lockdown at home unable to interact with others outside their home, connectivity increased in importance. Pandemic brought changes to personal and professional lives, industries worldwide evaluated and implemented processes enabling business continuity, despite workplace closures. With safety paramount, processes were developed ensuring employee safety.

Difficult to predict length of Covid impact. Organisations and employees adapted to new ways of working, with reliable connectivity services being vital for business continuity. Working from home had generally been restricted to certain employees whose roles allowed remote working. The unprecedented pandemic environment led to it becoming normal for most industries. New work approach wasn't as simple as telling staff to work from home, numerous barriers were considered – such as sourcing new IT tools, software and systems for virtualised collaboration and implementing upgrades to employee's home broadband. Both internal and external IT infrastructure were put under intense pressure to cope with rapid changes.

"The drive for greater distributed data coverage can only be delivered rapidly by wireless solutions. This was initially addressed using sub 6GHz unlicensed radios, but saturation is the Achilles heel of license-free bands"

Lockdown initiated a response lag from connectivity providers as they looked for alternative methods to increase bandwidth. 3G and 4G services normally satisfy homeworking requirements for few who worked remotely, with associated sudden upsurge of demand, saturation rapidly occurred. Most Africans now working from home initially relied on existing infrastructure of highly congested 3G and 4G mobile connectivity or localised shared community Wi-Fi services, often unpredictable with limited bandwidth.

Africa has a digital divide and home fibre connections aren't widespread. Connectivity is generally perceived as unreliable, fibres are often damaged, repairs are slow. For locations outside urban areas, cost of high-speed broadband can outweigh willingness to pay. The drive for greater distributed data coverage can only be delivered rapidly by wireless solutions. This was initially addressed using sub 6GHz unlicensed radios, but saturation is the Achilles heel of license-free bands.

Pre-Covid-19, broadband provisioned residential areas capacity for night-time peak loads and weekends, central business districts and industrial areas peak capacity is during business hours. During Covid-19 situation reversed. Data networks adapted and changed topology overnight. Licensed fixed radio networks generally came out top of fast-paced adaptation period, whereas fibre service provision either halted or lagged behind and connectivity using unlicensed radios crumbled under increased demand.

Within licensed radio arena, moving networks from protected 1+1 to 2+0 and thereby shifting the network design strategy from a protective to a higher capacity bias, gave an initial boost. Long term, more infrastructure is needed. Backbone networks have been expanded with radio delivery requirements moving further away from core.

Access and last mile solutions could be relocated away from core or new hardware purchased to facilitate expansion. The former was initially tried during the middle of 2020. Recently, providers have started to rebuild networks to deliver the updated strategy.

This has taken two directions. Firstly, unlicensed (UL) radios have regained favour and big players are looking to address this new market with this technology. Although UL radios have improved significantly over recent years, overutilisation of spectrum and interference will likely bring about quality experience issues for end users. Service level agreement (SLA) demands by end users is expected to significantly decrease deployment of UL radios in more populated areas. Licensed radios therefore provide a second, more reliable direction for operators to take, having been the market solution for years for locations where fibre wasn't a quick or practical choice. Today, the use of the current licensed point-to-multi-point radio successfully provides connectivity to the enterprise market.

In summary, network providers that came out on top during pandemic were those that chose topologies that could provide reliable coverage, over a wide area, that could be rapidly enhanced on a demand basis, without having to rebuild entirely from scratch. This scenario suited those who had previously chosen licensed point-to-multi-point networks.

Pandemic initiated African technology and service providers to adapt and change at unprecedented pace. Those embracing this have been positioned to help Africa better prepare for a post Covid-19 landscape and as discussed, existing point to multi-point licensed networks have had, and continue to have, a major role to play. We foresee significant market shift within coming years to where rollout of FWA 5G networks will likely grow and become dominant solution in enterprise and residential broadband market. Reliable, high data bandwidth 5G FWA delivery solutions in Africa will be realised during coming years becoming default solution over fibre. Is the market ready for such a product? Realistically, market has been ready since Covid-19 started. Bigger question is, are all African continent's regulatory and licensing bodies ready to embrace shift? This question overall remains unanswered. ■

Looking ahead:

1. Mobile network operators (MNOs) haven't had a good decade and continue to suffer low returns on investment. They've been selling assets such as masts trying to reduce debt burden and this will continue in 2022 with sales of subsidiaries and more outsourcing to cloud providers.
2. The shine will start to wear off mobile 5G as coverage in most countries remains relatively limited and new compelling applications prove elusive. It will remain a valuable tool for capacity enhancement but the push to convince consumers it is a big leap forwards will fade.
3. There will be an increased push for home broadband for all, with even more urgency than previous years due to increased home working. This will see more Government grants and more innovation in fixed wireless and satellite broadband.
4. Regulators will turn their attention to the mmWave spectrum band (24-30GHz) now that low/mid band 5G auctions have completed. Some will adopt innovative new sharing approaches.
5. Entire 6GHz band will be increasingly opened for Wi-Fi usage worldwide as the case for 5G in this band is increasingly dismissed. Wi-Fi routers will improve significantly as Wi-Fi6 becomes widely deployed.
6. 2022 will see peak of low earth orbit (LEO) satellite deployments and competition with SpaceX, OneWeb, Telesat, Amazon and others. By year end more clarity will emerge on which companies will survive and if there's a viable business model.

Craige Fleischer,
vice president EMEA, Trustonic

In recent years, we've seen huge investments into Africa's infrastructure development. Mainly from global and domestic operators who have built out 3G and 4G networks, continent wide, to boost connectivity. A good example is subsea cable infrastructure, with several large-scale projects in progress for years, such as Facebook's 2Africa system finally coming to fruition. These efforts have seen Africa's mobile network coverage leap in recent years. However, we are still by no means a fully digital, fully connected continent while millions still don't benefit from mobile internet connectivity. In fact, the digital divide is growing.

There has been a visible shift, in last 12 months, in the way many in the industry are approaching the African market. We've seen further announcements from both traditional mobile operators and big global tech brands like Facebook and Google committing to improve connectivity. Undeniably Covid-19's impact did much to highlight urgent need to take this problem more seriously. We are now seeing companies such as Google and Facebook really start to deliver on promises made over the years.

"Undeniably, the pandemic had the effect of highlighting the urgent need for connectivity improvement not just in Africa, but worldwide. This is one reason why there has been a renewed push from mobile operators and global technology companies to connect Africa"

Google recently announced it would invest $5 billion over next 5 years to improve connectivity and access to digital services including healthcare, education and supporting growing businesses. Similarly, Facebook and Liquid Technologies are rolling out their own fibre network from the DRC to Rwanda. The network will improve connectivity for 30 million people. Traditional mobile operators are doing their bit and recently Vodafone announced launch of its space-based commercial mobile communications service.

What these recent announcements have in common is they mark a change in how global and domestic players are approaching the African market. There has been a realisation that to connect this unique continent's vast population requires bespoke solutions and a tailored approach. This shift is highlighted in Vodafone's recent initiative with the UN's Broadband Commission for Sustainable Development. Initiative looks to connect the 3.4 billion people who currently don't have mobile internet access. When the initiative was launched, in addition to a renewed effort to build out network infrastructure, those involved also highlighted the urgent need to address the lack of digital skills. Importantly, the initiative addresses the need to improve device affordability allowing the unconnected access to networks.

Historically, the African market was approached with a certain degree of naivety. The push for 'affordable' smartphones for example missed the mark in the sense that in Africa, huge swathes of population are priced out, even for devices as low as $50. And those that could afford them were often met with

sub-par features that had the opposite effect. However, the change in attitude over the last 12 months cannot be ignored and marks an exciting time for Africa.

Several reasons have led to this shift in approach. The pandemic played its part and digital transformation has rapidly accelerated as a result. Undeniably, the pandemic had the effect of highlighting the urgent need for connectivity improvement not just in Africa, but worldwide. This is one reason why there has been a renewed push from mobile operators and global technology companies to connect Africa.

At first, Covid-19 was slow to impact Africa, but as new variants began to take their toll, within Africa there has been a local telecoms realisation of the need to be more self-sufficient. Tourism historically accounted for a huge proportion of the economy for many African countries. There now seems to be acceptance that African economies need to be sustained internally, and in my view, digitisation is key to this.

We cannot ignore the economic opportunity that Africa represents. With an enormous population, and it's projected working population increasing 50% by 2035, the opportunity for companies to access this, has been a driving force in renewed efforts to improve connectivity in Africa.

Trustonic's Telecoms Platform lowers the risk threshold of mobile operators and device retailers providing financing deals for mobile devices. We want to help Africa bridge the digital divide by enabling proliferation of internet-enabled smartphones to those previously unable to afford even entry-level devices.

Trustonic operations have always had the same challenge; convincing customers our technology can secure them against risk in what is considered an insecure environment. It has taken time to educate potential partners, but now we are seeing many operators and retailers approaching us for solutions, as they see where the market is moving. Over the last 12 months we have seen a huge increase in interest in technologies and solutions that enable us to put smartphones into the hands of those previously unable to afford them.

Trustonic is a change enabler for Africa. It's exciting to work on technologies to bridge the digital divide, at a time when so many are trying to do the same. We cannot achieve this without help from others in the industry. This year, we have signed deals with large operators and small retailers continent wide. Every deal we make, regardless of size, is equally important, as what matters is that these organisations are doing their bit to drive affordability for the underserved population of Africa. ■

Looking ahead: Africa has always been a place that has embraced entrepreneurship. There are examples of this all over and the enabling power of internet connectivity will allow this to flourish. Network expansion and efforts to increase affordability of devices makes the prospects of Africa's contribution to the world economy an exciting one. It's forecast that over the next two years we will see 4G coverage expand from around 50% to closer to 70%.

The power of digitisation will unleash the entrepreneurial spirit of Africa. It may be a bold statement, but as affordability mechanisms help proliferate internet-enabled devices, African economic growth will outperform what many economists currently indicate. Internet communications will have a direct impact on how Africa drives its own economy moving forwards. But to achieve this, we must be careful to ensure that we don't simply make pockets of excellence in small areas of the continent. It is essential that access to this technology is universal.

Clémentine Fournier,
regional VP Africa, BICS

It is a simple truth, that many people outside of Africa fail to grasp, that the continent is vast and diverse, and that these characteristics must be considered when doing business here. The geographies, cultures, politics, challenges, and opportunities can vary from region to region in Africa and consequently can be reflected in its communications and connectivity ecosystems.

For example, looking at access to connectivity. Internet-enabled devices are becoming more affordable and 3G and 4G coverage is continually expanding. However, some areas are still experiencing connectivity barriers. Sub-Saharan Africa has the highest data costs of all, rated at 10.2% of Gross Domestic Product per capita, according to the GSMA. This helps in the understanding of how this area is predicted to have the world's lowest adoption of 5G over the next five years.

This contrast in connectivity is the digital divide. However, operators are also seeing the opportunity this presents.

The digital divide has become even more apparent over the past 18 months. Stable internet connections have been key to being able to continue our daily lives. Those who can connect digitally have been able to soften the disruption. Those who can't, however, find themselves at a further disadvantage. Schools are a great example. Online learning became a critical tool the world over to continue education during the pandemic. However, according to one estimate, only 1 in 5 children in Africa have a reliable basic internet connection. This gap must be bridged, and continued investment in digital infrastructure by both governments and the telco community will help to do this.

"Combating fraud is an everincreasing priority, however, the growth in A2P SMS over the past year has also increased the opportunity for fraudsters"

Looking back over the last 12 months, we have worked with our partners and forged new alliances with telcos to further accelerate communications across the region. This gives me optimism and fills me with pride to play a central role in this important ecosystem. Even during the worst of the pandemic, we saw resilience from service providers, advancing with exciting developments across the continent.

For instance, many of our partners began to offer application-to-person (A2P) messaging. Around the world, we all turned to our devices to engage with businesses, banks, healthcare providers and so on. A2P allows for two-factor authentication, so consumers can access services securely. A one-time password sent by SMS can allow someone to safely access their bank, for instance. Or a healthcare provider can send appointment reminders to patients.

We are also seeing A2P adopted across Africa for its marketing advantages. With the agreement from their customers, businesses have been able to remain engaged with consumers through SMS updates, promotions and personalized

offers. The global messaging market is expected to grow from $62.1 billion in 2020 to $72.8 billion by 2025, and the African region is predicted to gain steady growth. So, this offering provides excellent opportunities for operators and enterprises alike.

Combating fraud is an ever-increasing priority, however, the growth in A2P SMS over the past year has also increased the opportunity for fraudsters. South Africa saw an increase in Covid-19 related scams, with about 1 in 4 South Africans being targeted. These included text messages telling subscribers they had been in contact with someone who had tested positive for Covid-19. The sender then requested payment for a healthcare worker to visit them in their homes, which was a scam.

It is not surprising, then, that we have seen telcos become more interested in anti-fraud tools in general. There has been growing adoption of SMS firewalls, for instance, these stop spoofed and faked messages, which means the network bandwidth is freed for revenue-generating traffic. Its security prevents content providers from bypassing SMS termination fees, so it makes it a far more secure messaging and roaming environment for operators overall.

Technology and tools are important in fighting fraud, but collaboration is equally as critical. It is important that telcos, regulators, and carriers like BICS work together to share resources and knowledge: there is strength in numbers! We have been supporting operators in Africa to mitigate fraud for years now, and use a crowdsourcing approach with our FraudGuard solution, which is used by most of the telcos operating in Africa today.

We have also seen greater demand for business intelligence tools over the past year. Having complete visibility of a network is becoming more and more important to operators. As well as monitoring for quality, these tools are helping operators understand how subscribers and IoTconnected 'things' are using their network. This insight allows them to allocate the right level of resources and provide a better end-user experience, even offering personalised plans and incentives. ■

Looking ahead: What does 2022 hold for the African market? First, a steady preparation for 5G, with operators sunsetting older technologies to start with. 2020 was a turning point, marking the first time that there were more 3G and 4G connections than 2G, and this trend will continue.

BICS expect the communications ecosystem will evolve to include more players from the global telco community who are waking up to the opportunities of this vast continent. Google recently announced a US$1 billion investment over the next five years, while Facebook has revealed plans to extend its 2Africa subsea cable to serve the African and Middle East region. We expect investments like these, from digital service providers, to continue into next year and beyond.

Africa will remain a strategically important focus for BICS. We will continue to work with telcos and the digital ecosystem throughout the continent and invest in the region's infrastructure. We are in prime position to bridge the gap between traditional telecoms and digital players, and we are sure the evolving landscape will be opportunity to do this. It's a diverse continent, and it's growing closer together through ever-more robust, resilient connectivity.

Susanne Neubert,
African sales director for enterprise & emerging markets, Speedcast

Providing connectivity in Africa has never been an easy task, but strides have been made at some locations over the last years with 5G rollouts, fiber laying and fixed wireless access. But remote areas where these solutions are not viable, satellite is an alternative. The technology remains an important tool in efforts to tackle the digital divide and providing connectivity to those without internet access.

Impact of global Covid-19 pandemic shows importance of communications and keeping in touch and how Internet access isn't a nice-to-have but a necessity, especially in hard-to-reach areas. Satellite providers can ensure remote, rural areas across Africa have the same access to connectivity as those in more accessible, built-up locations, where connectivity is easily deployed via fiber.

People now want connectivity for their homes, but it's essential for businesses. Across the energy, maritime, mining and construction industries and aid organizations, where multiple barriers exist for networks, satellite is key for enabling critical communications to function. Remote site or offshore workers need to be able to connect with other employees and if needed emergency services.

Connectivity has an essential role in industries' operations, whether that be for entertainment, staying in touch with loved ones, or improving and saving lives.

The energy sector has been a changing environment throughout 2021. Earlier in the year, the oil shock and global pandemic created instability in energy markets, but as the year closes, the oil price has returned to a pre-pandemic high. Development of alternative energy sources continues at pace, while global demand for energy continues to increase, we have to be aware that sources of that energy might change. If the locations of energy production continue to be in remote locations, satellite connectivity will remain crucial to their operations.

Connectivity is a large part of creating a productive, fast-flowing environment but reliable connections are often a challenge for operators, which are often beyond the reach of terrestrial networks. For applications that require a real-time connection to function, this poses a problem. Next-generation technologies continue to augment the growing toolkit of options to deliver optimal, ubiquitous connectivity to hard-to-reach locations. Medium and Low Earth Orbit (MEO and LEO) satellites coming to market will help meet demand for rural connectivity, providing stable internet connection to sites that cannot typically connect to terrestrial networks, such as oil rigs.

As the sources of energy continue to change and needs of industry develop, we will adapt for our customers' operations. The energy industry will continue to be a large focus for us, especially as we are ending the year with a renewed focus on sustainability because of the COP UN Climate Change Conference.

Global mining industry also experienced high disruption resulting from Covid-19, as seen at sites in South Africa, Ghana, Namibia and Nigeria along

"The energy industry will continue to be a large focus for us, especially as we are ending the year with a renewed focus on sustainability because of the coming UN Climate Change Conference"

with many other countries. The sector is constantly under relentless pressure to maximize productivity and profit, while reducing costs and maintaining safety. According to McKinsey & Company, production has fallen by around 42% worldwide.

Connectivity is key to relieving pressures of productivity, safety and expenses on mine operators. By harnessing the 'Connected Mine' these remote sites can take advantage of several different connectivity solutions such as radio local area networks (LANs), one-site wide-area networks (WANs) and VSAT connectivity, which facilitates new applications like IoT. Remote staff and crew's quality of life is improved with access to the outside world for entertainment and catch-up time with family and friends, but the Connected Mine also provides essential online support and provides insight for managers from data gathered from every application.

A major African gold producer is experiencing these advantages first-hand after Speedcast delivered a secure satellite communications network for sites in Africa and Australia. The network was seamlessly integrated into the company's existing communications infrastructure to leverage its existing investment and provide higher quality voice and data service. As a result, the producer noticed a boost in crew morale, more reliable communications across sites and a better return on investment due to the uplift in productivity and profit.

Resolute Mining, in Malia, West Africa, used automated vehicles and drills to extract 300,000 ounces of gold yearly. Its operational efficiency has been boosted by 30%, while the robotic technology allowed Resolute to train local Malians to do the work. Therefore, providing jobs for local people, rather than relying on expensive, experienced miners.

During the pandemic the maritime sector saw many crews stuck at sea for longer than the maximum time allowed under international treaty. Isolation for long periods of time can take dramatic tolls on crews' wellbeing and health. Having a reliable connection, to allow staff to communicate with their friends and family is a necessity, not a luxury. During times of hardship, such Covid-19, people reach out to their loved ones more.

The flexibility of offshore entertainment solutions like Speedcast's LAUNCH platform is improving life on-board for both crew and headquarters. There are different components to the platform, with LAUNCH TV and LAUNCH News, for example, providing entertainment and up-to-date information, which combats boredom. The evolution of technologies in recent years to offer lower latency and streamlined bandwidth management enables ship operators to seamlessly provide these now essential applications. ■

Looking ahead: Over the last year, many of the markets Speedcast serves have been hit hard. But, if 2021 taught us anything, it's that demand for connectivity is growing faster than ever. However, we know that one solution doesn't fit all, thus Speedcast's satellite connectivity solutions are important for connecting those in hard-to-reach locations. For its customers, flexibility and automation are key for ensuring seamless and easy-to-manage connectivity – no matter the location or distance from land. At this time software and automation services are especially important. As networks and satellite connections grow, network management becomes crucial to ensure seamless, reliable business operations for on-shore and off-shore customers. We want our customers to have uninterrupted connectivity and access to network management solutions they can rely on to ensure constant connectivity.

Angola Cables

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Angola Cables is a multinational operating in the global ICT sector. With a robust transport infrastructure and highly interconnected IP network we offer differentiated solutions to the wholesale and corporate segments. We offer customers access to the largest IXP's, Tier 1 operators and international content providers.

Through SACS, Monet and WACS submarine cable systems the company directly connects the Americas, Africa, and Europe with established partnerships to reach Asia. We manage the Tier III Data Centre AngoNAP Fortaleza (Brazil) and the Data Centre AngoNAP Luanda (Angola), PIX - and Angonix, one of the largest Internet Exchange Points (IXPs) in Africa.
Angola Cables provides digital services and network solutions to multiple industries with customized cloud and gaming resources available to our global customers.

ASN 37468

For more information, visit our website: www.angolacables.co.ao

BICS

Get In Touch - BICS

Roaming

Global IoT

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Fraud & Security

As a leading international communications enabler, BICS is at the heart of the communications ecosystem. We enable people, applications and things to connect, wherever they are. We are a global provider of international voice, messaging, mobile data, cloud communications and IoT services. Our solutions, delivered seamlessly and securely, are essential for supporting today's data-hungry consumers and digitally driven enterprises. Headquartered in Brussels, with a strong presence in Africa, Americas, Asia, Europe and Middle East, BICS powers the global communications that connect the world.

Sparkle
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IP&Data

Mobile

Voice

Enterprise

Sparkle is a leading global service provider offering a full range of ICT solutions, global connectivity, services and capabilities designed to meet the fast-changing needs of Enterprises, Internet Service Providers, OTTs, Media and Content Players, Application Service Providers as well as of Fixed and Mobile operators.

Thanks to a state-of-the-art global backbone of over 600,000 kms of fibre and through an extensive worldwide commercial presence distributed over 32 countries, Sparkle ranks #5 for IP globally and is among the top players for international voice traffic. Through a rich portfolio of services, a cutting edge network based on the latest technologies, a globally distributed sales force and advanced customer care capabilities, Sparkle is able to fulfil its mission of providing customers with top-performing and tailored solutions worldwide.

Enriched by its cultural variety and diversity, Sparkle is always committed to excellent relationships with all its stakeholders and operates with constant attention to maintain a safe environment where Partners, Customers, Suppliers and Employees can live and work better.

Sparkle. The world's communication platform.

Find out more about Sparkle at **tisparkle.com**

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Opening up a **new world** of digital connectivity

The South Atlantic Cable System (SACS) is bridging the digital divide between Africa, the Americas and Europe.

The South Atlantic Cable System (SACS) is open for commercial traffic.

This high capacity and ultra-low latency cable system connects Fortaleza (Brazil) to Luanda (Angola) in just 63 milliseconds.

SACS is 100% owned and managed by Angola Cables. With 4 fiber pairs it offers a total design capacity of 40 Tbps

Offering the lowest latency between the Americas, Africa and Europe

New York to Cape Town (236 ms with SACS - 197 ms) · Miami to Cape Town (338 ms with SACS - 163 ms) · London to Luanda (128 ms)
Fortaleza to Luanda (350 ms with SACS - 63 ms) · São Paulo to Cape Town (377 ms with SACS - 163 ms) · Miami to Luanda (125 ms)

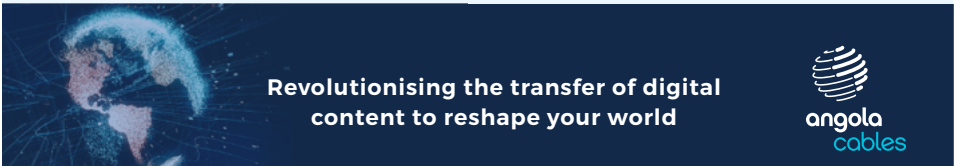
Angonap Fortaleza Tier 3 – Data centre Brazil

- Colocation
- IP Transit
- Angonix Peering
  Remote Peering
- Circuits (Transmission)
- Remote Hands
- Cross Connect

CONNECTING AFRICA TO THE WORLD

Angonap Luanda – Data centre Angola

- Colocation
- IP Transit
- Angonix Peering
  Remote Peering
- Circuits (Transmission)
- Remote Hands
- Cross Connect



Revolutionising the transfer of digital content to reshape your world

angola cables

chapter 7 Fibre

Paul Hamilton,
Hamilton Research

Africa's total inventory of operational fibre optic network reached the milestone of 1 million kilometres during 2018, increasing the number of people living within reach of a fibre optic node in sub-Saharan Africa to 620 million people. More broadband customers, with more bandwidth per customer, continues to drive Africa's international Internet bandwidth growth along an exponential curve, reaching 15.289 Tbps by December 2019.

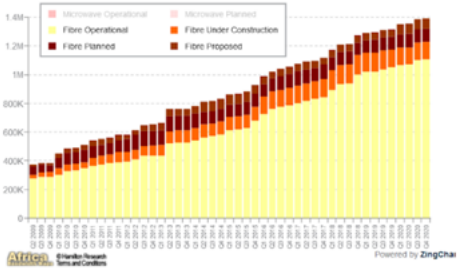
Terrestrial fibre networks reach 1.073 Million Route-Km.

According to the twelfth annual edition of the Africa Telecom Transmission Map published by Hamilton Research for 2020/21, the inventory of operational fibre optic network reached 1,072,649-km by June 2020, compared to 1,025,441-km in 2019, 936,102-km in 2018, 820,397-km in 2017, 762,167-km in 2016, and 622,930-km in 2015. In June 2010, the total fibre inventory was 331,066-km (see chart 1 below).

Since June 2019, an additional 47,208-km of fibre optic network has entered service, an average of 129-km of new fibre optic network entering service per day. In addition, there was in June 2020 a further 119,496-km of fibre optic network under construction, 95,057-km planned, and 69,702-km proposed.

The twelfth edition of the Africa Transmission Map shows the networks which are operational, under construction, planned and proposed for a total of 323 network operators and 72 submarine cable systems. Africa's total inventory of terrestrial transmission networks increased to 1,537,257-km by June 2020, compared to 1,474,983-km by June 2019,

Chart 1: Route-Kms of Terrestrial Transmission Network, Africa 2009 - 2020
Subscribers can access the route kilometre datasets by logging in.



1,389,475-km by June 2018, 1,254,413-km in 2017, 1,179,010-km in 2016, and 1,019,649-km in 2015. In June 2010, the total inventory of terrestrial transmission networks was 585,469-km.

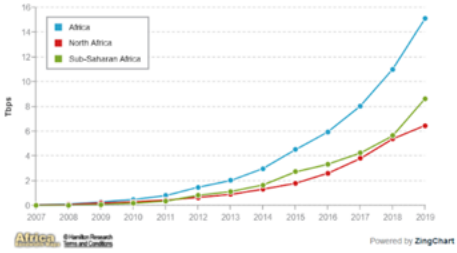
Fibre Networks Reach Increases To 55.9% Of sub-Saharan Africa

The expansion of terrestrial transmission networks continues to bring additional countries, regions, cities and towns within reach of fibre networks for the first time. In June 2020, 620 million people lived within a 25-km range of an operational fibre optic network node, compared to 584 million in June 2019 and 259 million in June 2010.

In June 2020, 55.9% of the population in sub-Saharan Africa (620 million) lived within a 25-km range of an operational fibre optic network node. This compared to 55.2% (584 million) in 2019, 54.2% (556 million) in 2018, 52.1% (522 million) in 2017, 48.1% (469 million) in 2016, 45.8%, (436 million) in 2015, 44% (410 million) in 2014, 41.8%, (371 million) in 2013, (345 million) in 2012, 36.3% (313 million) in 2011, and 30.8% (259 million) in 2010. Once the fibre network which is currently under construction enters service, the fibre reach of sub-Saharan Africa will increase to 59.6% (631 million), and once the network which is planned or proposed enters service it will increase to 64.1% (679 million).

Since 2010, network expansion has brought more than 361 million more people within access to high capacity national and international backbone networks. In the last year an additional 36 million people were brought within 25-km range of an operational fibre node.

Chart 2: Africa International Internet Bandwidth, 2008 - 2019
Click legend items to show or hide data for each region. Subscribers can access the international bandwidth datasets by logging in.



Africa's International Bandwidth Reaches 15.289 Tbps

Africa's total inbound international Internet bandwidth reached 15.289 Tbps by December 2019. This compared to 10.996 Tbps in 2018, 8.043 Tbps in 2017, 5.959 Tbps in 2016, and 4.524 Tbps in 2015 (see also Africa: Africa's International Bandwidth Reaches 7.939 Tbps in 2017). In December 2009, Africa's total bandwidth was just 295 Gbps.

The chart below shows that the total international bandwidth of 15.289 Tbps was split between sub-Saharan Africa, which increased by 57% to reach 8.814 Tbps, and North Africa which increased by 20% to reach 6.475 Tbps. Excluding Kenya, which reached 2.720 Tbps in 2019 (source: CA), the total bandwidth for other countries in sub-Saharan Africa increased by 37% to reach 6.094 Tbps in December 2019.

All of Africa's international bandwidth is supplied by submarine cables, terrestrial networks connected to submarine cables, or satellite. Of the total bandwidth of 8.814 Tbps in sub-Saharan Africa by December 2019, 8.126 Tbps (92.2%) was supplied directly by submarine cable, and 678 Gbps (7.7%) was supplied by terrestrial cross-border networks connected to submarine cables. In December 2009, the amount of international bandwidth supplied by submarine cable was 276 Gbps. ■

Dr Henry Lancaster,
senior analyst, BuddeComm

Across most countries in Africa the former bottlenecks which had contributed to the low take-up of broadband services are being addressed systematically. The region continues to attract considerable investment in laying additional terrestrial and subsea cable networks, and in providing upgrades to existing systems to increase their capacity.

The key players in these cable systems include existing companies such as Liquid Intelligent Technologies, which have operated in the region for many years, and also the social media giants such as Google and Facebook, which are deploying their own cables in collaboration with local partners. In addition, there are a number of regional schemes, such as the Djoliba fibre network providing connectivity to several countries across West Africa.

At the same time, owners of ICT infrastructure are upgrading their existing networks. Seacom recently announced that it was upgrading its regional network to 100Gb/s.

Many countries in the region have recognised that economic growth is largely dependent on the more intensive use of ICT, thus fostering the development of knowledge-based economic activity. Some countries are working on developing additional terrestrial infrastructure linked to submarine cables in a bid to become regional ICT hubs.

In the wake of the pandemic, it has also been evident that further investment in network infrastructure is required to manage the growth in data traffic. Thus far, most investment has been in mobile networks (principally LTE, and more recently in developing the groundwork for 5G), though there have also been considerable developments with fixed broadband infrastructure, tied to the growing capacity of internet bandwidth.

Nevertheless, it remains true that, depending on the market, between 90% and 98% of all internet connections are via mobile networks. As a result, governments and regulators alike have concentrated on this platform to deliver on their broadband targets in coming years.

African broadband market overview

The new and upgraded subsea cables which have been built in recent years, as well as a number of new ones due to be lit in 2022, are supporting the numerous national broadband plans in place across the region. Increased bandwidth is paramount for countries in Africa to make effective use of IP-delivered services. These services encompass e-government, tele-education, tele-health, and a broad spectrum of e-commerce platforms which are helping economies to be transformed for the digital age.

Thus far, the limited reach of existing fixed-line infrastructure has inhibited the take-up of fixed broadband services, and as a result in many countries fixed broadband penetration is below 1%. As a consequence of this, the vast majority of data traffic is channelled via mobile networks. In some cases, the investment required to develop fixed telecoms is prohibitive in relation to the potential revenue gained, and thus in practice investment is almost exclusively in the mobile sector.

However, progress is being made to increase backhaul capacity on both the international and national levels. This backhaul is being used to improve fixed-line telecoms, as well as to support growing mobile data traffic. During the last two years several new submarine cables have been completed to provide direct links to southern Europe and Brazil, while terrestrial cables have also been extended to link to telecom infrastructure in the interior landlocked countries.

One of the world's largest submarine cable

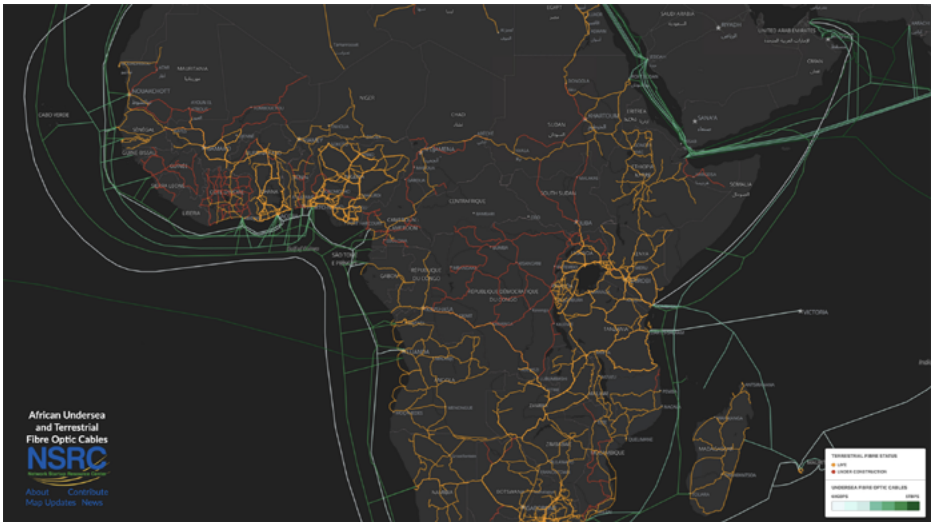
projects, known as Africa2, will serve the MENA region, with connections to Europe. The cable is being developed by a consortium of companies including China Mobile International, Facebook, MTN, GlobalConnect, Orange, STC, Telecom Egypt, Vodafone, and West Indian Ocean Cable Company. With a capacity of 180Tbps, it will have 21 landing stations in 16 countries and is expected to be completed in late 2023.

In September 2021 it was announced that the cable will be extended to the Arabian Gulf, India, and Pakistan, bringing its total length to over 45,000km. This additional section is known as 2Africa PEARLS. Landing stations are planned for Oman, UAE, Qatar, Bahrain, Kuwait, Iraq, Pakistan, India, and Saudi Arabia. A separate cable branch will join extensions to the Canary Islands, the Seychelles, Comoros Islands, Angola, and Nigeria.

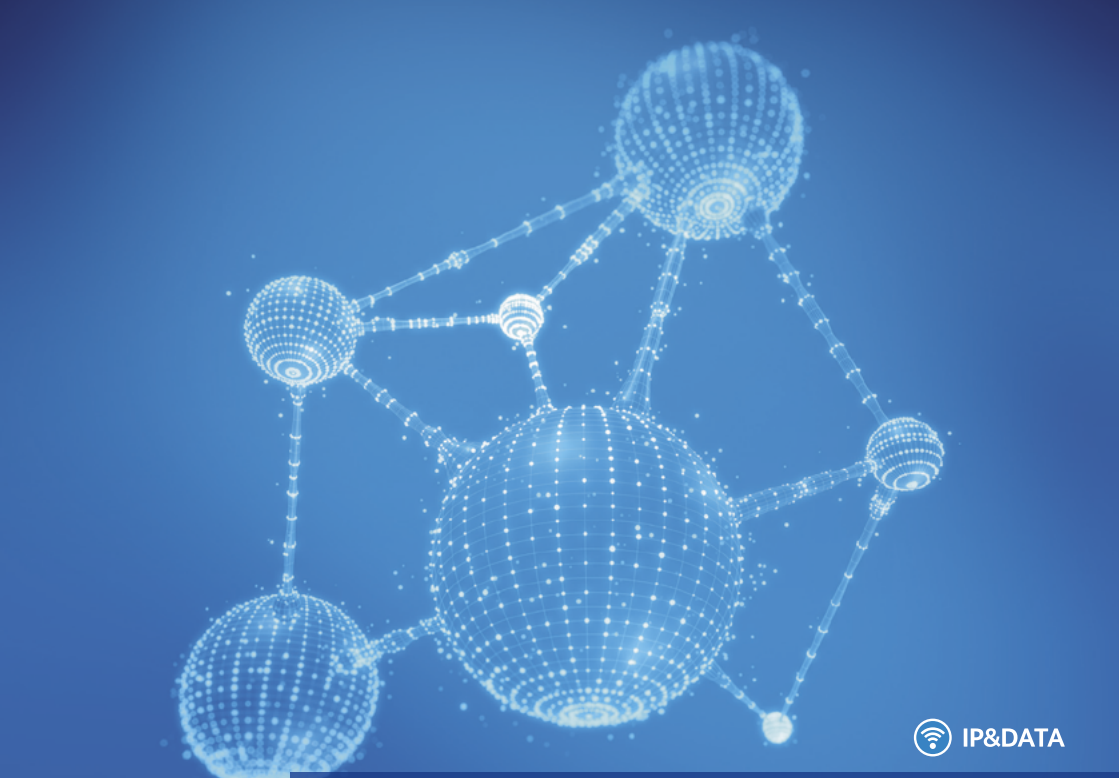
In addition to this fixed-line infrastructure there are ambitious plans to develop satellite broadband to cover remote regions. Beyond leasing capacity with existing satellite operators, some countries also have invested in developing their own fleets. The Ethiopian Institute of Space Technology and Science (ESSTI) launched its first satellite in December 2019 (from China), and its second in December 2020. In Angola, the AngoSat-2 satellite (built as a replacement for the failed AngoSat-1 craft) is expected to be launched in mid-2022.

Considerable efforts are still to be made in domestic telecom infrastructure, where bottlenecks restrict capacity provided by international cables from being distributed effectively, resulting in unnecessarily high local access prices. Bottlenecks have contributed to the take-up of mobile broadband for voice and data services, but mobile networks still need reliable fixed-line infrastructure for backhaul, and cross-border connections to link cities and provinces.

Regional schemes to address capacity restrictions are usually with a view to extending submarine cable access to landlocked countries. Schemes include the East African Backhaul System (EABS), serving Kenya, Tanzania, Uganda, Rwanda, and Burundi which provide landlocked countries with access to submarine cables. Another is the Central African Backbone (CAB), a program funded by the World Bank and the African Development Bank to build fibre-optic infrastructure serving 11 countries in the Central African region. ■



Credit: Network Startup Resource Centre



IP&DATA

You connect and together we evolve

Sparkle to Build Blue and Raman Submarine Cable Systems in Collaboration with Google

Sparkle is building, with Google and others, Blue and Raman Submarine Cable Systems connecting Italy to India and, along the path, France, Greece, Israel, Jordan, Saudi Arabia, Djibouti, Oman.
Each equipped with 16 fibre pairs and embracing the innovative concepts of open cable and open landing station, the two systems will provide diversification, scalability and latency for communications between Europe, Africa, the Middle East and South Asia.
Within the Blue System, BlueMed submarine cable is Sparkle's own private domain with four additional fibre pairs and private branches into France, Italy, Algeria, Tunisia, Libya, Turkey and Cyprus. Its flexible design will allow seamless express connections throughout the Mediterranean as well as sophisticated regional subsystems.
Discover Sparkle's IP&Data Platform, an interactive ecosystem based on a global communication network in constant evolution. Its governance ensures the creation of value for customers, suppliers and partners, every day, before they even know they need it. Because we're always looking ahead.

Sparkle. The world's communication platform.

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Leonardo Cerciello,
VP sales wholesale Asia & Africa, Sparkle

In Africa there is an increase in demand for telecommunications services. The need for internet connectivity and access to content is mainly driven by demographic increase and economic development. At the same time, the rollout of 4G and 5G technologies is enabling new applications which will have a strong social impact in bringing inclusion. Let's think of telemedicine, for example: with 5G, robotics, artificial intelligence and the IoT, it will be possible to bring healthcare to rural and remote places.

All this translates into opportunity and responsibility for a player such as Sparkle to guarantee connectivity and digital services.

Historically, Sparkle has been playing a major role in providing international connectivity services to North African countries, through its Sicily Hub in Palermo, a gateway for Internet traffic to and from Africa to Europe, the Middle East and Asia thanks to the interconnection of 18 submarine cables. However, Sparkle's challenge is to bring connectivity and capacity throughout the continent, opening new PoPs and investing in new pan-African cable systems, in order to satisfy growing demand, which is also shifting geographically: in the past, the main route of internet traffic was between West and East; today demand is growing exponentially from South, where the largest number of the next 'eyeballs', the new users, can be found.

"Our challenge is to bring connectivity and capacity throughout the continent, opening new PoPs and investing in new pan-African cable systems"

The pandemic has confronted us with the importance of ICT infrastructures - networks, clouds and applications - in everyday life: without the network, the lockdown would have been more difficult: we could not watch movies or TV series in streaming, video call relatives and friends and above all, in many cases, we could not work.

During the Covid-19 outbreak, we have experienced unprecedented, accelerated increases in demand on our networks - driven by requirements for critical services, remote working, and home entertainment services – and invested promptly on capacity upgrades to provide constant and stable connectivity.

However, we believe it's vital to assure ICT infrastructure and provision of ICT services are designated as an "essential service" in all jurisdictions to avoid any disruptions to global communications, ensure safety of operational staff in the field and continue customer service to end users.

To this purpose, we have joined the "Keeping the World Connected" advocacy campaign with other global service providers, to call on governments on this matter and call for a better collaboration among ICT infrastructure providers.

In recent years we have been expanding our presence in Africa opening new PoPs such as in Lagos and Casablanca and investing on large scale infrastructural projects to provide advanced connectivity between Africa, the Middle East, Asia and Europe.

Recently, we have announced our collaboration with Google and others to build Blue and Raman Submarine Cable Systems: Blue will cross the Mediterranean Sea connecting Italy with the Middle East, while Raman will connect Jordan, Saudi Arabia, Djibouti, Oman and India.

Each equipped with 16 fibre pairs and

embracing the innovative concepts of open cable, supporting multiple fibre tenants, and open landing station, enabling competitive access to the cable termination points, the two systems set a new reference in terms of diversification, scalability, and latency throughout these geographies.

Blue will be deployed along a new northbound route in the Mediterranean, crossing the Strait of Messina, rather than following traditional route through Sicily Channel. As a result, ISPs, carriers, telecom operators, content providers, enterprises and institutions will benefit from high-speed Internet and state-of-the-art capacity services with unparalleled diversity and performances.

Within the Blue System, BlueMed submarine cable is Sparkle's own private domain sharing its wet components with four additional fibre pairs and an initial design capacity of more than 25 Tbps per fibre pair and is extended up to Jordan with additional private branches in the Mediterranean, including into Algeria, Tunisia and Libya.

BlueMed flexible design gives seamless express connections throughout the Mediterranean Basin, unprecedented latency and spectral efficiency and sophisticated regional subsystems, based on specific customer requirements.

In addition, Sparkle's Genoa Open Landing Platform is set to become the alternative priority access for other upcoming submarine cables looking for a diversified entry to Europe, backhauled to Milan's rich digital marketplace, and thus a new reference gateway between Africa, the Middle East, Asia and Europe.

Blue and Raman are expected to be ready for service in 2024, with the Tyrrhenian part of BlueMed planned to be operational in 2022.

These investments will consolidate Sparkle's positioning in the Mediterranean adding new routes for Africa to Europe and to Asia connectivity. ■

Looking ahead: Sparkle sees increase of demand for internet traffic continuing throughout 2022 and beyond and will continue to expand its presence in the continent, opening new PoPs and investing on large-scale infrastructural projects, in partnership with local operators and with hyper-scalers/OTTs.

In terms of internet traffic Sparkle is the second largest network in Africa, thanks to its extensive network running around the continent and direct connection to Europe and to Asia, and thanks to its strategic hubs in Sicily and in Djibouti. However, we continuously expand our network to improve connectivity among African countries, and between Africa and the rest of the world.

In addition to the Blue and Raman Submarine Cable Systems, we are investing on new cables in the Mediterranean, to connect the North African countries to the main European hubs, as well as in new pan-African cables to add capacity and diversity.

In particular, we are investing on the expansion of our global Tier 1 IP backbone "Seabone" – one of the top 5 global IP networks – to increase IP connectivity throughout the continent and in particular to the South.

On top of infrastructure, we are evolving our service portfolio and capabilities to focus more on the provision of connectivity and digital services to multinational customers such as SD-WAN, security services, cloud and IoT solutions, especially in North African countries.

These are the initial steps of Sparkle's expansion plan to support the growing IP connectivity needs in the African continent in the coming years.

Crisostomo Mbundu,
senior product developer, Angola Cables

The population of Africa is currently estimated to be 1.36 billion and rising. Of this number, only about 22% are reported as having internet access. That equates to about 1 in 5 citizens on the continent. Although that statistic may be low in comparison to the other continents on the planet, the situation and numbers involved are changing at a rapid pace. This is why the demand for digital content in Africa is on the rise.

At present subsea cables facilitate the transmission of more than 440 terabytes of data – and this number is increasing tenfold · largely due to the high volume of analytic data and content that is now being stored in the cloud. It is estimated that by 2022, IP traffic will reach around 4.8 zettabytes of data. By 2025 the demand for data will skyrocket to 175 zettabytes of data per year. This is an enormous amount of data and the rising demand for data and bandwidth is set to continue.

"These vast amounts of content or data are being stored in the growing data centre ecosystems of Africa and internationally as well as being channelled through a plethora of Points of Presence (PoPs) that intersect and connect people, economies and cultures across the planet"

To carry these increasing amounts of data, additional bandwidth is required. Africa has surpassed other continents in international bandwidth growth for the past four years, largely as a result of new submarine cable builds. Although increasing international capacity is critical to Africa, it is also important to move data to and from Africa as fast as possible via low-latency network designs. This is why leading African service providers, such as Angola Cables, offer a broad low-latency service portfolio.

Driving the insatiable appetite for digital content and the demand for data is the growing requirement by governments, businesses, academic institutions and individual users for this digital content. From documents to streaming to complex Artificial Intelligence (AI) processes and algorithms driving the modern digital economy, data can be viewed as a new currency. These vast amounts of content or data are being stored in the growing data centre ecosystems of Africa and internationally as well as being channelled through a plethora of Points of Presence (PoPs) that intersect and connect people, economies and cultures across the planet.

For an acceptable Quality of Experience (QoE) for end-users, both humans and machines, network performance must reliably deliver scalable capacity at the level of low latency required by the specific use-cases. In short, latency is as important as capacity.

Who cares about this latency and why? Low-latency submarine network connectivity is important, to varying degrees, to Internet Content Providers (ICPs), gaming companies, financial enterprises, cloud service providers, and most end-users. Low latency can be the

difference between a profit or a loss when it comes to the High-Frequency Trading (HFT) world to (virtually) living/dying in a multiplayer online game.

ICPs, who are using most new network bandwidth and building many new submarine cables, covet low-latency end-to-end (E2E) performance to interconnect their data centres and better achieve search index synchronization, distribution of video content nearer to viewers – from Zoom conferencing to AI and machine learning that optimizes cloud services. New submarine cable routes not only provide much needed increased resiliency with improved route diversity, but often shorter paths between endpoints, which in the case of ICPs, is between their ecosystem of interconnected data centre assets.

Not all network operators provide the same latency, since not only are routes and distances different for each submarine cable, but terrestrial backhaul networks at each end of a submarine cable and intra data centre networks are also different. As a result, the pricing for premium routings can also differ.

End-to-end networks can be greatly enhanced through applications such as GeoMesh Extreme. Such programmes significantly simplify E2E network designs, overland and undersea, to provide a broad set of enabled benefits such as: reduced complexity, power, space and an overall reduction in latency.

Angola Cables is an African multinational telecommunications wholesaler network operator offering a broad range of services including leased circuits, IP Transit, Internet Exchange Point (IXP), data centre, and Information and Communication Technologies (ICT) products. The company also offers a broad range of international low-latency connectivity services via our South Atlantic Cable System (SACS), West Africa Cable System (WACS), and Monet submarine cable networks. Angola Cables provides, faster connectivity to and from Africa.

In terms of transoceanic network services, the submarine cable contributes most of the end-to-end latency due to its routed distance over several thousands of kilometers. As light in an optical fiber contributes roughly 5 milliseconds per 1,000 kilometers, latency on a submarine cable adds up quickly. This makes the selected route for a new submarine cable critical when designing low-latency networks, since once the cable is laid upon the seabed, its latency is essentially fixed over its lifespan, typically 25 years or more. Angola Cables has taken this into account when offering a broad range of low-latency services between popular endpoints, connecting Africa to Europe, South America, North America, and to other points in Africa.

Angola Cables understands the importance of a broad and vibrant ecosystem of submarine networks, terrestrial networks, and data centre assets. Subsequently, the company has created an impressive ecosystem of assets and international partnerships, to better serve their customers in Africa, Latin America, and other parts of the world.

Given the dramatic rise in data consumption and the anticipated increase in data usage over the next decade, Angola Cables has a secure and optimised network capable of accommodating this growth. As internet connectivity in Africa grows, so will the population's access to digital content and services grow, opening the door for more businesses and entities in Africa to grow and expand their businesses beyond the continent into other growing markets across the globe. ■

David Eurin,
chief strategy officer, Liquid Intelligent Technologies

It has been another busy year for the team at Liquid during which we completed our extensive business transformation from a telecommunications and digital services provider to a full one-stop-shop technology group.

Over the last two decades, Liquid has firmly established itself as a leading pan-African digital infrastructure provider, providing an extensive fibre network on the continent that spans in excess of 100,000km and is complemented by an extensive satellite network. Our rebrand to Liquid Intelligent Technologies reflects more accurately the expansion of our Cloud business, Cyber Security services, Internet of Things, and other technologies that Liquid has added to our existing telecoms and connectivity capability.

Despite these huge changes, at the very core of our business is our long-held belief that every individual on the continent has the right to be connected. We believe that the power of technology will create better and brighter lives for everyone.

"Our rebrand to Liquid Intelligent Technologies reflects more accurately the expansion of our Cloud business, Cyber Security services, Internet of Things, and other technologies that Liquid has added to our existing telecoms and connectivity capability"

As the adoption of cloud technologies progresses rapidly in Africa, such as MS365, Azure, and other cloud-based services, we have invested in building new data centres and fibre links to help OTT operators deploy services and bring more people online. We have succeeded in becoming the largest international DC operator in Africa with facilities in six countries.

To support the growth of international traffic, over 40% this year, we have invested in Equiano with Google, which will land in South Africa, Nigeria and Portugal by the middle of 2022. This is a piece of critical infrastructure for Africa, which should enable a richer digital life and support the development of increased global trade across the world and within Africa.

Across Africa, we have partnered with OTTs including Facebook, to build more fibre routes, such as in the Democratic Republic of Congo where we are busy linking for the first time Kinshasa to Goma. This will bring more affordable and reliable Internet to businesses and to millions of people in one of the largest, but least connected, places in Africa.

The Covid-19 pandemic affected all of us in both our personal and business life and its impact continues to resonate in Africa as it does throughout the world.

We realised the importance of connectivity as we saw it underpin and maintain business activity, enabling Liquid to keep in touch with customers.

For the team at Liquid our biggest challenge has been to keep up the pace of development of our data centre and pace of fibre deployment. In many countries, telecom services were deemed essential services and as such we were able to continue our work. This was not easy, as the health and safety of our employees, customers and contractors are paramount to us. We put in place many new processes and safeguards to ensure our work and services could be continued

in the best possible way, without compromising on safety or quality.

Liquid's stand-out moment in the last 12 months was when Liquid's fibre network reached 100,000km, making us the largest independent network provider not only in Africa but other emerging markets.

This landmark follows more than 13 years of blood, sweat and tears. We now connect more than 100 million people across 643 towns and cities in 14 countries creating new opportunities across the continent and ultimately accelerating the ongoing digital transformation in Africa.

Other highlights include the lighting of multiple East-West fibre routes, in central Africa starting in the DRC and along the coast of South Africa. This is now a reality for Liquid Telecom, while many others are still dreaming of this technological feat.

We also launched our Cyber Security business unit. With the future of network security driven from the cloud, we are focused on protecting our customers' data throughout its lifecycle.

As a Microsoft Gold Partner, we are redefining Network, Cloud and Cyber Security offerings through strategic partnerships with leading global players, bringing innovative business applications, intelligent cloud services and world-class security to consumers on the African continent. ■

Looking ahead: 2021 and the start of 2022 will see more dramatic changes in the way we use telecommunication services and how we operate networks, data centres and cloud services. We expect to become more productive and efficient and that our network will continue to expand into new countries to bring affordable and reliable access to the Internet.

Cloud service adoption and the transformation of businesses through the use of digital services (customer relationship, e-commerce, automated operations, cloud-based accounting and billing, etc.) will shoot up in many parts of Africa. However, this will inevitably be followed by more cybersecurity attacks, scams and other dangerous behaviour. We will develop more identity protection and cybersecurity services to help our customers cope with these challenges.

The data centre market should continue its rapid expansion, as more OTT and global software providers "land" more capacity in Africa, expanding outwards from South Africa towards other markets.

Liquid is in a fortunate position having a clear competitive advantage based on aspects such as owning infrastructure across 14 countries that we will draw upon as we continue to invest and build Africa's digital future and roll out new products and services.

Liquid intends to continue along its business path in continuing to provide tailor-made digital solutions for businesses and operations in both the public and private sectors across the African continent. We will expand our Managed Services offerings to drive and ensure successful adoption of tools to re-imagine our customers' businesses and how they work and connect. Whether they are focused on enabling collaboration or they are utilising the most advanced cloud applications available.

Liquid will continue to expand its fibre network across Africa through our own investments (where fibre does not exist or is insufficient quality) or partnerships with leading local fibre operators. We expect to be a truly pan-African fibre operator sometime next year with access to over 40 countries across the Continent, supported by our investments in the new subsea cables.

Brian Lavallée,
senior director of solutions marketing, Ciena

When it comes to international bandwidth growth, Africa is far surpassing any other region worldwide. With the fastest growth rate over the last four years and numerous new submarine cables being deployed, this is an emerging market with plenty of opportunity and new infrastructure projects.

A large part of Africa's bandwidth growth comes down to the population size – as the world's second largest continent it covers 20% of our planet's landmass. Africa is also home to 1.4 billion of the youngest people on Earth and it had a median age of just 19.7 years in 2020. A large, young, digital savvy and populous continent means networks play an extremely important role - with clear appetite amongst consumers who have a hunger for the latest content, video streaming and other digital applications. In addition, the networking industry also plays an instrumental role in helping Africa to remain connected to the rest of the world, and in creating a viable and sustainable economy as we continue to progress in the digital world. There is ample opportunity when it comes to connectivity services in Africa and a clear need for the region to remain increasingly connected – so how can the industry support this demand, what is working well, and what are the future developments on the horizon?

"A large part of Africa's bandwidth growth comes down to the population size – as the world's second largest continent it covers 20% of our planet's landmass"

One of the challenges is that network operators not only need to support the world's fastest growing bandwidth demand, but in addition deliver an acceptable Quality of Experience (QoE), as more bandwidth-intensive applications come to market. This means that delivering reliable and secure networks that rapidly scale and offer low latency is just as critical as supporting the capacity needs.

Low-latency connectivity is important for many stakeholders – from Internet Content Providers (ICPs), gaming companies, financial enterprises, and cloud service providers to consumers to varying degrees and for so many different reasons. Low latency can be the difference between winning or losing substantial amounts of money in the High-Frequency Trading (HFT) world or (virtually) surviving in a Massively Multiplayer Online Game.

In general, the lower the latency the better for most use-cases and applications, but as we get lower and lower, special "tricks" and architectures are required, which often lead to higher pricing for ultra-low-latency services, over and above being dependent on supply and demand.

Submarine cables provide massive scalability and relatively low latency using fibre optic cables laid upon seabeds carrying close to 99% of the world's intercontinental electronic communications traffic, so broader access to this undersea

infrastructure is critical for Africa.

In addition, it is not just about tapping into what is already available. Bandwidth demand growth is fuelling the creation of new submarine cables, as African network operators are rapidly evolving from network-centric service providers to fuller digital service providers. This explains the growing number of submarine cable landing points providing access to the massive amounts of undersea bandwidth encircling Africa. And with new submarine cables being deployed around the African continent, such as Equino and 2Africa, the amount of available capacity will massively increase once again. However, once submarine cables make landfall, the onus is then on terrestrial and mobile network expansion to enable Africans to access applications, content, and services flowing over existing and new submarine cable builds.

It is also critical to think about the physical placement when it comes to submarine cables. For transoceanic network services, submarine cables contribute most of the total end-to-end latency due to its routed distance of several thousands of kilometres and the fixed speed of light. This makes the selected route for a new submarine cable critical when designing low-latency networks, since once it's laid upon the seabed, its latency is essentially fixed over its lifespan, typically 25 years or more.

While the development of new cables will help to satisfy the capacity challenges, we are also starting to see a focus on investing in network assets to help manage, scale, and provide the low latency that the region really needs. The importance of a broad and vibrant ecosystem should not be overlooked, and we will start to see greater focus on this in the industry in the future.

There is also mature, field-proven technology available to help with this endeavour. As an example, at Ciena we have GeoMesh Extreme, which significantly simplifies end-to-end network designs – over land, sea, and cloud – providing a broad set of benefits, such as reduced complexity, power, space – and you likely guessed it – reduced overall latency. GeoMesh Extreme is increasingly being deployed, and looking at recent developments, this was something leveraged by Angola Cables, enabling faster connectivity to and from Africa.

At Ciena, we also worked with MainOne, an African submarine cable operator, helping to increase its submarine network capacity utilisation following the significant growth following the global pandemic and as it looked to expand its reach into more countries. It was the combination of a submarine cable network, terrestrial metropolitan fibre infrastructure, data centre assets, and broad interconnect ecosystem that makes MainOne a key enabler of digital transformation across West Africa.

When it comes to the telecoms and networking industry, ensuring connectivity in Africa is critical and it is a region where the opportunities really are plentiful. It is a market that we are certainly going to continue to see a bigger focus on. Although increasing international capacity is critical to Africa, it's also more important to move data reliably and securely to and from Africa as fast as possible via low-latency network designs and this is why innovative African service providers are offering a broad low-latency service portfolio. ■

Mike Last,
chief marketing officer and VP international business development, WIOCC

Over the last 12 to 18 months the demand for Bandwidth in Africa has soared, requiring all elements of the connectivity chain – from subsea cable systems and terrestrial fibre backhaul networks, to metropolitan networks and last-mile connectivity provision – to link together and scale seamlessly in delivering to increased demand and these new requirements.

It was only a few years ago that telco and internet service provider (ISP) requirements for international capacity in Africa were measured in multiples of STM1s (155Mbps). However, such has been the increase in uptake of high-speed internet services and bandwidth-hungry applications – including online gaming, music and video streaming, social media networking, etc. – that capacity requirements are now typically measured in multiples of 100Gbps.

Demand has also been exacerbated by the arrival of Covid-19 and the widespread introduction of new working and lifestyle measures designed to combat its spread. The huge increase in remote working brought with it the need for individuals to access services, communications channels and applications in the cloud, and people spending more time at home also ramped up their use of internet-based leisure and entertainment services. During the first six months of the pandemic, these measures collectively contributed to a reported 70% rise in daily Skype usage, a 26 million increase in Netflix subscriptions and a 10% increase in active Facebook users.

"During the first six months of the pandemic, these measures collectively contributed to a reported 70% rise in daily Skype usage, a 26 million increase in Netflix subscriptions and a 10% increase in active Facebook users"

The response to these rapid and very significant increases in demand for connectivity from cloud operators, content providers, ISPs and mobile operators was heavily dependent on working in partnership with an agile, fleet-footed wholesale bandwidth provider with the required network reach and the ability to rapidly scale up clients' capacity provision.

This period has clearly demonstrated that a primary consideration in choosing such providers should be their ability to access and rapidly activate additional capacity where needed, with this capability limited to those with a demonstrable commitment to long-term and ongoing investment in deploying resilient, truly hyperscale network infrastructure across the continent: networks that seamlessly link multiple international submarine cables to tens of thousands of kilometres of terrestrial fibre, metropolitan fibre networks and last-mile connectivity services.

Even for connectivity providers with a well-established policy of long-term network investment, there has still been a need to invest quickly in extra network capacity in specific areas to address anticipated bottlenecks in demand due to the pandemic, and to introduce enhanced measures for sparing and equipment redundancy, given the challenges in moving people and resources

around the continent.

A significant amount of infrastructure investment continues to be made in the continent's main bridgehead markets of South Africa, Nigeria and Kenya, with these representing the most promising initial markets for internet-dependant businesses looking to expand their operations into and within Africa.

For example, established, award-winning capacity wholesaler WIOCC recently completed a multi-billion Rand investment in South Africa, where it built a 16Tbps-ready, Optical Transport Network-enabled extension to its existing international hyperscale network infrastructure. This network extension includes wholly owned metro networks and a further 30 Points of Presence (PoPs) along the 1,700km NLD5 and NLD6 coastal corridors, enabling ISPs to extend more affordable connectivity to consumers' towns along the country's southern coastline.

With many of the older submarine cables at or approaching 100% capacity, there has been a drive to upgrade existing cable systems and build new ones in order to keep pace with Africa's burgeoning demand for international connectivity.

EASSy – serving Africa's eastern seaboard – undertook a major cable upgrade during 2021, and new cables going live over the last 12 months included DARE-1, linking Mombasa to Mogadishu, Bosaso and Djibouti; and METISS, linking the West Indian Ocean islands of Reunion, Mauritius and Madagascar to South Africa. ■

Looking ahead: With the rate of increase in demand for capacity in Africa showing no sign of slowing, opportunities for wireless communications companies are set to continue to multiply.

At a submarine cable level, a number of major new international cables are under construction, with more at proposal stage.

Two of the most significant new subsea cable systems are the Facebook-backed 2Africa cable, which will connect Africa to Asia, Europe, the Middle East and the Indian sub-continent, landing at 46 locations in 33 countries; and the Google-led Equiano cable, which will connect Portugal to South Africa and many countries along the west coast of Africa. These will inevitably change the connectivity landscape in Africa, bringing more capacity, alternative routes and cable landing points, and further diversity options for international connectivity within and out of Africa.

Alongside the incremental submarine cable capacity, there are also significant infrastructure investments being made on land to further increase utilisation of the additional international connectivity within Africa. Thousands of kilometres of new terrestrial fibre, additional metropolitan networks and enhanced last-mile connectivity options will all help businesses and individuals take advantage of faster, more affordable, high-quality access to the global internet and all the possibilities that brings.

Facilitated by this improved connectivity and the seemingly insatiable appetite for internet-based applications in particular, the scope for further increases in broadband penetration, internet uptake and access to information, services and improved business and social interaction in Africa is huge.

For companies involved with connectivity-dependent products, applications or services, the business opportunities in Africa look set to become even more attractive and compelling.

Angola Cables

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Angola Cables is a multinational operating in the global ICT sector. With a robust transport infrastructure and highly interconnected IP network we offer differentiated solutions to the wholesale and corporate segments. We offer customers access to the largest IXP's, Tier 1 operators and international content providers.

Through SACS, Monet and WACS submarine cable systems the company directly connects the Americas, Africa, and Europe with established partnerships to reach Asia. We manage the Tier III Data Centre AngoNAP Fortaleza (Brazil) and the Data Centre AngoNAP Luanda (Angola), PIX - and Angonix, one of the largest Internet Exchange Points (IXPs) in Africa.
Angola Cables provides digital services and network solutions to multiple industries with customized cloud and gaming resources available to our global customers.

ASN 37468

For more information, visit our website: www.angolacables.co.ao

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Put Our Capabilities to Work for You
SBA South Africa is a preferred provider for mobile network operators. Our experience, capabilities and resources assist carriers to meet their network coverage, capacity and performance requirements. Working with our experienced team ensures speed to market while helping carriers provide high quality, feature-rich voice and data service.

SBA South Africa is a leader in providing wireless communications infrastructure including towers, buildings and rooftops, with more than 1,000 communications sites throughout the country. We offer wireless service solutions that help carriers meet current and future network demand while remaining flexible with build times and design including:

- Site Leasing – leasing antenna space on our multi-tenant towers under long-term lease contracts.
- Site Development – Constructing towers in strategically chosen locations or at the request of wireless carriers under a build-to-suit arrangement.

As a preferred provider for mobile network operators, we are continuously setting the standard for customer satisfaction by "Building Better Wireless."®

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Sparkle is a leading global service provider offering a full range of ICT solutions, global connectivity, services and capabilities designed to meet the fast-changing needs of Enterprises, Internet Service Providers, OTTs, Media and Content Players, Application Service Providers as well as of Fixed and Mobile operators.

Thanks to a state-of-the-art global backbone of over 600,000 kms of fibre and through an extensive worldwide commercial presence distributed over 32 countries, Sparkle ranks #5 for IP globally and is among the top players for international voice traffic. Through a rich portfolio of services, a cutting edge network based on the latest technologies, a globally distributed sales force and advanced customer care capabilities, Sparkle is able to fulfil its mission of providing customers with top-performing and tailored solutions worldwide.

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Mobile Mark is a leading supplier of innovative, high performance antennas to wireless companies across the globe. We've been in the wireless industry for over 30 years and have our roots in the early Cellular trials. Today, we benefit from enhanced design capabilities and expanded production capacity – along with a greater understanding of new and emerging markets such as mining and exploration.

Modern mining operations rely on a battalion of vehicles, ranging from massive extraction vehicles to modest-sized material transport trucks. These vehicles operate in tough environments where high vibration is a frequent wear and tear challenge. Mining companies throughout Africa have relied on our rugged, foam-filled mobile antennas for consistent connections. Mobile Mark's infrastructure antennas have been used for rapid deployment and redundancy coverage for effective wireless coverage in isolated settings.

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chapter 8
Fixed Wireless Access

Paul Colmer,
EXCO member of Wireless Access Providers Association (WAPA)

Those among Africa's poorest must pay exorbitant per gigabyte mobile data costs when there are economically sustainable and under-utilised alternatives.

World Bank data shows that, while Africa's poverty rate decreased from 56% in 1990 to 40% in 2018, the actual number of poor continue to rise due to population growth, which means more than 430 million people now live in extreme poverty compared with 240 million.

Being able to legally use the potential of TV white space (TVWS) for communications is a potential game changer for Africa's unconnected people and Africans who face prohibitive mobile data costs. Data costs in Africa soar well above the world average, for over 600 million people.

TVWS is under-utilised bandwidth that was always reserved for older TV signals, which needed wide frequency bands to not suffer interference from other signals, but which using modern technology can be repurposed into high-speed Internet at low cost. This is now possible in South Africa, Kenya and could soon be the case in Nigeria, Ghana and Malawi.

One of the big challenges was always being allowed to use the TVWS signals in this way. But another challenge was sourcing affordable kit with which to build the networks. The market was always so small and demand so low that equipment was expensive to manufacture, supply, and maintain.

That is changing.

TVWS regulations exist in the US, UK, Kenya, and Singapore. South Africa has now joined their ranks. Both Ghana and Malawi have TVWS concept projects underway, although the results have not yet been finalised. In January 2020 Nigeria Communications Commission (NCC) released draft guidelines for TVWS for rural broadband.

TVWS has long range and broad coverage but, importantly, has great obstacle and

"The vast majority of these businesses, by combined revenues, fall into the US$300,000 to US$650,000 per annum bracket."

good building penetration characteristics. That makes it an ideal communications technology for much of Africa's broad, rugged rural regions, as well as for penetrating dense urban environments.

Using TVWS to connect people across the continent could usher in a digital renaissance.

It is particularly poignant as Africa's population continues to grow, expected to top 2.5 billion by 2050 and represent 39% of the world's total population by the year 2100. Many Africans are urbanising, trade across the continent is changing, and African national economies are either already transforming or they want to.

If Africans want to participate in the regional, national, continental and global economies, we must connect. TVWS is an ideal opportunity.

The commercial opportunity has never been greater. Media reports in April 2021 reveal that sub-Sahara Africa has six of the 10 most expensive countries worldwide for the cost per gigabyte of mobile data. The average is US$6.44 in sub-Sahara Africa, US$5.25 in South America, versus just US$1.53 in North Africa, citing a cable.co.uk study.

Kenya comes in at US$2.25, Nigeria at US$0.88 while Sudan takes a clear African lead at just US$0.27, which is still high compared against the world's cheapest, Israel, at just US$0.05.

Perhaps tellingly, the average monthly income in South Sudan, according to WorldData, is just US$38. It is US$48 in Malawi, US$147 in Kenya, and US$167 in Nigeria. In Israel, where the average mobile per gigabyte data cost is just US$0.05, the average monthly income is US$3,598.

People in South Africa pay between US$26 and US$39 per gigabyte of pay-as-you-go data (bought by the megabyte), compared with just US$0.13 to US$0.20 per gigabyte of data (bought in monthly bundled packages) for those who can afford it.

A prolonged study in South Africa demonstrated in an African context that a TVWS network, with each base station having a 10km coverage radius without requiring line of sight, could reach 13 million people currently living in 3.5 million rural dwellings in just two of the country's nine provinces. Currently, only 35% of these homes have Internet access using a smartphone. While regional regulations differ, the implications for millions of people in many other African countries are significant.

Exorbitant Mobile Data Costs	
Region	**Average US$ Cost per gigabyte**
Sub-Sahara Africa	6.44
South America	5.25
North Africa	1.53

Paying the Price	
Country	**US$ Cost per gigabyte**
Kenya	2.25
Nigeria	0.88
Sudan	0.27

The US$1 million, two-year study in South Africa proves it's possible to connect the unconnected. The Wireless Access Service Provider's Association (WAPA), Microsoft, Project Isizwe, Stadia Capital, Adaptrum, International Data Corporation (IDC), and the United States Trade Development Agency (USTDA) demonstrated the technical, commercial and socio-economic benefits of TVWS.

Each TVWS base station in the 470 to 694MHz bands was connected at 20Mbps with 30 total 2.4 and 5.8GHz Wi-Fi hotspots. The hotspots were within walking distance for each citizen in the trial regions. Subsequent to the project's successful proof of concept, Wireless Internet Service Providers (WISP) in South Africa have the opportunity to deploy as many as 1,600 TVWS base stations, reaching 50 000 hot spots, potentially serving 13 million people in rural areas.

The results of the TVWS project in South Africa, regulatory adoption in Kenya and draft guidelines in Nigeria, with trials underway in Ghana and Malawi, as well as adoption in other parts of the world, are significant on their own.

But making dynamically allocated TVWS spectrum available could not only stimulate affordable connectivity for digitally divided Africans, it's an opportunity for entrepreneurs to activate small businesses.

Surveyed wireless service providers in South Africa in the 2021 WAPA census reveal that nearly 80 independent and owner operated businesses generate over US$162 million per annum. The entire industry could be as much as US$200m. The vast majority of these businesses, by combined revenues, fall into the US$300,000 to US$650,000 per annum bracket. By total number of businesses, 63% are micro enterprises. They already employ thousands of people and serve hundreds of thousands of customers.

The most significant hurdle for fixed wireless service providers is the availability of spectrum and affordable equipment to build the networks that use it to provide telecommunication services to the people who need them.

TVWS, trialled at great expense and with deep care around the world, in Africa, and now being used to offer live services on our continent, is a viable commercial prospect to deliver cost-effective broadband Internet and IP telephony services to hundreds of millions of people. ■

"Media reports in April 2021 reveal that sub-Sahara Africa has six of the 10 most expensive countries worldwide for the cost per gigabyte of mobile data"

The biannual Ericsson Mobility Report provides projections and analyses of the latest trends in the mobile industry, including subscription, mobile data traffic and population coverage worldwide. The following is from the June 2021 report.

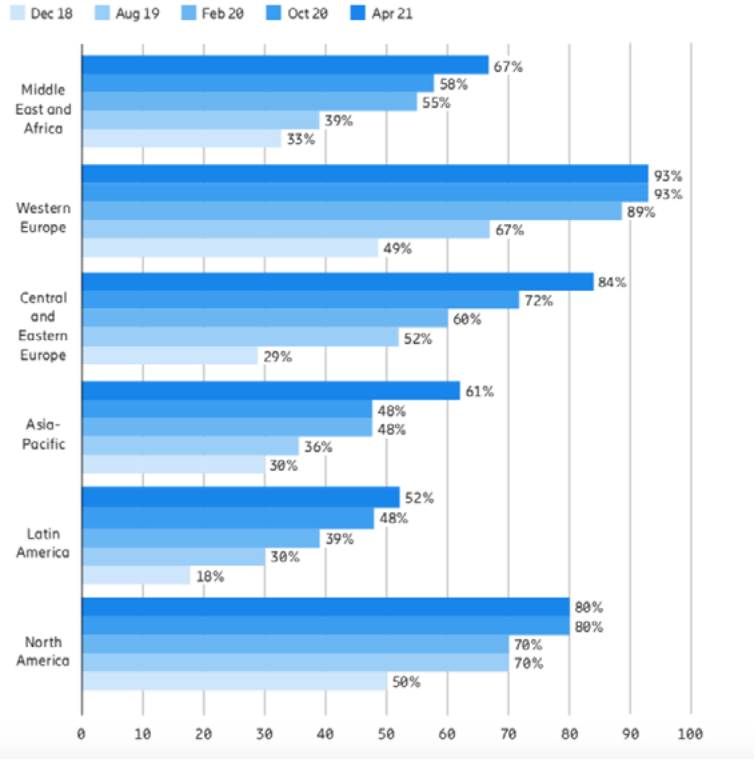
5G commercial launches drive FWA offerings

Over 70% of all service providers are now offering fixed wireless access (FWA) services. Connections are forecast to exceed 180 million by the end of 2026, accounting for more than 20% of total mobile network data traffic globally.

Over half of service providers in every region now offer FWA

According to the regional breakdowns, more than 50% of service providers in every region are offering FWA. The highest growth during the last six months has been in regions with the lowest fixed broadband penetration – that is, Middle East and Africa, Central and eastern Europe, Asia-Pacific and Central and Latin America. These regions grew between 4–13%age points. Central and eastern Europe has had a growth of almost 25%age points since the start of the pandemic in February 2020. Globally, they now have the second highest adoption at 84%, while western Europe have the highest FWA adoption at 93%. ■

Figure 6: Regional percentage of service providers offering FWA



Kamal Mokrani,
global vice president
at Infinet Wireless

Infinet Wireless has adopted a positive business outlook for the future, in relation to the ever developing and growing African market. Infinet Wireless has based this view on key criteria and the indicators for growth. Today Africa is an emerging, yet ever more prominent marketplace for telecoms, technology, and telecommunication services. The continent of Africa is one of opportunities, with an ever-growing entrepreneurial class and a middle class with increasing disposable income.

As an indication of our own belief in the economic future of the continent we opened in 2020 a new regional office located in Cameroon to help address our customer's needs in one of the world's fastest growing economic regions. This presence has been led by Kamal Mokrani, Global Vice President at Infinet Wireless, and this investment has already brought some promising results. Mr. Mokrani has responsibility for and supervises setting up technological programs and qualifications in the sub-Saharan region, while actively promoting the interests of Infinet Wireless and its brand.

Currently Infinet Wireless is progressing, at pace, with its strategic plans to benefit our customers and fulfill their business requirements. The company is fortunate in that our customers are well aware of the benefits and advantages in working with us and as a company we appreciate this commitment and confidence, especially as the world experiences the severe impact of the Covid-19 pandemic. Like many enterprises worldwide Infinet Wireless has had to adapt and change to a new way of working. The pandemic has slowed down the speed at which we would be normally moving forward as a business, but we have risen with our employees to the challenges of the pandemic and the needs of the market.

As part of this adoption of new ways, Infinet Wireless moved forward and instigated its first virtual event, the IW Tech Day 2021 West Africa. In what was a successful event the company set out and significantly achieved the aims of introducing Infinet Wireless and showcasing its solutions to connectivity companies and professionals across the whole of sub-Saharan Africa.

We feel this event had a positive impact with our customers and prospective customers and stimulated an increased interest in what we do and the solutions we provide to the market.

We are pushing forward as a company in these continuing challenging times and our plan for next year is to continue to grow Infinet Wireless's presence in other regions of the continent.

We see the challenges ahead, and in relation to moving into new regions we see how some regions have more of a tendency to having a bond with the Middle Eastern market, but this is a market that Infinet Wireless already has a history with. As a company we feel a level of excitement, although well aware of the challenges we face, in dealing with this expanding area and we are confident that as a company, working positively with our employees, partners and customers we will rise to the challenges ahead and become a stronger company in the future to service our customers' requirements. ■

Justin Farnell,
founder, WiFiontheMove

WiFiontheMove has been offering a fully managed, cloud-based WiFi solution to market leading (bus, coach and train) transport companies across Southern Africa for over 3 years.

My anchor client is Irizar, the Spanish maker of luxury class coaches. Irizar have a regional headquarters and transport depot located in Centurion, Gauteng. Whenever they supply a customer with one of their i6s 60-seater luxury coaches, I then go on to supply a fully configured Teltonika router, which is enabled with Global Positioning System (GPS) tracking, a custom branded captive portal on the Linkyfi platform for Wi-Fi passenger analytics, and a hard capped daily LTE data allowance, to control usage costs.

The Teltonika also has the advantage of being a dual SIM router, this allows, when needed the ability to provide and support cross border connectivity too.

In the past twelve months. I have also started connecting the Teltonika to a Poynting PUCK-5 antenna. It is a 5 in 1 (LTE Mimo x 2, dual WiFi and GPS) antenna which can significantly improve signal stability and throughput. This can be particularly important for optimising Long Term Evolution (LTE) on the move, and when a coach leaves the connectivity of the city. I have for the past 2 years also used Vodacom as they are a network that fulfils the needs of our system and product well for LTE coverage on the main highways in and around South Africa.

> "Although Covid has caused many negative affects both socially and economically, because of lockdowns, it has re-emphasised one of life's fundamental laws which is, one has to adapt to survive and those that do adapt, can and will prosper"

It goes without saying that reliability and quality of service is crucial for a positive passenger experience and is critical to delivering WiFiontheMove. We are receiving from our customers approval ratings between 80 and 90% based on information we gather via the Linkyfi feedback form when passengers log back into the onboard WiFi.

So, it is a complete end to end solution. There could be hundreds of WiFi routers installed on buses operating within South Africa, that are literally gathering dust across South Africa, as a consequence of not being supported and managed, resulting in a lost opportunity to monetise capabilities. This is the value proposition of WiFiontheMove. I'm not just shifting tin.

Two reasons: firstly, as a consequence of a trip I was taking to see family back in the United Kingdom, I decided to use the National Express coach service going from the capital city, London to a major city in the north of the country, Leeds. I was excited to discover that Wi-Fi was advertised onboard. Unfortunately, on this occasion, what was my first experience, as a customer, of onboard Wi-Fi turned out to be very disappointing. I couldn't connect! But on the return trip,

my customer experience was better as I was able to browse and message on WhatsApp to my then future wife Phiwe back home in South Africa. She asked where I was (because my LTE roaming was disabled to save money) and when I said I was on the coach using Wi-Fi she replied "Wow!"

That is the point in time when WiFiontheMove was born because I realised that what many take for granted in developed countries such as the UK, is still a novelty in a developing country such as South Africa.

Which leads me on to the second reason for founding the business. I made contact with all of the major coach operators and found there was little or no Wi-Fi being offered to passengers on coach and bus services across South Africa.

Well, I'd be lying if I said it's been anything other than horrendous for the passenger transport industry in general. International travel restrictions due to the Covid pandemic have particularly hit the tourism sector in South Africa - Greyhound was forced to close after 37 years of service. Inter provincial travel bans and social distancing restrictions on coach and bus capacity have also hit the long haul and city commuter buses.

WiFiontheMove was pre pandemic in a position to commence trials on Gautrain Buses and with a host of other operators, but the lockdown has put paid to all of that.

"Yes, business is picking up! I've just had my best month in two years, with Irizar starting to place orders again, primarily with Zambian and Zimbabwean customers."

To be blunt, I am thankful to be staying in business, fortunately, I am a service orientated company and my cost base is low, as I work with partners rather than employing my own staff directly. To make ends meet, I also took on a digital consultancy contract to see me through.

Yes, business is picking up! I've just had my best month in two years, with Irizar starting to place orders again, primarily with Zambian and Zimbabwean customers. South Africa is going to take longer but I am now seeing the commuter market waking up, with Municipalities putting out tenders for enabling Wi-Fi on their Metro buses. ■

Looking ahead: I am bullish in my outlook for 2022. There has been, in my view, a noticeable positive shift in business sentiment, combined with a distinct pick up in business procurement activity. People are also starting to travel again as travel restrictions both locally and nationally are being removed, this obviously helps a great deal.

Although Covid has caused many negative affects both socially and economically, because of lockdowns, it has re-emphasised one of life's fundamental laws which is, one has to adapt to survive and those that do adapt, can and will prosper.

For WiFiontheMove I see a huge potential for growth in emergent markets such as southern Africa, because just as these days you wouldn't buy a car, if it didn't come with Bluetooth as a standard, so are coach and bus travelling passengers coming to expect WiFiontheMove as a standard, as part of their travel experience, not just as a nice to have.

Lux Maharaj,
director of sales, Africa, Parallel Wireless

With the worldwide impact of the Covid-19 pandemic it has been very difficult to meet customers and stakeholders from across the globe in person, as safety and health for everyone is our top priority. People want and need to stay connected for social and economic wellbeing. Our Parallel Wireless vision is to reimagine wireless networks, so all people are connected whenever, wherever, and however they choose. Our mission is to deliver innovative products that unlock value and disrupt the economics of wireless networks through intelligence and openness. Our customer's success is our success, as we have a Customer First mindset.

During the pandemic Parallel Wireless sales team members, project management, engineers and other customer support staff continued to develop strong relationships with our Mobile Network Operator (MNO) customers from across the globe by utilizing MS Teams video and audio and other platforms to continue the dialog and strengthen relationships. We were able to activate networks remotely, without sending people there – showing the ease of deployment of Open RAN networks.

"The federal government of Nigeria is committed to facilitating the achievement of its' national policy goals for universal service and access to information and communications in Nigeria"

Our MNO customers are searching for wireless network providers who will be around for the long term and those who have significant market share in Open RAN. Operators want suppliers who have high powered solutions with features and KPI performance and ease of management which match those of legacy vendors. In addition, they want turnkey solutions which include hardware, software, and professional services. Wireless networks are more important than ever as voice and data communications are commonplace and often required due to the pandemic instead of in person communications. Advanced applications such as Internet of Things (IoT), autonomous driving, robotics, remote surgeries will all require robust, reliable, and secure wireless networks.

Despite the pandemic throughout 2020 and 2021, working closely with the our sales teams, product management, engineering and other key stakeholders across the company we have clinched customer wins such as; Axiata Group, Millicom, Etisalat, Vodafone Ireland and IPT in Peru to name a few.

We have also won numerous contracts with major operators in the African continent. In subSaharan Africa,, according to the GSMA, a quarter of the population still live outside of mobile broadband coverage compared to 7% globally. The federal government of Nigeria is committed to facilitating the achievement of its' national policy goals for universal service and access to information and communications in Nigeria. In December of 2020, Parallel Wireless and Hotspot Network Limited, a Network as a Service (NaaS) provider, announced plans to deliver on Nigeria's connectivity vision, helping to build and expand wireless networks across Nigeria, providing next-generation digital services

to local communities.

In July of 2020, Parallel Wireless and Orange announced a partnership to deliver open, software-based, and virtualized Open RAN network architectures to deliver scalable 2G and 3G, broadband services in the Central African Republic (CAR). In Africa, Orange is implementing a program called IDEAL – Include Digital in Every African Life. This program aims to provide digital services to their customers who do not have any connectivity today. The Central African Republic is a digitally divided country with only 48% unique mobile connections and limited network infrastructure.

In April of 2020, Parallel Wireless and the Ghana Investment Fund for Electronic Communications (GIFEC) announced a partnership to provide All G, cloud-native, O-RAN compliant, Open RAN networks enabling telecommunications and Information and Communications Technology (ICT) to unserved, underserved, and deprived groups and communities in the country of Ghana. Africa is the most digitally divided continent with only 44% unique mobile users. Though Ghana has one of the more competitive telecom markets in the region, there are approximately 1,020 communities without mobile signals.

During the Covid-19 pandemic there were and continue to be challenges in many areas of the world, however our employees have persevered utilizing digital tools and resources to their full extent to continue developing thorough leadership and strengthening communications with our valued customers. As examples of our successes during the Covid-19 pandemic we can include the creation of; Open RAN explainer videos, webinars, case studies, whitepapers, blogs, solution briefs, FAQs, over 45 plus OpEds in industry publications and educational materials such as the Open RAN e-book. In addition, we have developed an extensive social media following by creating the #OpenRANdailyfact on LinkedIn which has attracted a significant number of followers. And at the end of June 2021, we exhibited our leading edge All G, O-RAN compliant, Open RAN networks at MWC21 – Barcelona under strict Covid-19 precautions to protect the safety of those attending. ■

Looking ahead: We are extremely optimistic about the future of telecommunications especially wireless networks for 2022 and beyond. With Open RAN solutions which are cost effective and easy and efficient to deploy, rural and urban environments are quickly enabled with ALL G – 2G, 3G, 4G, and 5G connectivity. Parallel Wireless was recently named by Appledore research in their 'Who's winning in Open RAN report' as the most deployed vendor with many O-RAN compliant, Open RAN successes over the last year with Mobile Network Operators from across the globe such as, Axiata Group, Millicom in Columbia, Etisalat in Afghanistan, Indosat Ooredo in Indonesia, Hotspot in Nigeria, Orange in the Central African Republic (CAR) to name a few.

In Africa, according to the GSMA Mobile Economy Report 2021 there are 800 million people in the sub-Saharan Africa region still not connected to the mobile internet. However, most of the broadband growth in the African continent from 2021-2025 will happen in 4G. Open RAN networks will help to bring 4G connectivity and capacity to enable voice and data communications.

We are excited about the potential to connect the unconnected in Africa and around the world, providing leading edge services such as digital banking, e-learning, digital health, Internet of Things (IoT), Industry 4.0, autonomous driving, and so much more. The future is bright for telecommunications, bridging the digital divide and empowering economies across the globe.

Paul Fick,
managing director, Webb Industries

Over the last 18 months, dramatic changes due to Covid-19 occurred, business operations changed, and billions worked from home to create profit.

This shift in societal and industrial interaction prompted an increased need for high-quality, reliable, and fast connectivity. Investment followed to cope with the demand for services and commodities required by the new generation of remote workers.

Quality digital communication has never been in such demand. Service providers scrambled to deploy additional services and infrastructure; enablement of radio access networks (RAN), fibre optic services such as FTTH and FTTB, LTE WIFI routers and WIFI mesh networks.

If such services hadn't been available, the world and African economy would have taken a bigger hit.

At a software level, giant companies like Google, Microsoft, Apple, and Zoom pushed hard to improve the stability of their virtual meeting platforms. We all now have access to virtual meetings.

Webb Industries played a critical role in providing Mobile Network Operators with vital components and services during the pandemic. Webb provided everything from cables to Antennas to project services such as In-Building Solutions (IBS), active integrated Distributed Antenna Systems (iDAS) and Cellular Enhancement Systems.

One aspect still hampering the communications industry is the unavailability of the required spectrum to roll out additional services and capacity. The Independent Communications Authority of South Africa (ICASA) and Mobile Network Operators (MNOs) routinely argue in the courts and expend money on fees. Meanwhile, South Africans are waiting for opportunities to expand their businesses. Without access to the RF spectrum, the country loses economic benefits.

Would it not be better to regulate how the Tier 1 providers share the spectrum usage under their control, thus making it possible for Tier 2 Innovators to use the network at a fair price? This way, more South Africans can innovate at the Tier 2 level.

Webb has consistently, over the years, been at the forefront of innovations in our market niche. Recent examples include designing and developing a surge and lighting protection device for telecoms power supply systems and the manufacturing and supply of tinned copper cable to reduce outdoor cable theft.

The African continent has the highest lightning incidence in the world. Webb provides World Class Surge Protection Device components from our partner agent Dehn Africa. Webb deploys these SPDs into a range of Webb designed DC Distribution Panels, especially for the RAN Telecommunications Industries.

We expect the superpowers to start flexing their muscles to get their territories operating and growing again. African countries may feel left behind as countries in the Northern hemisphere are in flux and attempting to overcome the Covid recovery delay.

This short- to medium-term supply chain gap will impact Africa's power and communication needs. Hazardous cargo, which includes all types of batteries, is likewise subject to severe restrictions by shipping companies.

Perhaps this is a good time for Africa to become more protective of its raw

minerals. We should better negotiate the supply-demand balance.

How will 5G be used? The most general applications will be in Critical Communications, Large scale IoT, and enhancing current smartphone innovation and applications.

Critical Communications: 5G will enable rapid traffic control, intelligent vehicles, remote medical operations and critical security reaction components.

Large Scale IoT: white goods will have the ability to self-report status to manufacturers and owners, controlling and monitoring items at home and in business, monitoring frail relatives or patients, and monitoring security status at home and on company premises.

Just like all its predecessors (2G, 2.5G, 3G, and 4G), 5G will stimulate innovation beyond our current imagination. To recall history: after GSM, we had 2G, and quickly 2.5G followed by 3G and 4G. Back in the 2G/2.5G era, "smartphones" were not all that smart, but hardware and software Innovators were all saying, "give me more bandwidth and data speed and watch this space!"

Sure enough, 3G did the trick, bandwidth and speed as never before were seen on Radio Access Networks (RAN), but what will we do with all this capacity? Well, big and small Innovators came from every direction, and smartphones suddenly had a "name". Then the software Innovators, from Operating Systems (OS) to every possible application the human mind could conceive. The demand was so high that RAN manufacturers and MNOs now had to play catch-up with the Innovators. 4G and aggregation of frequencies was the answer, but not for long. ■

Looking ahead: The Innovators are hungry for more, so now it's 5G. Already, there is talk of 6G. Sadly, in SA, we still have to drive 5G to its maximum! So let the "Big RF Carriers" do what they do best to enable the Innovators to drive the economy! Please, ICASA?

The promises of 5G capabilities are monumental and yet not an easy task for Mobile Operators to implement. For one, the capital investment required is massive, and two, will consumers or businesses be willing to pay more? That remains to be seen!

What are the benefits?

- Next-level connectivity,
- Up to 20 times faster mobile speeds than the current 4G network,
- Better exchange of information,
- Longer battery life of mobile devices,
- Low latency in communication and
- Connecting a vast number of different devices simultaneously.

Still, the question remains: is 5G an immediate requirement?

A study done by PWC confirmed that only a third of consumers are willing to pay more for 5G, even with higher data speeds. Most consumers are not in a hurry to get the new technology if it requires purchasing a new mobile device. Only 26% said they would rush out to buy a new device if they were not yet eligible for an upgrade.

Will 5G take off in our country? Will South Africa have 11 million subscribers by 2025, or how far away are we from mass adoption?

We are living in exciting times indeed!

Ted de Boer,
regional sales director for southern Africa, Siklu

The 2021, sub-Sahara Spectrum Management Conference (SSMC), covered developments in millimeter wave (mmWave) frequencies and implementations helping to close African digital divide.

ITU's WRC-19 meeting, identified spectrum for IMT in mmWave bands resulting in potential mmWave-based applications, covering private and public networks, taking shape worldwide. In Africa, most countries across sub-Sahara haven't started to explore these frequency options, except South Africa, which was in first 'wave' of countries launching commercial 5G mmWave networks.

It's important to distinguish 5G "NR" (New Radio) and 5G fixed wireless access (FWA) services, such as those represented by Terragraph ecosystem (within 60 GHz V-band) and other applications operating in 70/80 GHz bands (E-band).

In Africa, 2021 marked exploration of topics such as mmWave 5G spectrum licensing, network deployment, specific 5G use cases for mmWave frequencies and resulting socio-economic benefits. 2021 also saw progress in real mmWave network deployments in terms of Terragraph trials and backhaul deployments for private network services.

Nigeria for example. Delta State University (known as DELSU), in Abraka city, started with one campus at Abraka and one at Anwai, Asaba. It expanded in1995 at Oleh. DELSU operates multi-campus systems serving 22,000 students (2019/2020 roll). Having 22,000 students and growing catalogue of courses, programs and distance learning initiatives, DELSU needed to boost its networking bandwidth available to students and staff.

To improve learning environments and productivity, implementation of 802.11ac Wi-Fi networks across campuses, featuring multiple access points occurred. Intercampus backhaul links were required, topologically connecting locations "A and B" 1.2 km apart and B to C 2 km apart. Given numerous access points and backhaul traffic, only Gigabit-level solutions would suffice. Complicating matters, in terms of provision of bandwidth, campuses had no fiber PoP, nearest being 5 km away.

Nigeria has a history of wireless network development, particularly 5 GHz band and the campus locations proved no exception. DELSU's installer surveyed the area determining interference and noise levels, limiting capacity of another 5 GHz DELSU network.

Addressing the interference problem, provider and DELSU decided to move higher in the frequency spectrum to wide-open E-band (70/80 GHz), allowing 10 GHz availability and virtually zero interference.

Compared to provisioning fiber for DELSU's requirements, involving prohibitive costs and time, the installer needed three days to establish three Full Duplex links carrying a combined 1 Gigabit traffic linking all campuses. They serve as backbone for enhanced network, integrating hundreds of Wi-Fi access points and point-to-multipoint radios deployed for intra-campus connectivity.

Like E-band, V-band has available spectrum and the Terragraph system proves it can offer fiber-like connectivity speeds cheaper than fiber. Numerous trials are underway in Africa, that prove benefits as envisioned years ago when Facebook started the Terragraph project.

Terragraph doesn't bridge rural digital divides, given propagation range is typically 300m, but the majority African population live in urban and sub-urban areas, it shows tremendous promise providing Gigabit-speed alternative to mobile phones for Internet connectivity.

The nature of 60 GHz signals and use in Terragraph equipment means band won't be saturated and little real interference. With 14 GHz available spectrum worldwide, service providers can use it without interference.

Further, concept behind Terragraph is mesh topology. For mesh networks in urban digital divide environments, or anywhere in city or suburb, 300m is adequate range. Suburban areas, typically single-family homes are well within 300m of each other. In cities, the technology is deployable on street furniture, with links less than 300m.

A mesh network with limited propagation means higher frequency reuse and in a mesh environment is a critical factor. Previously, mesh networks operating 5 GHz band reputationally were "RF polluters" due to a technique known as "listen before talk." Resulting in operators having many devices trying to talk at the same time, creating interference.

With Terragraph, Project OEMs made changes that increase capacity, making mesh products fundamentally different from past ones. For instance, Terragraph uses time-division multiple access (TDMA) technology, each device taking its turn to talk. Process unfolds cleanly, nobody stepping on top of each other from a device access perspective. Combined with capacity from 60 GHz band, the scheduled access Terragraph provides with TDMA means operators have mesh networks providing high quality of service.

Another Terragraph advantage is deployment speed. Deploying wireless network versus wired one saves time, especially when wireless network offers same Gigabit speeds as fiber, it becomes a game changer. Terragraph time advanatge increased by beam steering technique.

Urban mesh networks with thousands of nodes becomes prohibitive to manually design each node location. Beam steering solves issue as it's fundamental to the concept of "auto-connecting" devices. Providing each is within sight of the other, devices will locate and connect.

This feature and software dynamically monitor thousands of nodes for RF health, automatically rerouting connections around obstructions or link outages, making Terragraph installation easy. Network installation doesn't require an experienced RF installer but similar skills to home satellite dish installation, "out of the box" simplicity, means end users can fix terminal unit to wall, plug in, it automatically scans area, locating next node in network and connecting while network provides access permissions.

Having multiple OEMs participating in Terragraph ecosystem, 2022 should see significant Africa Terragraph network growth. ■

Looking ahead: What's happening or expected to happen next year in South Africa may serve as a useful illustration for Africa.

Discussed SSMC, many Africa Terragraph trials are in the works, while in South Africa, plans are underway with 100% black-owned ISPs establishing "proof of concept" networks. This government initiative called B-BBEE, broad-based black economic empowerment, provides preference to companies wholly black- and female-owned, or a combination. These efforts seek to prove Terragraph viability in delivering low-cost Internet to areas with significant populations lacking connectivity, thus bridging long existing digital divides, while providing and publicizing projects on social media platforms, via hashtag #mmwaveforthemasses.

An emerging trend concerns a new technique to expand reach of high-capacity, multi-Gigabit mmWave links. As above, the E-band (70/80 GHz) frequencies are becoming more popular and now it's possible to combine those radios with those operating in microwave bands to creating dual-radio systems that effectively creates multi-gigabit connections up to 10km plus in length, fiber-equivalent reliability of 99.999%,even in bad weather.

Establishment of mmWave networks will be buttressed by regulatory activities, as multiple filings (e.g., on 60 GHz for point-to-multipoint networks) are submitted to Independent Communications Authority of South Africa as part of the 2021 Draft National Radio Frequency Spectrum Plan, for submission to the Minister of Communications and Digital Technologies for final review and approval in 2022.

Mark Goosen,
sales director sub-Saharan Africa,
Cambium Networks

The world's reliance on digital technology is increasing, particularly in relation to access to information and critical services such as education, banking and healthcare. Research from The Borgen Project, March 2021 cites approximately 80% sub-Saharan Africa's population don't have basic internet access connection, highlighting the Africa digital divide. Working towards closing the gap, the African Union, supported by World Bank Group, set a goal of connecting all individuals, business, and governments to wireless access by 2030. Africa has been faced with a lack of spending on infrastructure which is needed for network access, leading to gaps in coverage across the region.

Cambium Networks has been able to work alongside and support regional internet service providers to deploy technologies needed for more accessible and reliable connectivity. Facilitated through local partnerships, such as with local wireless provider Tizeti Network Ltd. to improve connection in Nigeria and expanding to Ghana and with First Direct to improve connectivity for small and medium enterprise locations and governments.

We worked with Facebook to develop a 60 GHz fixed wireless solution to expand access to affordable and multi-gigabit broadband. This was done through leveraging Facebook's Terragraph meshing technology to provide fibre-like connectivity, at a lower cost to more people faster, without the need to trench new infrastructure. In doing so, mobile and satellite operators, and internet service providers are supported to build, grow, manage, and operate their Wi-Fi networks and services. The aim is to provide a wider area with broadband, connecting businesses and residents in urban and rural environments. Focus has been placed on providing wireless connectivity in a sustainable and scalable way.

Subsequently, Cambium Networks partnered with Tizeti Network Ltd. to deploy and accelerate the use of Express Wi-Fi within Africa. This has been used to expand and increase connectivity in public areas, within the education sector, and for small and medium enterprises. By leveraging Cambium's fixed wireless access technology, Tizeti has been able to connect 2 million users in Nigeria with Express Wi-Fi. Previously, approximately, 200 million people had poor broadband access. Yet, this partnership has provided over 70,000 GB of speed per day to subscribers in Nigeria. Due to its successes, Cambium Networks and Tizeti expanded their wireless solutions to Ghana, resulting in wireless access becoming increasingly available to more people in West Africa.

This is possible through fixed wireless applications where Tizeti owns and operates over 100 towers across Nigeria and Ghana. These wireless deployments are being run on solar power, which means costs associated with installation and maintenance of necessary equipment is reduced. The reduced operating costs help address the issue of affordability, which prevents many across Africa from being able to benefit from broadband access. Tizeti is passing these benefits onto consumers via lower prices, allowing more people a means to access wireless connections.

Despite low levels of investment in wireless infrastructure, and challenging conditions, Tizeti has been able to deploy resilient networks throughout Nigeria and Ghana. This is because, without the requirement to install generators and underground cables, the fixed wireless solution has been far cheaper to deploy. Furthermore, fixed wireless solution used has been found to provide a more reliable and efficient connection than 2G, 3G and 4G.

These connectivity increases are crucial when bridging the gap between access in various parts of Africa. Even so, this new technology is affordable and can be resilient without any pre-built infrastructure, meaning more communities will have an improved wireless connection with better reliability at lower cost to customers. Tizeti has also passed these cost savings onto their customers, allowing more people to be able to afford this wireless access.

Cambium Networks also played a role in assisting the deployment of improved wireless connectivity with purpose-built networks in enterprise spaces. With more enterprises and government agencies in Africa choosing fixed wireless and Wi-Fi technologies to deliver improved broadband speeds and, for some of them, even connect some to the internet for the first time.

First Direct is a value-added IT distributor focused on small and medium enterprises and is a distribution partner of Cambium Networks in South Africa. Additionally, these solutions have been delivered throughout several countries in Africa, including Angola, Botswana, Union of Comoros, Democratic Republic of Congo (DRC), Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Tanzania, Zambia, and Zimbabwe.

This relationship has helped improve wireless and Wi-Fi connectivity for small and medium enterprises, industrial locations, and governments in urban, suburban, and rural environments. Cambium Networks and First Direct have been able to increase the availability of connectivity without the time consuming and expensive process of building new infrastructure or placing cables underground in challenging environments.

We worked with service provider Tizeti and channel partner First Direct to continue to improve network infrastructure and give more people a stake in digital opportunities. The need for wireless connectivity will always continue to grow as it becomes more and more necessary for life. ■

Looking ahead: As the continent continues to develop, wireless needs and connectivity will become even more important and should continue to be improved for more people to benefit. With unpredictable changes, wireless and Wi-Fi should be resilient to continue to support those in all parts of Africa. The pandemic has shown just how important an internet connection is. As such, the demand for these technologies is there but has not been met yet. Next year and beyond, through our partnerships, wireless technologies will continue to be developed with access becoming reliable and secure at a cheaper cost.

As wireless access could become easier to access and more readily available, an increased number of devices will be connected to these networks. Therefore, rises in mobile needs will be the push for an expansion of wireless access. Currently, 2G, 3G and 4G networks have been rolled out around Africa, but the future may see a widespread 5G rollout, with more spending on wireless infrastructure. This could also lead to more hotspots around the continent which may be deployed by broadband providers or other external partners.

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Mobile Mark is a leading supplier of innovative, high performance antennas to wireless companies across the globe. We've been in the wireless industry for over 30 years and have our roots in the early Cellular trials. We have grown and evolved over the years, along with the industry. Today, we benefit from enhanced design capabilities and expanded production capacity – along with a greater understanding of new and emerging markets – all of which have allowed us to become one of the best antenna developers in our field. Our customers have been our partners throughout the years. We believe in taking the time to understand our customers' individual needs. Through close consultation with clients, we are able to deliver innovative, tailored solutions that meet specific antenna requirements. Rapid prototyping capabilities allow us to take our designs from concept to reality in an extremely short time span, and to verify the performance of the antenna. Mobile Mark antennas are used in many sectors of the wireless industry. Here are just a few examples:

- Emergency services
- Commercial fleet management
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- Smart cities & smart highways
- Remote monitoring & surveillance
- Mining & exploration
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Stratosat Datacom, established in 2002, provides cost effective tailor-made turnkey satellite and microwave communication solutions in Sub-Sahara Africa. We have rendered products and services to the majority of Telco and Satellite Operators in Africa.

Our customer focussed team provide expertise in equipment supply, installation, systems integration, commissioning, handover, training, maintenance, support and network monitoring.

Stratosat's main solution offerings are:

- High-Speed Satellite Managed Broadband Connectivity, Mobility (CoTM & CoTP),
- Managed Services,
- Tailor-made Communication Network Solution Design, Project Management,
- Satellite Equipment Supply & Distribution and Implementation & Management of Large Astronomy Projects (SKA / MeerKAT).

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Home & Business Ultra Broadband FWA

chapter 9
Country by country

Sébastien de Rosbo,
research manager, BuddeComm

Wireless communications have enabled 100s of millions of Africans to connect to the internet so that they can reap the benefits of today's digital economy. However, more needs to be done. Africa is arguably the most diverse continent on the planet, with a plethora of different cultures, religions, tribes and customs. That means countries have different priorities, ways of working and deliver projects at different speeds.

With that in mind, we at BuddeComm, a leading research and analysis firm, have partnered with Kadium to supply their readers with an in-depth look at the 54 nations that make up the world's second largest continent by land mass.

Numerous countries in Africa form key anchors for international submarine cables, which run across the Pacific Ocean, the Mediterranean, and the Indian Ocean. Landing points provide the connectivity for a growing number of terrestrial cables which cross the continent. Liquid Intelligent Technologies manages a direct terrestrial fibre link connecting the East and West coasts of Africa, running from Muanda in the DRC via Zaire to Tanzania, where it connects to the SEAS, EASSy, and SEACOM submarine cables. There are also links to LIT's 'One Africa' network, which now runs to some 75,000km.

Other regional loop networks serve groups of countries, such as those in the Sahal. As this infrastructure expands, it is continually increasing the capacity available to ISPs, thus encouraging the downward trend in costs for end-users, and facilitating the development of digital economies. The infrastructure is crucial to providing backhaul for mobile networks, which account for most voice connections and data traffic.

Specifically in this new chapter entitled Country by Country, BuddeComm's team will take a close look at what's going on in six countries - Angola, Kenya, Libya, Morocco, Tanzania and Zambia. To begin here are their mobile subscriber figures into 2022:

Table 1 – Growth in the number of mobile subscribers in select countries (million) – 2020 – 2022

Year	Tanzania	Libya	Zambia	Morocco	Angola	Kenya
2020	49.42	5.43	19.10	49.42	14.64	61.41
2021 (e)	52.88	4.88	19.96	52.88	14.31	67.55
2022 (f)	55.79	4.99	21.08	55.79	14.43	71.94

Source: BuddeComm

Tanzania

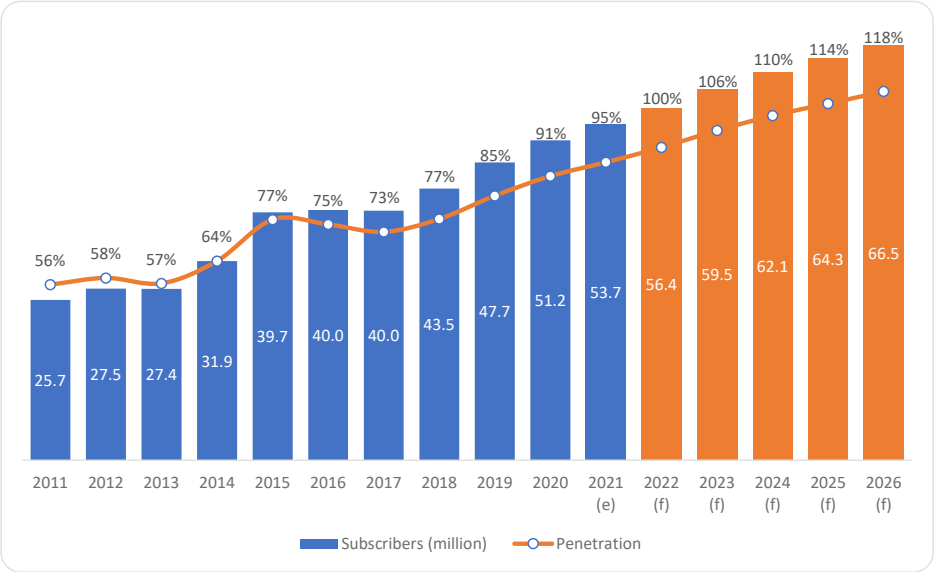
Tanzania's telecom sector has seen some considerable changes in recent years. Tigo Tanzania completed its merger with Zantel in late 2019, and the merged entity was sold by its parent company MIC in April 2021 as it sought to focus on its operations in Latin America.

The government has aimed to increase broadband penetration by adopting a range of measures, including the reduction in VAT charged on the sale of smartphones and other devices, and reductions in the cost of data. Public opposition to a controversial tax on m-money transactions forced the government in late 2021 to reduce these charges by 30%.

The MNOs are developing revenue growth from mobile data, m-money, and m-banking services, and to this end they have invested in network upgrades to support increased data traffic, and promote customer satisfaction through improved quality of service.

The landing of the international submarine cables some years ago revolutionised the market, which up to that point had entirely depended on expensive satellite connections. LIT's recently completed terrestrial cable network has a key terminus at Dar es Salaam linking to three submarine cables. In parallel, the government is completing a national fibre backbone network, having signed an agreement by which the incumbent telco TTC can make use of the infrastructure of the national electric supply company Tanesco, and so extend broadband availability to 94% of the country. ■

***Chart 1** – Growth in the number of mobile subscribers and penetration – 2011 – 2026*



Source: BuddeComm based on regulator data

Libya

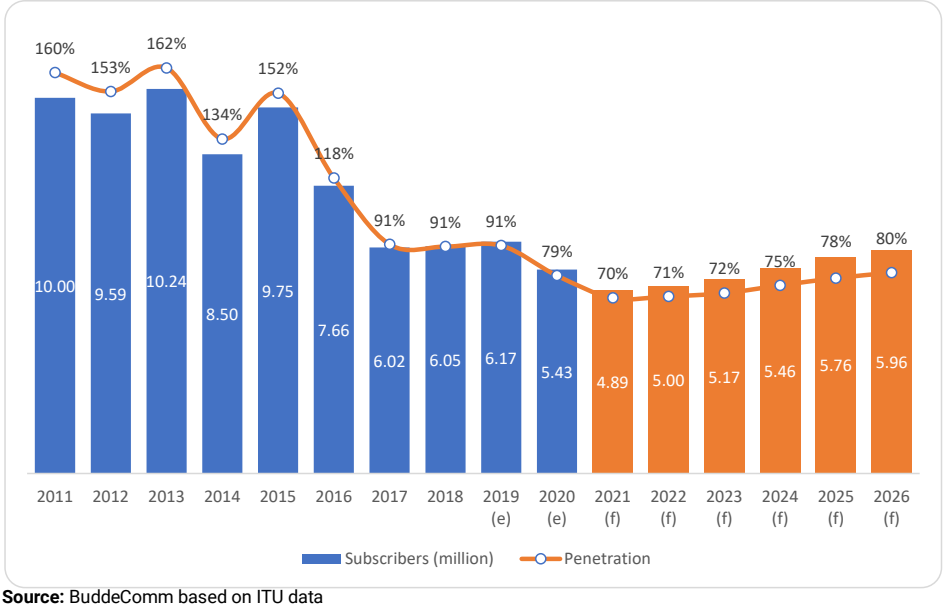
During the last few years Libya has struggled to rebuild its economy and infrastructure, much of which was destroyed or stolen during periods of civil war or fighting between opposing factions. Reconstruction efforts were stymied, with two opposing administrations lacking consensus or the ability to rebuild on a national scale. However, some change is anticipated following the formation of a UN-brokered Government of National Unity in March 2021, though this was an interim measure pending the anticipated presidential and legislative elections set for late December 2021.

There has nevertheless been some recent progress made in rebuilding telecom networks. The MNOs in particular have cooperated to extend the reach of LTE services in the south of the country.

The government-owned telco LPTIC has been instrumental in this rebuilding, having developed a working relationship with US companies for the first time in many years. Its subsidiary Hatif Libya in mid-2021 contracted the US-firm Infinera to provide an optical transport network to unserved areas of the country, and to improve service quality to existing customers.

In itself, this shows a positive response to calls from LPTIC for governments and the private sector to invest in the country's telecom infrastructure. Financial, technical, and regulatory assistance has been solicited from a range of countries, including the US, the UK, Italy, Algeria, and Egypt. Other services and cooperation have been offered in relation to developing digital infrastructure and transformation, and to creating a workable legal framework for the ICT and telecom sectors. ■

***Chart 2** – Growth in the number of mobile subscribers and penetration – 2011 – 2026*



Source: BuddeComm based on ITU data

Zambia

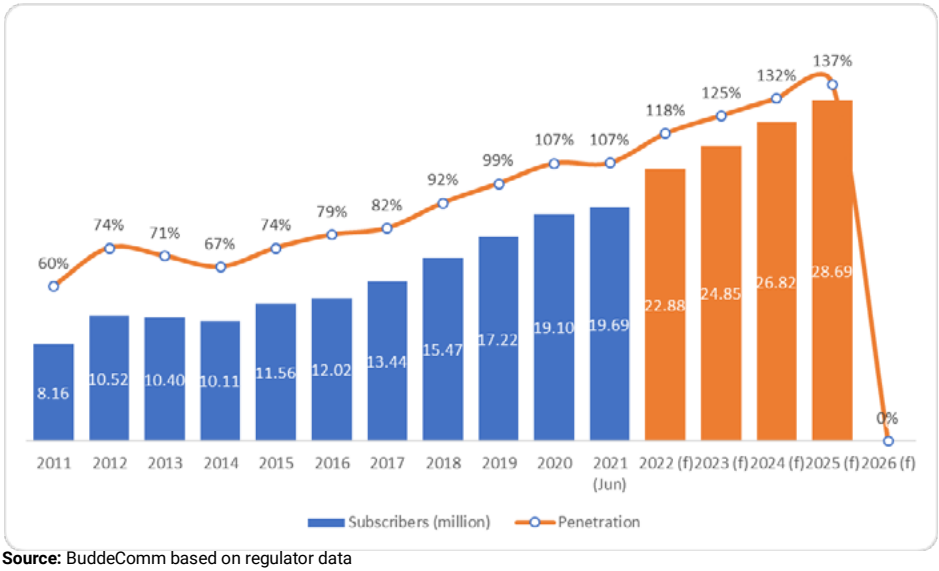
Following elections held in August 2021, the new government immediately established a Ministry of Technology and Science to promote the use of ICT in developing economic growth and social inclusion. This focus on ICT, and on telecoms in particular, has been central to government strategies for some years.

As part of the Smart Zambia initiative, investment has been made in data centres, a computer assembly plant, ICT training centres, and a Smart Education program. These efforts have been combined with the extension of broadband access and improved connectivity to international submarine cables. In turn, this has resulted in a considerable reduction in fixed-line and mobile access pricing for end-users.

Mobile network operators continue to invest in 3G and LTE-based services, while the government has also contracted to upgrade the state-owned mobile infrastructure for 5G services. Delays in holding spectrum auctions have held back the development of 5G thus far. However, in mid-2021 the regulator completed a consultation of auctioning low, medium, and high band spectrum for 5G use, aiming to provide sufficient spectrum to meet the anticipated increase in data traffic in coming years. ■

"Mobile network operators continue to invest in 3G and LTE-based services, while the government has also contracted to upgrade the state-owned mobile infrastructure for 5G services"

Chart 3 *– Growth in the number of active mobile subscribers and penetration – 2011 – 2026*



Source: BuddeComm based on regulator data

Morocco

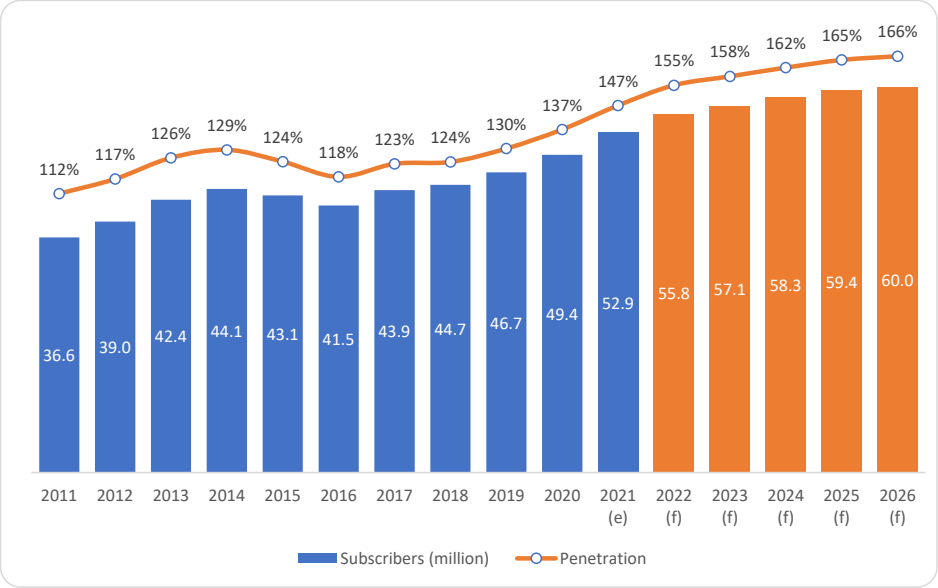
Morocco has one of the more advanced telecom sectors in Africa. It has been supported by the government's Maroc Digital 2020 strategy (which encourages the development of a digital economy) and the National Broadband Plan (which aims to provide the entire population with fixed or mobile broadband by the end of 2022).

The extension of mobile broadband services has gone far to improving internet access, which accounts for 93% of all internet connections in the country. If the government succeeds in achieving its universal broadband goal by 2022, it will be largely thanks to the widespread coverage of LTE networks.

Most fixed broadband connections in Morocco are via DSL, a segment of the market that has long been dominated by the incumbent Maroc Telecom but which, at the same time, has been restricted by the limited reach of the national copper-based network, which only covers about 20% of the population. The number of fibre broadband connections grew almost 80% in 2020, but the technology is at a relatively nascent stage in Morocco, accounting for less than one% of all connections. ■

"If the government succeeds in achieving its universal broadband goal by 2022, it will be largely thanks to the widespread coverage of LTE networks"

Chart 4 *– Growth in the number of mobile subscribers and penetration rate – 2011 – 2026*



Source: BuddeComm based on regulator data

Angola

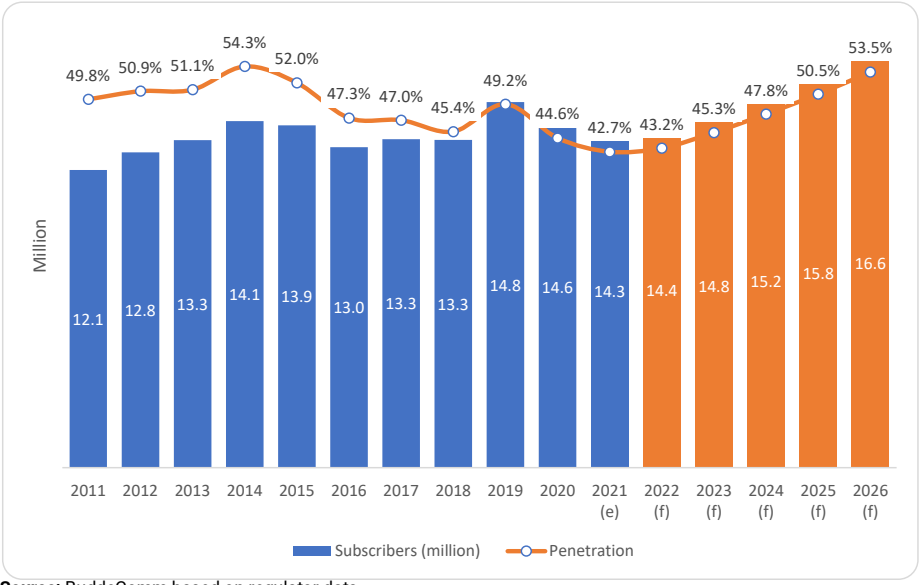
Angola's telecom sector in recent years has benefited from political stability, which has encouraged foreign investment. The government and regulator have also set in train mechanisms to open up the sector to new competitors, with Africell having secured a universal licence and in so doing becoming the country's fourth MNO.

The MNOs were slow to develop LTE services, instead relying on their GSM and 3G network capabilities. Angola Telecom did not launch LTE services until mid-2018. This tardiness was partly due to the relatively high cost of LTE-capable handsets, which continues to discourage users from upgrading from GSM and 3G. As a result, there has been slow progress in LTE network development, with only a small proportion of the country covered by network infrastructure.

Despite the evident remaining usefulness of LTE and 3G in relation to current data demands, there has been some progress made with 5G. The Ministry of Telecommunications in early 2021 set up a 5G hub to assess 5G user cases, while Unitel and the new MNO Africell since mid-2021 have contracted vendors to provide 5G-ready transmission networks.

The government has also continued to develop telecom infrastructure to help diversify the country's economy and lessen its dependence on offshore crude oil production, which accounts for almost all exports and up to 80% of tax revenue. By extending and upgrading telecom networks the government expects businesses to become more efficient, and for e-commerce to become a more prominent feature of economic growth. In addition, networks will facilitate rural access to education and health care. However, there is much progress to be made if the country is to improve the business climate and attract investors. ■

Chart 5 *– Growth in the number of mobile subscribers and penetration – 2011 – 2026*



Source: BuddeComm based on regulator data

Kenya

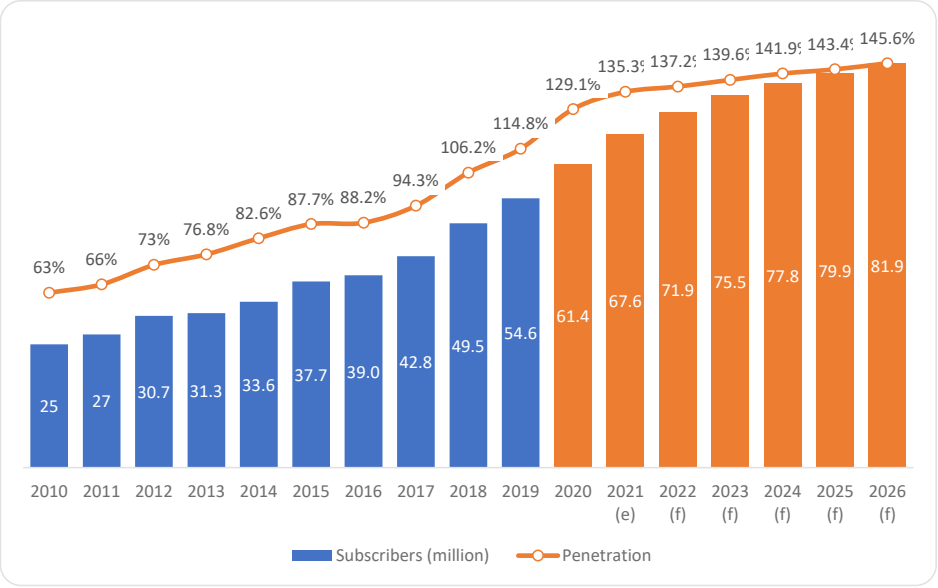
Kenya's telecom market continues to undergo considerable changes, fostered by increased competition, improved international connectivity, and rapid developments in the mobile market. The landing of submarine cables in recent years has dramatically reduced the cost of phone calls and internet access, allowing internet services to be affordable to a far greater proportion of the population. In parallel, the sector's regulator has reduced interconnection tariffs and implemented a range of regulations aimed at developing further competition.

The incumbent telco has struggled to make headway in this market, prompting a reorganisation in 2018 which included a sale and leaseback arrangement affecting its mobile tower portfolio. Competition authorities approved the acquisition of Telkom Kenya by Airtel Kenya, hoping that the merged operator would provide a greater challenge to the market dominance of Safaricom, but the merger was cancelled in August 2020.

Numerous competitors are rolling out national and metropolitan fibre backbone networks and wireless access networks to deliver services to population centres across the country. Several fibre infrastructure sharing agreements have been forged, and as a result the number of fibre broadband connections has increased sharply, including a 49% increase in 2020, year-on-year, though this slowed to a 10% increase in the first six months of 2021.

Much of the progress made in the broadband segment has been due to the government's revised national broadband strategy, updated with goals through to 2030. The strategy is largely dependent on mobile broadband platforms based on LTE and 5G. ■

***Chart 6** – Growth in the number of mobile subscribers and penetration – 2011 – 2026*



Source: BuddeComm based on regulator data

Thanks to...

Compiling the African Wireless Communications Yearbook each year could not be achieved without the help and support of those who contribute to its contents through opinion, statistics, research and interview.

We are therefore indebted to every person and company that submitted this editorial or agreed to be interviewed for the appropriate sections and below is an acknowledgement of this year's contributors.

As publisher of both Southern African Wireless Communications and Northern African Wireless Communications, we look forward to continuing this partnership within the regular issues throughout 2022 and as part of africanwirelesscommms.com – please keep in touch!

Thank you from team Kadium.

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BuddeComm explores developments in fixed and wireless telecommunications, infrastructure, regulatory measures, government programs, and a range of applications and concepts based on the digital transformation of societies (e-commerce, smart grids, etc). Our regularly updated reports cover most countries globally, as well as the operations of more than 500 companies involved in the sector.

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Submissions to government and regulators

The Dynamic Spectrum Alliance (DSA) is a global, cross-industry, not-for-profit organization advocating for laws, regulations, and economic best practices that will lead to more efficient utilization of spectrum and affordable broadband for all.

Consumer demand for wireless connectivity is surging and spectrum is a finite source. Through communication with governments and regulators, the DSA promotes licence exempt access to the spectrum and the sharing of underused spectrum bands to unleash economic growth and innovation.

The DSA produces technical material that highlight the potential of spectrum sharing, which are available to view via the DSA website. One of the latest studies: 6 GHz License Exempt: Why the Full 1200 MHz and Why Now? explores the need for license exempt access in the 6 GHz band.

Every year, the DSA holds its annual Global Summit, where policy makers, regulators, academia, and private sector leaders in spectrum management are invited to discuss and debate spectrum sharing methods and models. 2022 will see one decade of the global summit, as the DSA celebrates the event's 10th anniversary.

ACKNOWLEDGEMENTS

Global mobile Suppliers Association - GSA
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GSA (the Global mobile Suppliers Association) is a not-for-profit industry organisation representing companies across the worldwide mobile ecosystem who are engaged in the supply of infrastructure, semiconductors, test equipment, devices, applications and mobile support services.

We actively promote the 3GPP technology road-map – 3G; 4G; 5G – and we are a single source of information for industry reports and market intelligence. The website https://gsacom.com is used by industry professionals and organizations from over 200 countries globally as a single source of information on 4G & 5G. Users, who can register for free on the web site, download over 220,000 reports, charts and presentations annually.

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MEF runs six market-specific programmes. Each one give members a forum to share best practice, create new initiatives and meet new partners - Enterprise Communications; Payments; Connectivity; Mobile IoT; Personal Data & Identity; Content & Advertising.

The association's activities can be grouped into three areas.

- Insight - MEF pulls the expertise of its members to create reports, white papers, enterprise surveys, and other educational documents. MEF also carries out its own annual global consumer survey of over 6500 smartphone users across 10+ countries.
- Interaction - MEF members collaborate with – and learn from – each other, and the wider industry, via webinars, virtual and physical events, working groups and informal networking.
- Impact - Collectively, MEF members have the knowledge, influence and experience to impact the future of their sectors. They do so via best practice schemes, registries, consultations and more.

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We believe in and promote the principle of open and competitive markets worldwide through the use of open standards and harmonised spectrum. We drive the development of common global mobile standards for critical broadband and maintain and enhance the TETRA Professional Mobile Radio (PMR) standard. TCCA is the 3GPP Market Representation Partner for critical communications and our members actively contribute in 3GPP working groups. TCCA supports the ETSI MCX Plugtests™, is a member of the MCS-TaaSting project, and supports the Mission Critical Open Platform (MCOP) project. To find out more, please visit www.tcca.info and www.critical-communications-world.com

Wireless Access Providers Association (WAPA)

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International Data Corporation (IDC)
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ALAN HADDEN is a respected mobile industry veteran and consultant, former adviser to the UK regulator (now Ofcom) and senior manager at MNO One2One (now BT/EE), inaugural GSA President (1998-2015) delivering an influential voice from vendors to policy makers and all stakeholders globally, an effective contributor to GSMA, 3GPP, ETSI etc., and is a published author, international speaker and chairman/moderator.

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