chapter 5 Broadband

Fresh approaches to connecting the next billion

International Telecommunication Union

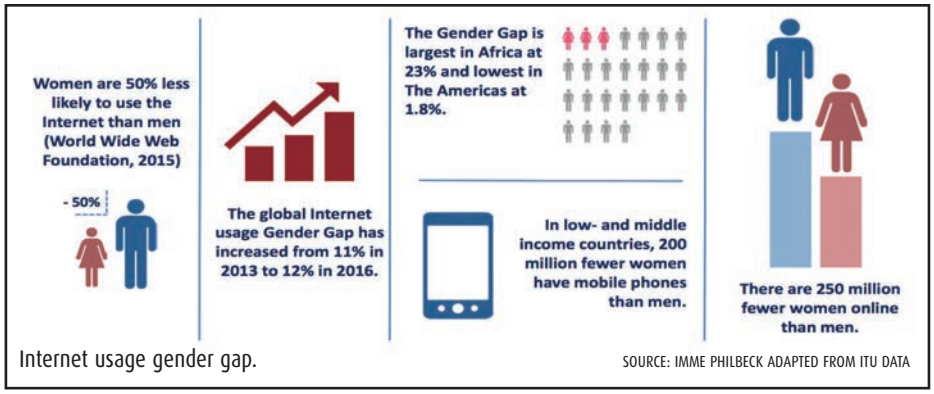
There are still some 3.9 billion people, more than half the world's population, who have never been online and are therefore excluded from all the knowledge and opportunities that are so readily accessible to nearly half the world.

Moreover, the offline population is disproportionately female, rural and poor; among those still unconnected, some 58 per cent are female and roughly 60 per cent are rural. These data must translate into future national connectivity action plans that ensure gender equality (in terms of access, skills and opportunities) and that the rural poor are fully included.

Therefore, global leaders must urgently accelerate progress toward universal and affordable access to ICTs if the world is to meet the UN's Sustainable Development Goals (SDGs) by 2030. During a Special Session co-organised with the World Economic Forum held in Davos, Switzerland in January 2017, the UN Broadband Commission for Sustainable Development called on governments around the world to prioritise broadband connectivity in countries and regions under their influence.

Speaking at the time, ITU secretary-general Houlin Zhao told government ministers, UN leaders and C-suite industry executives that fresh investment models were needed to unlock the power of ICT connectivity that fuels growth in today's digital economy.

"Without more innovative public-private partnerships and leadership, we will miss our opportunity to fast-forward progress on the SDGs," said Zhao. "We will miss the chance to improve lives for everyone, no matter who they are or where they live."



Internet usage gender gap.

SOURCE: IMME PHILBECK ADAPTED FROM ITU DATA

The leaders in attendance identified and addressed several key areas. These included: new financing models for broadband infrastructure; new last-mile business models; new country partnership models; and new approaches to ending the gender digital divide.

They also discussed the critical role of responsive leadership to drive progress in each of these key areas, and how they could work together to lead the charge to connect the world's next billion people. "Broadband access is about leadership," said Irina Bokova, UNESCO director-general and Broadband Commission co-vice chair.

The ITU contributed a discussion paper, written by independent consultant Imme Philbeck, to the Davos Special Session. It stated that the regions faced with the most significant challenges in overcoming internet adoption barriers are Africa and Asia-Pacific.

According to Philbeck, Africa still faces challenges in relation to all internet adoption barriers, including affordability and relevance, capability and infrastructure. She wrote: "Africa is the region with the highest rural population at 62 per cent[1]. It also shows the lowest levels of income and education[2] as well as the highest internet usage gender gap."

The report continued by saying that while at the country level there is very high variability in the data for a range of ICT indicators, women fare poorly across almost all regions and development levels.

The GSM Association estimates that 1.7 billion women in low and middle income countries do not own mobile phones, and that women are on average 14 per cent less likely than men to own one.[3] In terms of access, women are 50 per cent less likely than men in the same age group and at similar education and income levels to be connected to the internet than men.

[1] ITU research shows that 33 out of 46 African countries have a proportion of rural population of 50% or more, and 23 out of 46 African countries have a rural population in excess of 60%.

[2] Alliance for Affordable Internet (A4AI) *Affordability Report 2015-2016,* p.14 & 18. The report shows that most African countries are within the lower half of the 51 countries that have been examined as part of the Affordability Development Index. A large proportion of African countries have literacy rates of less than 70% (19 out of 37 countries that data was available for).

[3] GSMA 2016, www.gsma.com/newsroom/press-release/results-of-new-mobile-phone-gender-gap-survey/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The key socio-economic drivers of internet access for women are education and age.[4] In terms of use, women are half as likely to speak out online and a third less likely to look for work than men.[5] In this regard, Philbeck said the *A4AI Affordability Report* highlights lack of knowhow and technical literacy, as well as the high costs to connect as the key reasons for not being online for women who live in urban areas.[6]

The ITU's *Measuring the Information Society Report 2016* report highlights a persistent gender gap[7] in relation to internet use, which is largest and has widened between 2013 and 2016 in Africa (from 20.7 to 23 per cent) and the Arab States (from 19.2 to 20 per cent).[8]

ITU research reveals that, based on current population and connectivity trends, the next billion to come online by 2020 are most likely to be: urban; from Asia-Pacific and the Americas; and live in areas that are already within reach of wireless and wireline infrastructure; and not among the poorest.

Connecting the next billion is not just an infrastructure issue, according to the paper. The research uncovered the importance of driving demand, including increasing the affordability of online services and, notably, increasing the availability and relevance of local-language applications and content.

On the supply-side, the key areas in which to focus investment for connecting the next billion include new 'last-mile' technologies, network expansion or upgrade, and broadband rollout. Moreover, for the remote and rural populations of the next billion, new financing models for connectivity are needed to cover so-called 'uneconomical' areas where return on investment proves more challenging.

"Without pathways to connectivity, we will not achieve sustainable economic growth," said Paul Kagame, Rwanda president and Broadband Commission co-chair. He added that Rwanda aims to achieve universal access to broadband by 2020. ■

[4] A4AI *Affordability Report 2015-2016*, Chapter 4, p.32.

[5] World Wide Web Foundation, *Womens' rights online: Translating Access into Empowerment*, 2015, http://webfoundation.org/docs/2015/10/womens-rights-online21102015.pdf

[6] A4AI, p.32. Also, women earn on average 30% to 50% less than their male counterparts, see www.researchictafrica.net/publications/Evidence_for_ICT_ Policy_Action/Policy_Paper_13_-_Lifting_the_veil_on_ICT_gender_indicators_in_Africa.pdf

[7] Gender gap is defined as the difference between the internet user penetration rate for males and females in relation to the internet user penetration rate for males, expressed as a percentage.

[8] At the global level, it has also widened from 11% to 12.2%; at the developing level from 15.8% to 16.8%; and LDC level from 29.9% to 30.9%. The gender gap has slightly narrowed in Europe (9.4% to 6.9%), CIS (7.5% to 5.1%), and at the Developed Country level (5.8% to 2.8%). The Americas has the lowest gender gap at 1.8%. It is the only region where more women were online than men in 2013. See ITU, *Measuring the Information Society Report*, Chapter 6, 2016.

The insatiable desire for capacity boosts

By the end of 2016, 3.9 billion people around the world will still remain cut-off from the internet, according to ITU data. In its latest *ICT Facts and Figures 2016* report published in July, the union said that while almost one billion households in the world now have internet access, 84 per cent of them are connected in Europe compared to 15.4 per cent in Africa. So what were companies doing to solve this? Increasing coverage and capacity, of course.

SES played its part by boosting broadband connectivity in East Africa with the launch and support of new services. In November 2015, it unveiled *SES Broadband* for Ethiopia, Ghana, Kenya, Nigeria and South Africa. The satellite operator said it would offer up to 1Gbps for both customisable data rates and fixed packages. It claimed the new service would have more than 99.5 per cent availability and be supported by a "highly responsive" round-the-clock operations team.

In a separate deal, Intersat said it would expand its internet services to East Africa using Ku-band capacity on SES's *NSS-12* via the Djibouti teleport. The firm said it would offer shared and dedicated internet services delivered via iDirect VSAT technology, with a capacity of up to 70Mbps. "Intersat is in the business of breaking down the price barrier that has held back the majority of Africans from benefiting from the internet," said Subrata Roy, CTO, Intersat.

Uganda saw a new broadband service launch. ISP iWayAfrica used Yahsat's

JANUARY 2016

The second phase of expanding ACE has now begun. It will extend the subsea cable network 5,000km from São Tomé and Príncipe to South Africa. The development of the second phase was originally announced in 2015. When it is completed by the end of 2016, ACE will cover a total distance of 17,000km, enabling access to high-speed internet services for up to 25 countries. As well as São Tomé and Príncipe and South Africa, phase II will connect DRC, Congo-Brazzaville, Angola and Namibia. An extension to Cameroon is also included.

FEBRUARY

The *AAE-1* cable consortium will use Xtera's high-capacity, long-haul optical transport solutions to equip the three terrestrial segments in its 25,000km network connecting Asia, Africa and Europe. They comprise crossing Egypt to connect the Mediterranean and Red Seas; crossing the Thailand peninsula to minimise the latency for the landing sites in East Thailand; and crossing Malaysia to connect the cable landing station north of Kuala Lumpur to Singapore. All three are based on two physically diverse fibre routes in order to maximise network availability.

MARCH

Casablanca-based cloud services provider N+ONE Datacenters has launched Morocco's first neutral IXP (internet exchange point). With support from France-IX and offering the promise of improving in-country connectivity, the CASIX IXP aims to give ISPs and content delivery networks (CDNs) a neutral location for peering. According to N+ONE, this means less reliance on international IP transit and its associated costs, and also eliminates the possibility of the IXP owner, which is often a carrier, of having influence over the peering community or their customers.

APRIL

PCCW Global will build an undersea cable system connecting Africa with the Middle East and South Central Asia. The Hong Kong based telco has signed agreements with MTN, the Saudi Telecom Company, Telecom Egypt and Telkom South Africa to build the *Africa-1* cable. As a minimum, the system will feature a three-fibre core that stretches more than 12,000km across Africa's east coast, with up to a further 5,000km for additional branches. The consortium plans to launch commercial services in 2017.

MAY

iWayAfrica Zambia has launched fibre-to-the-premises (FTTP) services for enterprises and consumers. The firm says the new service has already been successfully deployed to major corporates seeking to establish dual-links for redundancy purposes. Ulrich Lassen, head of business at iWayAfrica Zambia, says: "The

Intersat will expand its services to East Africa using Ku-band capacity on SES's NSS-12 via the Djibouti teleport.

YahClick service to provide broadband coverage across the country. The two companies are providing user equipment, installation, and customer care services. They say they are offering packages designed to cater to the needs of business and home users, and claim subscribers can now instantly connect to the internet from anywhere in Uganda using a small dish and satellite modem. iWayAfrica said satellite technology is providing reliable internet services, even in the remotest places, without the need for terrestrial infrastructure.

"The partnership will enable iWayAfrica to offer Ka-band VSAT connectivity in areas within Uganda not currently covered by other service providers," said iWayAfrica's Uganda CEO, Godfrey Sserwamukoko.

Elsewhere on the continent, Botswana Fibre Networks (BoFiNet) inaugurated its 32km Kachikau-Parakarungu fibre network. Speaking at a ceremony to mark the occasion in mid-October 2016, company chairman Ratsela Mooketsi said villages in the region now have the capacity and capability to host high-speed access network stations. He said the project offers the country's established service providers, such as BTCL, Mascom, Orange, *et al*, a platform to deploy broadband technologies. "This will greatly assist in the upgrading of existing infrastructure which was becoming obsolete and no longer capable of supporting today's bandwidth hungry users," said Mooketsi.

BoFiNet spent around BWP12.8m (USD1.2m) on the civil and cable works, as well as BWP5m (around USD477,000) on the transmission terminal equipment, shelters and power complete to the project. The implementation started in March 2016 and was completed at the end of May 2016.

High-end users were the target market for Malawian ISP Skyband. The operator is now using RADWIN's point-to-multipoint (PMP) platform to serve major corporate customers in Blantyre and Lilongwe.

RADWIN specialises in sub- 6GHZ wireless systems, and Skyband has deployed its *JET Beamforming* PMP solutions in licensed 3.X GHz band for its enterprise users which include banks and government organisations.

Skyband said the major challenge during implementation was the high interference in the cities where many of its customers operate. The ISP said *JET*'s *Smart Beamforming* technology mitigated interference, enabling it to maximise frequency planning and channel reuse.

"[The] solutions allow Skyband to stay ahead of the competition and provide valued enterprise clients with ultra-capacity SLA service," claimed Skyband CTO Asif Kassam.

Feeding the last mile

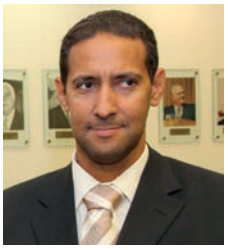
The capacity for operators to provide a good broadband service will ultimately rely on the fibre networks that connect Africa to the rest of the world. There were a variety of new cables and upgrades during 2016.

One such project comes from Liquid Sea, a wholly-owned subsidiary of Liquid Telecom. The firm is building a new submarine cable that will run approximately 10,000km from South Africa to the Middle East with onward connectivity to Europe.

The system will connect to the operator's pan-African terrestrial network to offer what's claimed to be a "reliable and affordable" international connectivity service to landlocked and coastal countries in Africa. Liquid said the project will also include landing stations in several ports that are currently not served by existing undersea cables.

Liquid Sea promised it would offer speeds of 20-30Tbps which are said to be up to 10 times the capacity of existing submarine cables in the region. The project is already fully funded and will take around two years to complete.

Another new cable announcement came from Angola Cables and NEC who will build the southern hemisphere's first subsea



Angola Cables CEO António Nunes said SACS will support the region's expanding data requirements both for today as well as into the future.

launch offers customers a full turnkey solution for their communication needs. This extends from dedicated internet, IP transit, MPLS, VSAT backhaul and redundancy, to numerous value added services such as mail hosting and backup."

JUNE

Epsilon will deliver a complete communications hub for BringCom, providing interconnection with more than 500 operators across the globe. BringCom manages the Djibouti Teleport through a joint venture with Djibouti Telecom, and its MPLS network connects 17 countries in Africa. With an outsourced solution, Epsilon says the operator will be able to focus on developing its satellite and fibre infrastructure in emerging markets in Africa, the Middle East and the Caribbean.

JULY

Huawei has joined the Smart Africa Alliance (SAA) as ICT advisor and 'Platinum' member. Smart Africa is a commitment from African heads of state and government to accelerate sustainable socioeconomic development on the continent through affordable access to broadband and ICT usage. Huawei has been working in Africa since 1998. It will support Smart Africa through the deployment of flagship projects, experience sharing, and talent cultivation.

AUGUST

The Communications Authority of Kenya has advertised the initial infrastructure tenders to increase access to broadband services in the country. The initial findings of a study commissioned to provide a roadmap for its universal service fund (USF) strategy were released 21 January 2016. It revealed that around 94.4 per cent of the population has access to ICT services while 5.6 per cent remain unserved, accounting for around 2.66 million people. Of the KES2.94bn USF collected so far, KES1.5bn has been set aside for projects focusing on voice and broadband. The full report was completed in March and released in April. The authority had said the tenders were likely to start appearing in September but August saw a tender to bring broadband to selected secondary schools being advertised on their website.

SEPTEMBER

In a project valued at INS29m (USD7.6m), Israel-based MER Group has been contracted to deploy a 330km long optical fibre communications network in an African country. MER is a specialist supplier of communications, security, intelligence and cyber solutions. This latest deal, announced in late September, is its third optical fibre project on the continent. While the company has not named the country it will work in, it says the project is for a new client and will provide a broadband high-speed internet connection for residents of a West African nation.

fibre optic cable system to link Africa and South America. The USD160m *South Atlantic Cable System (SACS)* will connect Luanda to Fortaleza in Brazil 6,200km away. From there, it can join the 17,800km *America Movil Submarine Cable System-1 (AMX-1)* which stretches to Miami, enabling Africa to connect directly to the USA.

It's claimed the system will feature the latest optical technologies to provide the most advanced submarine telecoms system. It will also be integrated with a control plane based on SDN technology to serve bandwidth-intensive applications. *SACS* will have an initial design capacity of 40Tbps (100Gbps x 100 wavelengths x four fibre pairs) and is expected to go live by mid-2018.

Cameroon's broadband connectivity was improved thanks to the Nigerian-Cameroon Submarine Cable System (NCSCS) which went live in 2016. Work on the NCSCS started in June 2015 following a partnership between Cameroon's Ministry of Post and Telecommunications, MainOne, and Huawei Marine Networks.

The new cable connects Kribi in Cameroon with Lagos. MainOne said the six-pair, 1,100km repeater system has been lit with 40GB capacity from day one and will deliver capacity of up to 12.8Tbps in Cameroon. It is expected to boost the country's extremely low fixed broadband penetration which was estimated to be around five per cent.

David Nkoto Emane, GM of Cameroon Telecommunications (Camtel), said: "The NCSCS enables us to provide users with faster bandwidth connectivity at a significantly lower cost. By providing direct connection to Nigeria, [it] will also serve to enhance Cameroon's position as the major bandwidth hub in the region and to Europe and beyond."

It wasn't only new cables that were making (or promising to make) broadband ever faster and accessible. Several upgrade projects were also carried out over the year

For instance, MainOne enhanced its submarine network between Nigeria, Ghana, and Portugal to a 100G wavelength system. The upgrade was carried out using Xtera's *Nu-wave* Optima optical networking platform. The system now has an upgradable capacity of more than 10Tbps.

In other news, MENA (Middle East and North Africa) announced it had also upgraded its submarine cable system and could now rapidly deploy bandwidth in increments of 100Gbps. The operator is using Infinera's *DTN-X XTC Series* transport platform to integrate its subsea network connecting the Mediterranean and Middle East regions with its existing Infinera terrestrial network. The vendor said its platform allows MENA to deliver 100Gbps of coherent transmission capacity via 500Gbps 'superchannels' today, while supporting scalability to provide terabit superchannels in the future.

The links between North Africa and Europe received an expansion when the Libyan International Telecommunications Company (LITC) and Sparkle, the international services arm of Telecom Italia Group, upgraded their jointly owned cable. As a result of increasing demand for advanced services between Libya and Europe, the 570km long cable connecting Libya to Europe through Sicily has been fitted with 100Gbps technology.

The challenging road to staying connected

Offering broadband services is not always a smooth road to travel. South African operator Telkom said it was ramping up efforts to migrate customers to wireless and fibre technologies in an effort to tackle cable theft syndicates.

Speaking in May 2016, the company said more than 6,000 incidents of theft had occurred across its copper network during that past year, and that thieves were becoming more sophisticated.

Telkom spokesperson Jacqui O'Sullivan said: "These criminals now target our manholes armed with customised heavy duty vehicles, allowing them to hitch the cable to the vehicle and drive out kilometres of cable, cutting off thousands of customers in a single incident."

O'Sullivan said that dealing with the crimes is challenging. For example, she said there are areas in the Western Cape where gang violence sometimes makes it dangerous for the company to send in technicians to replace stolen cables. "In many high-theft areas, cable is repeatedly stolen, sometimes within days after replacements or repairs," she added.

For the 2015 financial year, Telkom spent ZAR100m on cable theft repair costs and an additional ZAR107m on security services. The company said it was now looking at migrating customers in high copper theft hotspots to alternative technology platforms such as Wi-Fi and fibre which are not so desirable for criminals. For instance, Telkom said 4,000 customers had already switched to its wireless *Waya Waya* service which does not rely on a copper network. Using a mains-powered GSM device, subscribers could retain their landline numbers while also benefiting from SMS functionality and other features.

Earlier in the year, Telkom had also launched a trial giving customers an opportunity to upgrade their copper-based connectivity to fibre for free *(see Broadband taking off, p64)*. As part of its ongoing efforts to reach more people and places across South Africa, the operator is now using Vumatel's open access fibre network to complement its own cable infrastructure.

It's not only cabling on land that suffers from problems. On 17 October 2016, SEACOM announced that it had identified a 'shunt fault' in the Mediterranean Sea between Egypt and France. A shunt fault

OCTOBER

Tunisie Telecom (TT) has successfully completed a series of tests of G.fast access technology with ADTRAN. G.fast stands for 'fast access to subscriber terminals' and is standardised as part of the ITU-T G series of recommendations (hence the letter 'G'). It is a DSL protocol and aims to deliver between 150Mbps and 1Gbps over local loops shorter than 500 metres. However, using ADTRAN's *500G* series testing equipment, it's claimed TT's G.fast experiments saw high-speed services reaching more than 800Mbps at a distance of about 100m on an existing copper infrastructure.

NOVEMBER

Omantel Wholesale is interconnecting the *Gulf to Africa (G2A)* and *Silk Road Gateway-1 (SRG-1)* cable systems to deliver ultra-low latency networking between Asia and Africa. *G2A* connects Oman to Somalia via two redundant landing stations in Puntland (Bosaso) and Somaliland (Berbera). Omantel says the system provides onward connectivity to Ethiopia and will connect Kenya, Mogadishu and South Africa in later phases. *SRG-1* connects Oman to Pakistan with onwards connectivity to Afghanistan, China, Iran, Turkmenistan and Tajikistan.

DECEMBER

Regulatory approval comes through for Liquid Telecom for its move to create what's claimed to be the "first pan-African fibre player". Liquid Telecom will acquire South African converged communications operator Neotel. Liquid partnered with investment group Royal Bafokeng Holdings (RBH) which has a 30 per cent equity stake in the venture. Neotel's current owners had agreed a sale price of ZAR6.55bn (USD4.28bn). Liquid said the acquisition will create the continent's largest broadband network comprising 40,000km of cross-border, metro and access fibre.

occurs when a submarine fibre cable's insulation becomes damaged, creating a short circuit when seawater comes into direct contact with the metallic core.

SEACOM said all transmission traffic on the East Coast of Africa to and from Europe was affected as a result of the incident. It said that while customers with IP services remained unaffected, they could experience higher latencies with possible degradation of service, as traffic was predominantly re-routed via WACS and SEACOM's network to the Asia gateways.

The company mobilised a vessel to facilitate the necessary repair work, which affected services whilst being carried out. A smooth operation with no delays due to weather or sea conditions meant that the fault was successfully repaired on the target date of 28 October.

Services are on cloud nine

The success and maturity of Africa's broadband infrastructure can be gauged by how far cloud services have come. Offering services via the cloud is only really an option when you have stable, fast connections.

Last year saw Burkina Faso claiming to have become the first West African nation to use cloud networking. The country is using the cloud to enable connectivity between public departments and municipalities via an e-government platform.

The project is part of an ambitious ICT strategy being administered by the country's Ministry of Development of the Digital Economy and Posts (MDDEP), and forms an integral element of Burkina Faso's Economic and Social Development Strategy.

Financing for the project was facilitated by the Danish government through the Danida Business Finance agency which is contributing EUR30m. Under an agreement with the ministry, Alcatel-Lucent is supporting network and infrastructure operations. It will supply its NFV, *Cloudband* and IP platforms which will be integrated into the government's 'G-Cloud' infrastructure. This is being built around virtualised network resources from cloud nodes in Ouagadougou and five provinces. Around 400 buildings in 13 regional urban centres will be connected via a 513km fibre optic IP/MPLS WAN. Alcatel-Lucent will also provide a training and development programme for more than 100 government staff.

Backhaul is being provided by an 800km fibre transmission system that will become part of Burkina Faso's National Fibre Optics Backbone.

South Africa also boasted progress into the world of cloud. Vodacom claimed it would become the first company in the country to offer cloud managed enterprise products such as IaaS and SAP-certified PaaS.

The operator now hosts a fully redundant IBM *CMS Cloud* delivery centre for Africa in its Midrand and Roslyn data centres. This is the first *IBM Cloud* centre to be rolled out in the Africa and Middle East region. The cloud services are linked via Vodafone's global IP VPN network to IBM's CMS platform in multiple locations in Europe.

Vodacom said customers will benefit from "significant" savings in investment costs and skills as the partnership with IBM will deliver a solution offering the same world-class standards, skills and services as other IBM Cloud centres across the world.

The operator added that the new service will enable businesses to run critical applications in the cloud with integrated access to a broad array of applications, such as enterprise mobility, security and IoT. It said that the service will also offer faster network speeds along with improved performance and reach to end users.

Vodacom Business chief officer Vuyani Jarana suggested the upsurge of enterprise cloud computing on the continent was being driven by large enterprise and multinational organisations expanding their presence and IT requirements across Africa.

MDDEP minister Nébila Amadou Yaro (pictured second from right) said the G-Cloud project will lead to micro and macro economic growth in Burkina Faso.

Within weeks of Vodacom's announcement, the MTN Group revealed it had selected UK-based cloud specialist BCSG to deliver SaaS and IaaS solutions to enterprise customers.

Using BCSG's *Cloud Management Platform*, the operator has initially launched its *Business Cloud Services* platform targeting SMEs in Swaziland, Rwanda, Uganda, Ghana and Cameroon.

All the applications and services are available from a single web portal and will be offered across a variety of MTN channels. The operator said there will be one log-in to access all the services, managed through a "user-friendly" dashboard, wherever the business has an internet connection and by using any device.

Speaking at the tie, Debbie Minnaar, acting executive of MTN Group's enterprise business unit, said the platform was developed to address some of the "pain points" experienced by its business customers, especially SMEs.

"While the benefits of cloud services for SMEs are numerous, the process of accessing and purchasing such services can be daunting," she said. "Through the *MTN*

Rahiel Nasir, Editorial director, The African Wireless Communications Yearbook 2017

The year ahead: As I write this in mid-March, the UN's Broadband Commission for Sustainable Development has just held its Spring meeting and committed to what it said were "concrete actions that will spur the roll-out of broadband around the world".

Once again, the commission's co-chair and president of Rwanda Paul Kagame highlighted the importance of broadband for the "betterment of economies and societies", while ITU secretary-general Houlin Zhao once again spoke about how critical it was for the UN to achieve its Sustainable Development Goals.

Year in, year out, the UN/ITU invests a great deal of time and resources in international talking shops only to bang out the same message every time. We all know broadband is a much needed utility, and if there is one thing for sure in 2017 it is that we will continue to hear that from the Broadband Commission.

In Africa, things continue to move on the broadband front. With more satellites, 4G and fibre on the way, technology will continue to enable greater broadband access across the continent. The means to gain that access, such as smartphones, will also continue to grow.

But in order to be a truly mass market proposition and reach those at the so-called 'bottom of the pyramid', prices for connectivity as well as for all the necessary equipment have to be significantly lower. Failing that, Africa runs the risk of seeing a new divide between an urban and predominantly middle class 'digerati', and those who lack the means to buy and run the devices needed for broadband.

Business Cloud Services platform, the emphasis is on simplifying this process and meeting customers' needs – essentially we are putting control in our customers' hands."

Broadband taking off

Algeria will see the first commercial rollout of an eLTE system at an airport in Africa. Following its successful bid, Huawei announced in July that it would be responsible for the broadband trunking project at the Houari Boumediene Airport in Algiers. Under the contract, the company would provide an eLTE core network, base stations, trunking terminals, multimedia dispatching, and other devices and systems.

At the time, Houari Boumediene used TETRA for routine scheduling and dispatch. But its narrowband system was said to be insufficient for broadband data transmission, mobile video surveillance, or multimedia dispatch. Furthermore, ground handling services are performed in a complicated and noisy environment, making voice dispatch error-prone and increasing security risks.

Huawei planned to provide a system capable of interworking with the existing TETRA platform to improve the accuracy and efficiency of ground dispatch. The vendor said its real-time, large-bandwidth eLTE platform would enable the airport to carry out multimedia trunking dispatch, video surveillance, and other applications on a single network that covers both indoor and outdoor working areas for the ground staff.

To cope with noise in the airport, Huawei promised its system would support throat vibration mic earpieces, noise-cancelling headphones, and additional accessories to guarantee voice trunking performance.

The company added that eLTE can offer complete video dispatch and real-time monitoring services through backhaul of onsite images to the command centre. It will also provide an open eSDK for interconnection with third-party airport applications.

South Africa continues to be a hotbed of progress for broadband. At the beginning of February 2016, Telkom gave its DSL customers the opportunity to upgrade their copper-based connectivity to a fibre network. South Africa's incumbent telco said that more than 11,000 DSL subscribers living within its fibre footprint would be able to experience the technology at no additional cost.

As part of the trial, customers were allowed to choose to migrate their copper-based 2, 4 or 8Mbps DSL service to an equivalent fibre-based service. During the two-month trial they would be able to test the 10Mbps and 20Mbps line options. At the end of the period, customers could then decide which fibre package to adopt, or they could return to their original DSL service, although their line will have been permanently upgraded to fibre. Telkom consumer MD Attila Vitai said that the unique trial offer was a "win-win" for customers.

The country also boasted a global exclusive. In November 2016, MTN became the world's first mobile operator to deploy and test the *Voyager* open optical packet transport platform, after joining the Telecom Infra Project (TIP) earlier that year.

The TIP initiative had been launched in February 2016 by Facebook, Deutsche Telekom, EE, Globe Telecom, Intel, Nokia, SK Telecom, amongst others. Their aim was to develop fresh approaches to building and deploying telecoms network infrastructure, while at the same time reducing costs and accelerating the rollout of internet connectivity.

MTN is part of the Open Optical Packet Transport project group, and worked closely with the TIP community to field-test the *Voyager* next-generation technology in its South African data centres between 14th Avenue in Fairlands and Soccer City in Soweto.

The tests were carried out at the end of October and the operator claimed the results showed the highest performance with zero packet loss, and potential for significant overall cost savings.

"We are excited about the possibility of bringing more than 19Tbps of connectivity to the community using open optical networking technology," said MTN Group CTO Navi Naidoo. "Open platforms move away from the vendors' proprietary platforms which usually come at a huge cost.

This means that the roll out of the *Voyager* platform will enable operators to install a network at a lower cost, which in turn will result in cheaper connectivity for customers."

The results of the test were presented at the TIP summit held in the US at the start of November. At the time, the next steps were to obtain necessary approvals and explore commercial rollout of the platform. ■

Houari Boumediene airport handles 10 million passengers each year, but the government is building a new terminal to increase its capacity to 14 million.

Frank McCosker, GM affordable access & smart financing, Microsoft 4Afrika

Microsoft is on a mission to empower the continent's communities. In 2013, it launched its 4Afrika initiative, focusing on three critical areas of development for the continent: skills; access to technology; and innovation. It has had many success stories since then, from seed funding startups and mentoring app developers, to providing technical support to public sector organisations and building experimental wireless networks.

"It has been four years since 4Afrika launched its first TV white spaces connectivity pilot in Kenya," says Frank McCosker. "*Project Mawingu* sought to use unused television frequencies to deliver high-speed, low-cost broadband to last-mile areas. Now, sitting in 2017, Microsoft 4Afrika has 15 TV white spaces connectivity pilots running across six countries in Africa, and *Project Mawingu* continues to expand. There are currently 26 schools connected to the technology, and the commercial side of the project has grown from 15 Wi-Fi hotspots to more than 500, serving roughly 100 customers per hotspot."

During 2016, McCosker said Mawingu Networks has received a USD4.1m financing loan from the Overseas Private Investment Corporation. "With this financing, we expect to see exponential growth and rapid deployment over the next year, with affordable access reaching an additional three million people in the short term. All this in an area where, prior to *Project Mawingu*, only 17 per cent of adults and nine per cent of teenagers in the coverage area reported using the internet.

"In February 2017, we also joined forces with Liquid Telecom which operates the largest independent pan-African fibre network, spanning more than 40,000km across 12 countries. Together, we will work to improve and accelerate the use of cloud services across Africa – particularly for SME growth and development – and enable TV white spaces technology and the partner ecosystem to provide further connectivity across the continent. Through better connectivity, faster internet and secure cloud offerings, we hope to help more local businesses scale and succeed.

"Four years on, our commitment to TV white spaces technology remains unchanged. We still believe in the power of wireless technologies to make access to the internet truly affordable in Africa."

Over the last 12 months, McCosker says he has seen a lot of organisations, who were previously invested in fibre and satellite, start to opt for wireless. He reckons this is because wireless technologies, such as TV white spaces, have proven their ability to make access to the internet affordable.

"In emerging markets, the United Nations has set the affordability threshold at five per cent of average income. *Project Mawingu* has come very close to achieving this, currently providing access for only USD3 a month. Wireless is also the most effective technology for achieving affordable last-mile access.

"Governments in Africa are also becoming increasingly open to technology like TV white spaces – albeit some faster than others. The challenge for us has been delivering on the existing demand. Deregulating the markets and scaling the projects takes time.

"Our strategy here has been to take a step back and see what we can do within the existing ecosystem. In May 2016, through our *Affordable Access Initiative*, we awarded grants and technology support to help scale five African companies who are working to bring low-cost internet access and/or cloud-based services to underserved markets. These include VistaAfrica, who are leveraging TV white spaces, cloud and mobile technology to bring e-health services to outlying communities; and New Sun Road in Uganda, who design, build and install *SolPower* micro-grid systems with broadband internet.

"In December 2016, we renewed this fund for a second round and are currently assessing more than 200 local applications. As we continue to deregulate and democratise the market, we hope to see more of these local technologies, services and locally-relevant business models bubble to the surface and thrive."

In the connectivity space, McCosker says last-mile infrastructure, opening up of regulations to allow more competition and reap the benefits of the 'digital dividend', and affordability continue to be challenges.

"But these are challenges where we see opportunities in Africa. Microsoft 4Afrika hopes to scale its current TV white spaces pilots, expanding them into countrywide projects.

"A key element in ensuring this scalability – and sustainability – is in commercialising each project and continuing to deregulate and democratise the markets. We've managed to do this in our connectivity pilot in Ghana. In 2015, the National Communications Authority of Ghana became the first regulator in Africa to issue a commercial license, enabling our partner SpectraLink Wireless to use TV white spaces technology to deliver internet access to students. For as little as two Ghana cedi per day, students can now buy internet bundles, as well as devices on a zero-interest financing plan.

"Microsoft never entered this space to be a connectivity provider. Rather, we are here to be a connectivity *enabler*. We will continue to create enabling markets, invest in local partners, and work with public and private entities to accelerate the development of low-cost internet access solutions. We are in this space to achieve affordable access in its truest sense."

Paul Hamilton, Director, Hamilton Research Ltd., Africa Bandwidth Maps

The continent's fibre optic market has doubled in size over the last five years. By December 2016, the amount of operational fibre optic network in Africa had more than doubled to 790,067 route kilometres, compared to 393,502km in 2011. There was a further 119,690km of fibre network under construction, 100,182km planned, and 51,304km proposed.

There are now 276 terrestrial network operators across the continent, including 107 operators providing a total of more than 400 operational metro/FTTH/FTTB network deployments across the region.

The landing of new submarine cables and expansion of terrestrial transmission networks is bringing additional countries, regions, cities and towns within reach of fibre networks for the first time. In the last five years, network expansion has brought 156 million more people within access to national and international fibre optic backbone networks.

By June 2016, 48.1 per cent of the population in sub-Saharan Africa (469 million people) lived within a 25km range of an operational fibre optic network node

Roughly one-fifth of the total fibre inventory is within cities: out of 790,067km of operational terrestrial fibre in December 2016, at least 130,610km was metropolitan fibre rings and FTTH/B networks. In addition, there was at least a further 44,051km of metropolitan fibre networks under construction. These metro rings distribute bandwidth from fibre optic nodes to districts and suburbs around each city. FTTH/B networks provide the last-mile access, delivering fibre bandwidth right to the door. Certainly, the deployment of FTTH/B is a significant driver in the growth of international internet bandwidth, with business and residential customers subscribing to broadband packages with speeds of up to 20Mbps, 50Mbps or 100Mbps.

2016 saw a growing number of FTTH/B rollouts in sub-Saharan Africa, with the number of homes and buildings passed double during the year to more than one million. Kenya, Mauritius and South Africa are the leading countries by number of FTTH/B deployments, homes or buildings passed and subscribers.

There are now at least 132 operational FTTH/B deployments in more than twenty countries, with recent deployments in Congo (Brazzaville), Côte d'Ivoire (Abidjan), Gabon (Libreville), Ghana (Accra and Tema), and Namibia (Finkenstein Estate). Other FTTH/B networks have been deployed in Angola, Cameroon, The Gambia, Lesotho, Mali, Mozambique, Nigeria, Réunion, Rwanda, São Tomé and Príncipe, Seychelles, Zambia and Zimbabwe.

Whilst the inventory of fibre optic transmission networks in Africa has doubled in the last five years, international bandwidth capacity has increased almost ten-fold. Africa's international internet bandwidth reached 4.555Tbps by December 2015, compared to 3.015Gbps in 2014 and 497Gbps in 2010. At current growth rates, a CAGR of 55.8 per cent from 2010-2015, the continent's international bandwidth will have reached 7Tbps by the end of 2016. The total of 4.555Tbps in 2015 was split between sub-Saharan Africa which increased by 64 per cent to reach 2.759Tbps, and North Africa which increased by 35 per cent to reach 1.796Tbps.

Of the total bandwidth of 2.759Tbps in sub-Saharan Africa by December 2015, 2.594Tbps (94.1 per cent) was supplied directly by submarine cable. There is plenty of room for future growth: 2.594Tbps is still just a fraction of the total design capacity of at least 64Tbps that is potentially now available on the 18 submarine cables serving the region in December 2015. The total design capacity has increased both with the introduction of new submarine cable systems, and with the upgrading of capacity on existing systems from legacy 2.5G wavelength technology to 10G, and from to 40G to 100G and potentially 400G. As a result, the total design capacity has increased from 59Tbps in 2014, 26Tbps in 2013, and 13Tbps in 2011.

While 469 million people lived within a 25km range of an operational fibre optic network node in June 2016, only 55 million lived within a 25km range of a submarine cable landing point. A look at the map of metro/FTTH/B deployments[9] clearly shows that the pattern of deployment of FTTH/B reflects and is underpinned by the fibre transmission infrastructure to support it. Nearly all deployments are in cities which are either directly connected to submarine cables, or are connected with multiple high-capacity national and regional fibre networks connected to submarine cables.

In the same way that the capacity which is activated on submarine cables is stepped up in line with demand, this is true also of national backbones and terrestrial cross-border links. Domestic network operators have incrementally increased capacity on their networks in line with demand, typically from STM-4 (622Mbps) to STM-16 (2.5Gbps) and STM-64 (10Gbps).

For example in Botswana, BOFINET has been expanding the reach of its national fibre transmission network from 6,000km to 7,000km during 2015/6. It is deploying FTTx networks in Gaborone, Kasane, Kazungula, Maun and Francistown, and has upgraded transmission capacities on parts of its national backbone, notably those carrying international traffic from STM-16 (2.5Gbps) to STM-64 (10Gbps).

In a growing number of cases, operators are upgrading their terrestrial fibre networks from 10G to 100G, typically along major trunk routes serving submarine cable landing points. There are several examples here.

In 2011, SEACOM deployed 100G on its fibre route in South Africa from the Mtunzini landing station to Gauteng, and in 2015, 10G and 100G WDM solutions on new metro networks in South Africa and East Africa and its East African regional backbone.

In 2012, GBI announced it had deployed 100G on Telecom Egypt's terrestrial fibre route across Egypt connecting the submarine cable landing stations on the Red Sea (Zafarana) and Mediterranean (TE Transit Corridor).

In 2013, Liquid Telecom awarded a contract to Ekinops for its new long-haul 2,500km DWDM network across South Africa, Zimbabwe and Zambia. The new network carries multiple 10G wavelengths, can scale to support many more 10G and 100G services, and was built to accommodate the growing demand for bandwidth in the region.

In a separate deal in February 2017, Ekinops also won a contract to upgrade the transmission capacity of Orange Côte d'Ivoire's fibre network along main strategic routes from 10G to 100G without changing the network's existing infrastructure.

Meanwhile further east in Kenya, by September 2016 Safaricom had upgraded 70 per cent of its national fibre optic backbone to 100G, compared to 30 per cent by 2015.

Nic Rudnick, CEO, Liquid Telecom

According to Nic Rudnick, Liquid Telecom is the only company to provide access to 12 countries across the continent through a single fibre network. He claims the company is continuously exploring ways to expand its network reach, and says there were several "exciting" developments in this respect last year.

"There is, of course, our agreement to acquire South African communications network operator Neotel, which received unconditional approval from the Independent Communications Authority of South Africa (ICASA) in December 2016. The combined network assets and service platforms gives Liquid Telecom unrivalled reach across Eastern, Central and Southern Africa, enabling it to offer access via a single connection to more than 40,000km of cross border, national and metro fibre networks across 12 countries.

"In October, Liquid Telecom also entered into a telecoms joint-venture with utility company Botswana Power Corporation (BPC) in Botswana. The joint venture will commercialise existing optical ground wire

[9] See http://www.africabandwidthmaps.com/ftth/

(OPGW) cable installed alongside BPC's power lines that form part of the country's national grid. This will provide Liquid Telecom with 1,500km of additional fibre across the country, including long distance routes between the Botswana capital of Gaborone and the north-east city of Francistown. The new network will improve telecom infrastructure across Botswana, increasing internet speeds and access for local businesses and consumers.

"In December, Liquid Telecom also received the final regulatory approval to close its latest transaction in Tanzania and has become the majority stakeholder of Raha, Tanzania's leading ISP. Raha today serves over 1500 businesses as well as a growing number of retail customers with a range of connectivity solutions, including fibre, satellite, WiMAX and Wi-Fi. The acquisition provides Liquid Telecom's enterprise and wholesale customers with direct and faster access to Tanzania."

Rudnick says Liquid is driven by bringing high-speed fibre optic services to as many people in Africa as possible. He believes fibre is the future of internet access for the continent's people and businesses, providing a platform for digital growth and innovation.

As well as connecting more of Africa, Rudnick said the company is also committed to improving the quality of service and range of solutions offered to enterprise and carrier customers across the region.

"For example, we were the first operator to build a sizeable FTTH service in Africa, starting in Rwanda, Zambia and Zimbabwe before being further developed in Kenya, Tanzania and Uganda. This provides up to 100Mbps internet access to households and small and medium-sized enterprises. That's among the fastest broadband speeds in Africa and comparable to what's found in the US and Europe. It's a breakthrough service in sub-Saharan Africa, offering speeds that were until now reserved only for the largest multinationals at a premium price.

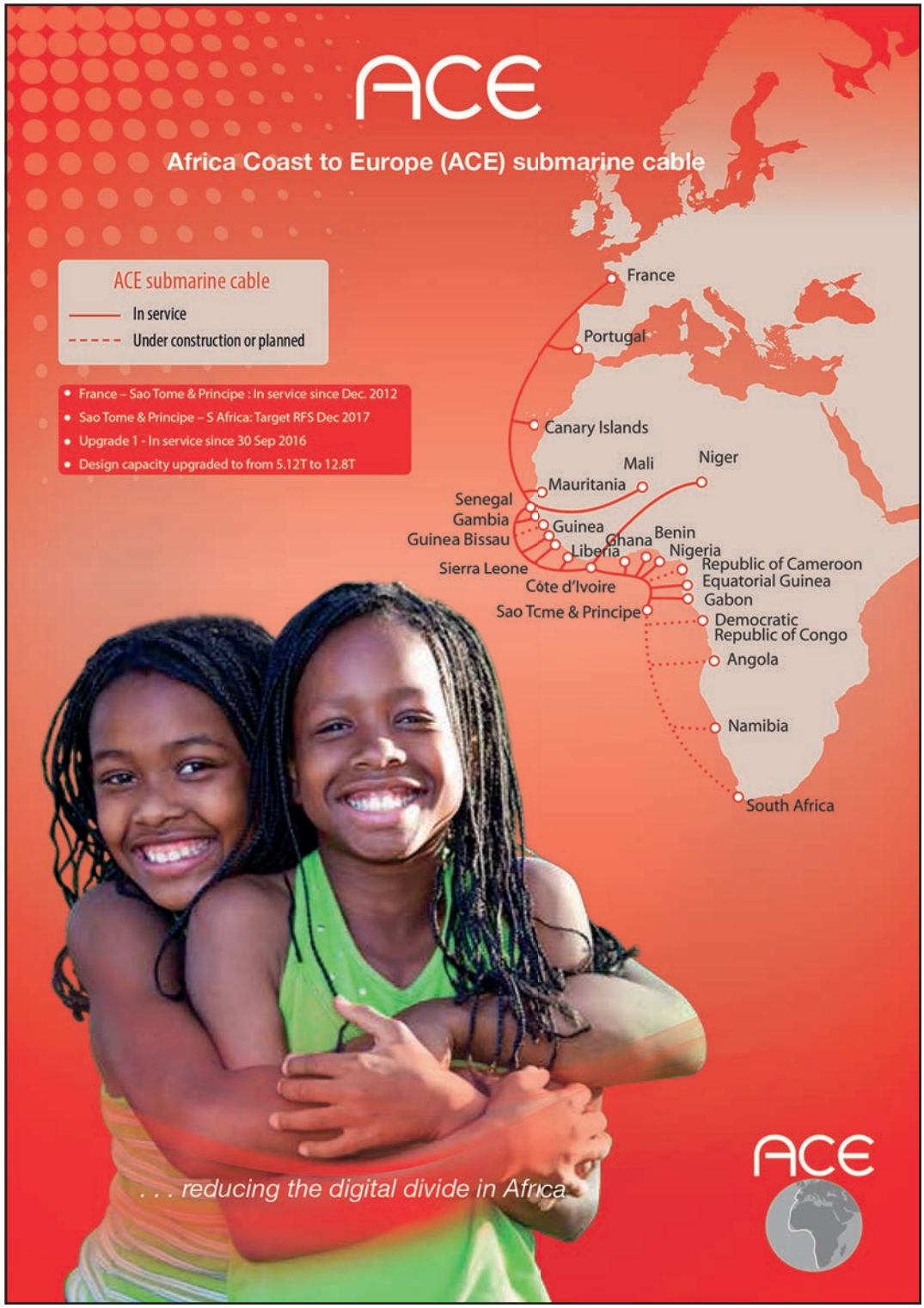
"In the short term, Liquid Telecom aims to double its FTTH network, with an additional 100,000 connections. In some cases, we are delivering fibre to areas where reliable internet connections were previously virtually non-existent, enabling local communities to reap the full benefits of digital services for the first time.

"We are also focused on connecting Africa to the rest of the world. Liquid Telecom is about to start building a new 10,000km subsea cable linking Africa to Europe, the Middle-East and Asia, called 'Liquid Sea'. This will create a more reliable route, additional capacity of 20,000 to 30,000Gbps, and will further help remove bottlenecks."

Of course, none of that will be easy. As Rudnick knows only too well, Africa presents a combination of enormous geographical challenges and regulatory hurdles.

"The distances alone present a unique problem, but our network must also navigate through difficult terrain and hold its own against wildlife – our fibre has been attacked by everything from elephants to giant rats!

"Crossing borders with new telecoms links has been immensely challenging at



times, as has been obtaining the licenses and authorisations to build national fibre infrastructure.

"Despite this, Liquid Telecom has often managed to breakthrough into markets before any other carrier. For example, we were the first to establish continuous fibre connections between South Africa, Zimbabwe, Zambia and DRC."

Rudnick reckons Liquid has accomplished far more than it originally expected since it began life in 1997 as Econet Satellite Services, a subsidiary of Econet Global specialising in satellite and voice services. After rebranding as Liquid Telecom in 2004, the group now employs more than 2,000 people operating over 40,000km of fibre networks in 12 sub-Saharan countries.

"We were recognised as Best African Wholesale Carrier at the Global Carrier Awards for the fifth year in a row – no other company has ever won so many times consecutively before," says Rudnick.

"Moving forward, Liquid Telecom will continue to build on its biggest strategic advantage, which is that we enable people and businesses to connect using a single fibre network covering more than 12 countries. It means an enterprise can connect to another branch on the other side of the continent as seamlessly as if it were located just across the road.

"We will continue to look for further opportunistic acquisitions and partnerships, while at the same time supporting African companies with the highest quality and most extensive connectivity on the continent."

Mike Last, CMO & VP international development, WIOCC

Founded in 2007, Mauritius-based WIOCC (West Indian Ocean Cable Company) famously describes itself as "Africa's carrier's carrier". It is jointly owned by 14, mostly African, telcos that are all said to be "leading" operators in their respective markets. They include: BoFiNet in Botswana; Dalkom Somalia; Djibouti Telecom; Gilat Satcom; Lesotho Communications Authority; Libya's LPTIC; ONATEL Burundi; Seychelles Cable System Co.; TDM Mozambique; Telkom Kenya; TelOne, Zimbabwe; U-COM Burundi; Uganda Telecom; and Zantel in Tanzania.

According to Mike Last, the company's mission is to make an "enduring contribution" to Africa's communications. To achieve this, he believes WIOCC must constantly evolve its capabilities to align with changing industry needs and end-user demands. "With terrestrial backhaul networks now in place across many parts of Africa, it is becoming increasingly vital to offer carriers and ISPs more cost-effective access to their business customers' premises. This will enable them to deliver high-capacity, seamless, end-to-end connectivity solutions at more affordable prices by reducing the cost of local loop delivery.

"In 2016, WIOCC created the largest metropolitan area network in Africa. The Johannesburg MAN offers cost-effective, direct access, over a protected network, to more than 2,000 business premises across 95 business parks and shopping centres in Johannesburg and Pretoria. There has been rapid initial take-up of connectivity and additional MAN infrastructure investments are in the pipeline."

In Somalia, Last says WIOCC has been offering local carriers and ISPs "dramatically increased" international capacity, with transformational latency reductions of up to 80 per cent and improved diversity options. Working with local partner Dalkom Somalia, WIOCC expanded access to international connectivity in the country last year. Last says: "Fibre optic connectivity was extended through a metropolitan area network in Mogadishu, making it easier for an increasing number of residents, businesses, government ministries and embassies to access direct, high-capacity, low-latency, international fibre connectivity for the first time."

Last year also saw the company create international internet exchange points in Europe and the US. "In early 2016, WIOCC established new remote peering internet exchange points in Virginia, New York, Amsterdam and Frankfurt. This not only gave WIOCC's customers enhanced access to the global internet, it also improved WIOCC's network redundancy."

Back in Africa, the company has also scaled up its workforce in Kenya and internationally to serve the needs of an ever-growing customer base. Last hopes all this will put WIOCC in good stead to overcome the foreseeable challenges on the continent in 2017 and beyond.

"Continued investment in network infrastructure is essential if an increasing percentage of Africa's 1.1 billion population are to be able to take advantage of the many benefits that access to high-speed international connectivity offers.

"For WIOCC this means enhancing the reach, capacity and reliability of international connectivity in Africa, whilst continuing to make it ever more cost-effective, through continuing to invest in both submarine and terrestrial cable infrastructure.

"Keeping pace with the rapidly evolving needs of industry and the demands of end-users in Africa is a challenge for all. WIOCC is constantly evolving its capabilities to align with these changing needs. In the early days, carriers and ISPs were looking for pure point-to-point international bandwidth, which then changed to include the need for built-in protection. This has moved on again, with carriers and ISPs now requiring support in delivering the more complex network solutions that their customers are now demanding.

"Over the next 12 months many of our carrier customers will look to extend their own networks into new geographies, and will also seek help in taking their multinational corporation customers further into Africa – at a cost and level of performance that matches their needs and expectations.

"Delivering expert solutions that enable carriers, ISPs, content providers and OTTs to overcome their complex international connectivity challenges is at the heart of what we do at WIOCC. Enabling our wholesale customers to get closer to their own customers is a key objective moving forward, and we see the deployment of further metropolitan networks as a key element in making this happen.

"We will continue to evaluate and pursue opportunities to create additional metropolitan networks, to increase our in-country coverage, and to further extend our network to new African markets."

Yves Bellego, Director of technical & network strategy, Orange

Most of the African countries that Orange operates in are backed by fibre networks, says Yves Bellego. He explains that Orange's need for fibre begins where it has the highest need for capacity, and that's coming from international connectivity.

"Fundamentally, we bring fibre closer to the radio sites. We invested a lot in deploying submarine cables for adding connectivity to the bigger international route, and are now deploying national backbones using pure microwave or a combination of microwave and a fibre. So progressively, we are bringing fibre closer to the different mobile switches and radio sites."

Bellego believes there are two aspects to fibre. One is FTTH and connecting customers. This is very different to the other aspect – creating the backbone networks which include the submarine, terrestrial and international systems.

"Around two thirds of African countries with Orange networks already have national backbones using fibre. That includes our own deployments but we do also rent fibre connectivity. Also, there are still some networks and countries where the national backbone is almost all microwave."

Bellego is keen to point out that microwave is not a temporary solution that gets replaced as soon as fibre becomes available. "For me, fibre, terrestrial microwave and satellite are all technologies that are evolving, costs are going down, capacity is increasing, and we will still need the three of them.

"For us, the latest generation satellites represent a new opportunity, not a threat, because we need to have different technical solutions and use the best one depending on the geography and the level of traffic. Satellite will never be able to compete with fibre into the big cities, but fibre will never be able to compete with satellite into remote areas. So there is a business case for each technology in each area.

"We still need satellite for more remote areas and to connect radio stations that are quite remote; microwave is evolving and is capable of handling the capacity for 4G; and when we have the really huge need for capacity, specially in the big cities, fibre remains the most efficient. So we'll keep all three, although the ratio may vary.

"For example DRC is one of the countries where we have almost full microwave and a bit of satellite. While we don't do many long-term predictions, we plan to upgrade our microwave there as the technology has evolved and now has the capability to carry the traffic for some time.

"So we may not need fibre for a very long time in such areas; in the short- or mid-term fibre will not reach those areas. It is very expensive and we have better and more cost-effective solutions for remote areas with microwave."

Orange is part of the consortia behind the LION 1 (Lower Indian Ocean Network), LION 2 and ACE (African Coast to Europe) subsea fibre systems.

Bellego says it's important not only to have fibre international connectivity but also to have different routes so that services can continue in case one route goes down. And once the global connectivity was in place, Orange could support mobile broadband.

"The deployment of mobile broadband is really the driver for the fibre backbone. The real need came when we started to see take-up of 3G, and it is even more obvious with 4G. So the volume of traffic and the speed that we need to deliver 3G and 4G drives the increase of capacity and performance of the backbone and backhaul networks.

"But it is a step-by-step process. We did international connectivity, we are doing the national backbones, and to have fibre more closer to the radio sites and backhaul will come later because that is really dependent on the increase of traffic."

Editor's note: the above interview with Yves Bellego was originally conducted for the *Digging for glory* feature published in the Aug-Sep 2016 issue of Northern African Wireless Communications magazine.