Moving heaven and earth to bridge the digital divide

2013 will be the year that satellite and fibre really go head to head in Africa. With O3b's much anticipated launch expected in the coming months and the ever increasing rollout of submarine cables around the continent, who will win the battle to connect Africa's remote and rural areas?

Omar Trujillo, Regional VP Africa and Latin America, O3b Networks

As expectations for improved broadband speeds and online user experiences increase across developed and urbanised areas, mobile operators are looking to rural and unconnected regions as areas of huge potential and future growth.

People in South Africa and other sub-Saharan nations are among the continent's most connected, yet much untapped promise remains. Infrastructure in many countries is very poor and mobile phones are often the best and only way to connect and communicate. Yet 36 per cent of all people living within Africa's 25 largest mobile markets have no access to mobile services (source: www.africafocus.org). That's opportunity knocking.

In stark contrast, saturated urban markets pose a host of huge challenges for operators, including competition from other industry players, increased regulation, and rapid traffic growth, often not reflected in revenues. Terrestrial fibre has arrived in much of Africa, especially along the coasts, and at first glance it may appear to cut into satellite's piece of the pie. But in reality, nothing could be further from the truth. Fibre has introduced faster services in the big cities but has so far only managed to whet consumer appetites for such services in small towns and communities that are out of its reach. But new satellite technologies, like those provided by O3b, can deliver fibre-like solutions even in the remotest of villages.

Mobile backhaul is at the centre of Africa's growth opportunity. Traditionally, this has been prohibitively expensive to roll out in rural areas, with the building of towers and infrastructure driving up costs and stamping out possibilities.

Likewise, fixed wireline transmission technologies present similar obstacles. They require extensive management, entrenching and power, as well as the population levels and utilities capabilities which are not found throughout most rural areas. These are just a few of the hurdles that have made it difficult for operators to enhance remote and rural connectivity cost-effectively.

MEO will give the MNO a competitive edge

O3b Networks is on the verge of launching a new medium earth orbit (MEO) constellation aimed at delivering a greatly enhanced internet experience and more affordable solutions in markets outside the profitable reach of conventional satellite and telecom service providers. According to a report from Informa Telecoms and Media, MEO-driven backhaul is the most effective technology, especially when compared with geostationary earth orbit (GEO) satellites.

The first of O3b's new satellites is scheduled for launch in May with services available in the third quarter of this year. O3b differentiators include fibre-like speed and low latency for a high throughput backhaul solution ideal for deploying data services. The MEO satellites are 4.5 times closer to the Earth than traditional GEO satellites. This reduces launch costs and drastically decreases latency from nearly 500 milliseconds to less than 150 milliseconds. That spells the end to the delays and echoes that can make web browsing and phone conversations anything but enjoyable.

In addition, O3b enables operators to deploy voice and data services beyond the reach of terrestrial circuits without compromising on voice quality, data throughput, or performance. Real broadband is the result. When the quality of the

Left: O3b's much anticipated Medium Earth Orbit satellites are expected to begin launching in May. **Right:** fibre can be cost effectively and easily deployed in remote and rural areas alongside new infrastructure projects such as electrification, and building roads and railways.

user's mobile experience improves, MNOs who offer these MEO-delivered backhaul offerings will have a competitive edge – an advantage that will be tough to beat as African markets mature. To differentiate themselves, operators are looking for ways to increase speeds, reach, and profitability while driving down costs. MEO-backhaul provides global reach, low latency, and the ability to extend services to new markets and boost market share. In a region where communications is predominantly delivered and consumed on mobile devices, high-performance mobile broadband is sure to accelerate economic development and growth, allowing operators to add subscribers in rural and emerging markets.

Ahead of the curve

Rather than give up on satellite in favour of fibre, many key customers across the region have already spotted the potential of MEO satellite technology. For example, wireless broadband services provider Netcom Africa has secured a chunk of O3b's capacity to deliver high-capacity connectivity to ships and drilling rigs off the coast of Nigeria. Service providers have really struggled to meet the unique needs of the continent's oil and gas industry, despite the arrival and availability of fibre on the coasts. For the first time, Netcom's offshore customers will be able to talk with friends, family and colleagues without delays, and large data files can be delivered to and from shore quickly and seamlessly.

The Etisalat Group already serves more than 100 million customers across Africa, the Middle East and Asia, and is poised to meet long-term capacity demands across these emerging markets together with O3b. Armed with cutting-edge satellite broadband services, each regional Etisalat operation will have a competitive market advantage. The end result is reduced costs, increased network efficiencies and broader, connectivity-driven success.

Johannesburg-based ICT solutions provider Mavoni Technologies will use O3b capacity to deliver connectivity at fibre-like speeds in Limpopo, Mpumalanga and the Northern Cape, where nearly 2,000 schools will be connected in rural areas alone.

The challenges of delivering high-speed internet connectivity in remote Africa are steep and often impossible for traditional and terrestrial solutions to overcome. Small, rural communities and villages often lack the population and economic potential to justify a viable business case for dedicated wired networks. O3b was originally created to help solve the connectivity challenges in such places. Demand is high and the door is wide open to providers who can deliver high-quality and affordable services in this relatively untapped region. O3b's Ka-band capacity will soon embark on a global debut that is sure to ignite a new wave of opportunities and connections in Africa and beyond.

Dr Jabulani Dhliwayo, Market development manager, Africa, Corning Optical Fiber

Since the turn of the century, the deployment of 12 optical cables with design capacity of over 20Tbps along Africa's shorelines has gone some way to bridging the digital divide between the continent and the rest of the world. However, a massive gulf still exists between the region's urban and rural areas.

Only 13 per cent of Africa's population is currently connected to the internet and of these, the majority live in urban areas. That means rural communities have very little or no connectivity. So far, most attempts at providing broadband access for landlocked communities have focused on wireless technologies such as mesh or GSM-based solutions. However, the majority of these mobile networks use very low-capacity satellite links or microwave relays to connect remote communities. But without high-capacity fibre-optic backbone networks, users in these locations are unable to take advantage of emerging broadband services that could improve the quality of their lives. Without this internal connectivity, the tens of terabytes per second of capacity at African shores will be quite irrelevant.

Optical fibre can replace long-distance microwave links to ensure profitability for operators and ultimately deliver the benefits of the continent's submarine connectivity to the people of Africa's more remote communities.

The current status of African connectivity

In 2000, the UN issued its Millennium Development Goals whereby ICT was identified as a key vehicle for sustained economic development. Subsequently, African leaders and key industry players have focused on making broadband available to as many people on the continent as possible. Yet most of this is still concentrated in urban areas.

African governments have pushed for ICT programmes that support improvements in areas like health and education; but sadly the people who could benefit most from such initiatives live in rural areas where there is an acute shortage of essential broadband infrastructure.

In 2000, Africa relied mainly on satellite networks, coaxial cable, or microwave relays to communicate – the exception being a few countries in North Africa and Senegal, which was served by undersea cables such as SE-ME-WE-2 and Atlantis. By 2002, SAT-3/WASC/SAFE was connecting South Africa and the west coast to Europe and the Far East. About a decade later, there were more than 10 fibre-optic networks connecting the region with a combined design capacity of more than 20Tbps. It was becoming increasingly clear that it would take fibre-optic networks to bridge the continent's digital divide.

According to World Bank statistics, 60 per cent of people in sub-Saharan Africa live in rural areas where the main and readily-accessible form of

broadband is very costly satellite connections. For example, a 4Mbps connection via VSAT can cost more than USD2,000 per month with download data limited to only 30Gb. This problem could be alleviated by deploying fibre backbone networks deeper into rural communities, reducing the price of connectivity.

Africa has seen phenomenal growth in mobile penetration to over 60 per cent, amounting to 600 million subscriptions which prove that a real desire for connectivity exists. But still, there is a bottleneck between these subscribers and the near-unlimited submarine capacity at the shores of the continent, with inadequate backbone capacity to transport mobile traffic from one community to another and to the cables.

Reports have shown dwindling operator revenues from voice services, with data and video services offering greater potential for revenue. By making mobile subscriptions broadband-capable, operators could increase their revenue base and rural inhabitants could finally realise Africa's digital potential.

No need for fibre to connect every hut and homestead

Perhaps the greatest challenge in deploying terrestrial long-haul networks in Africa is the size of the continent itself, which has an area of approximately 30 million square kilometres – that's larger than the USA, China, India and Western Europe combined. It also has a low population density of 31 people per square kilometre, which means that deployments require significantly more investment per capita compared to areas with higher densities.

However, the assertion that fibre is required in rural Africa should not be taken to mean that it is needed to connect each homestead and hut. What it needs to do is provide the backbone for most broadband technologies, including mobile. The notion that fibre cannot be deployed to rural areas of Africa is erroneous. But it does require unique approaches and innovative solutions to the challenges unique to this part of the world.

There are a number of key considerations for boosting broadband penetration in the region:

Regulation: Although the regulatory environment in Africa has changed greatly over the past decade with multiple firms now licensed to operate mobile networks, development of regulation is needed.

Rights of way to deploy fibre are often difficult to obtain meaning operators with funding to deploy national backbones could have to wait years before commencing rollouts. When rights of way are eventually granted in this price-sensitive region, they come at significant cost which is a major disincentive for operators to connect rural areas.

This environment could be improved if governments were to offer incentives like subsidies or free rights of way to operators willing to deploy backbone networks to rural areas. Certain governments such as Nigeria's have established such incentive programmes, but these are taking a long time to implement. Other countries, including South Africa, have established universal services funds which require operators to to make annual contributions to. These funds will then be used to subsidise broadband rollouts in underserved areas.

While such initiatives can go a long way to boost broadband deployments, the focus has mainly been on the access portion of networks. It is now recommended that such incentives be extended to backbone networks and their implementation expedited.

Concerted approach to infrastructure: Most (if not all) African countries have some plan to develop infrastructure in rural areas. Roads and railway lines have been built, but perhaps the most prominent of these projects is rural electrification, giving power to previously underserved regions.

Electrification projects can be effectively combined with rural broadband initiatives by requiring power companies to install Optical Ground Wire (OPGW) on all new power lines. OPGW is a composite power grounding cable with fibre-optic strands embedded in it, and provides functionality for both power distribution and communications. Many power companies have installed OPGW with a few fibre strands for internal SCADA applications, but others such as Kenya Power, ESKOM in South Africa, and ZESA in Zimbabwe have deployed further strands to be leased to telecommunications companies.

The additional cost of embedding strands into the ground wire is negligible relative to the cost of deploying power lines, while the long-term benefits for ICT is priceless. It therefore makes sense for all power distribution companies in Africa to adapt this model and deploy OPGW on all new power lines. The same argument applies for underground cabling along new railways and roads to underserved areas.

Innovation: Bringing broadband to remote parts of Africa is not always as simple as replicating solutions that have been implemented elsewhere. Conditions in Africa are unique and network engineers could be tasked with connecting remote areas separated by deserts and jungles. Factors such as this necessitate careful consideration of the initial cost of deployment and overall cost of network ownership.

For example, in a typical network using standard single-mode fibre, Erbium-Doped Fibre Amplifiers (EDFAs) and dispersion-compensating modules are installed every 80km to 100km in the transmission link. The amps are required to boost signals as their power fades after propagating over long distances, while the dispersion-compensating modules are used to correct for distortions caused by dispersion. On top of the component price, the capex of a facility to house and cool this equipment can reach USD500k. The shortage of electricity in Africa and the use of diesel engines to power amplifiers can push opex much higher than the global average. Moreover, some amplifiers may even be unreachable in heavy rains due to poor, unpaved roads – further enforcing the need for development of infrastructure in general. However, by selecting the right combination of optical fibre, transmission equipment and amplification technologies, engineers can eliminate some or all of the amplifier sites and come up with a lower capex and opex solution.

There are many different types of optical fibre for terrestrial long-haul networks, from standard single-mode fibre to non-zero dispersion-shifted fibre, and optical attributes differ significantly fibre-to-fibre. With a proper understanding of these properties, as well as the different transmission systems, amplifiers (including EDFAs and Raman), and other communication modules available to them, engineers can design a network that overcomes unprecedented challenges. For example, working with a system and amplifier vendor, Corning recently demonstrated a solution for connecting two sites around 400km apart without the need for intermediate amplifier sites. The test used Corning's ultra-low loss solution which is suitable for many situations in Africa.

Africa's ICT revolution will be incomplete if people in rural areas – which constitute more than half of the continent's population – do not have broadband access. By increasing broadband penetration, operators can significantly boost their revenue base and offer data and video services to more customers. With more favourable regulatory conditions, deep understanding of technical parameters, and a concerted approach to networks from key industry players, the fast and affordable broadband services needed in rural Africa could eventually become a reality. ■

Left: One of the biggest challenges of deploying terrestrial long-haul networks in Africa is the size of the continent itself: it has an area that's larger than the USA, China, India and Western Europe combined. It is also said to have a low population density of 31 people per square kilometre. That means deployments require significantly more investment per capita compared to areas with higher populations.
Right: Corning says there are many different types of optical fibre for terrestrial long-haul networks, from standard single-mode fibre to non-zero dispersion-shifted fibre, and optical attributes differ significantly fibre-to-fibre. With a proper understanding of these properties, engineers can design a network that overcomes the region's unprecedented challenges.