Ready to re-build backhaul?

Has the time come for all mobile operators on the continent to switch to fibre for their backhaul networks? RAHIEL NASIR finds out.

De-constructing backhaul: operators who want to migrate wireless backhaul networks to fibre will probably need to scrap existing equipment. But Q-KON says that fibre needs wireless technologies like satellite as the two share a "symbiotic" relationship.

The IP trunking market had its turning point in 2010 and its last strongholds, notably in Africa, are now "under siege from powerful market forces." That's the view of Northern Sky Research, and in the 10th edition of its *Broadband Satellite Markets* report, the analyst notes that fibre and undersea cable deployments are "eating away at the base of IP trunking demand, first swallowing the largest links and then progressively eyeing smaller and smaller satellite trunking plays".

So is fibre really the ultimate backhaul solution for Africa? And will it sound the death knell for wireless alternatives such as microwave and satellite?

Even Q-KON, the South African-based satellite network provider, agrees that microwave and satellite rank below fibre when it comes to terrestrial connectivity. CEO Dawie de Wet says: "Fibre as a medium to provide terrestrial connectivity was, and will always be, the optimum choice. Next is wireless and third is satellite. Fibre is the first choice due to it's reliability, mega bandwidth capacity, and long-term operational benefits. It only becomes feasible to deploy alternative technologies when the practical constraints of implementing a fibre network – such as mobility, rapid deployment over difficult terrain, landlord rights, etc – become issues."

US-based Corning Optical Fiber invented the first commercially viable low-loss optical fibre in 1970. Naturally, it believes that the technology offers "significantly more" advantages than the traditional transmission media that have been used for most applications on the continent.

"Compared to satellite technology, fibre provides much higher capacity and lower latency at a lower cost," says Corning's market development manager for Africa, Dr. Jabulani Dhliwayo. "While satellite technology is likely to support the needs of Africans in remote areas in the years to come, it is costly and impractical to install satellite links as the main source of continent-wide transmission.

"In addition, in the places where low transmission latency is needed, fibre dramatically outperforms satellite technology. For example, for a 2,000km link, fibre could provide 24 times lower transmission latency than a geosynchronous satellite, and 5.5 times lower latency than medium-orbit satellites such as O3b. (The latency values are calculated assuming 35,786km and 8,063km orbit positions for geosynchronous and O3b satellites, respectively)."

Dhliwayo goes on to explain how fibre also trumps 5-42GHz microwave and 60-90GHz millimetre-wave technology for mobile backhaul. He says that due to its "almost unlimited" capacity, fibre needs to be deployed only once while further upgrades to higher bitrates can be achieved by simply changing transceivers in the terminal site.

"In the case of microwave technology, transition to higher bitrates would require a completely new set of point-to-point or point-to-multipoint equipment, causing significant expenses every time an upgrade has to be made. Also, microwave and millimetre-wave transmission is significantly affected by rain, leading to the reduced loss budget. This a major limitation of using radio links in equatorial Africa."

Microwave can cope with 4G

Tata Communications believes fibre is the "secret weapon" for mobile operators to cope with increasing data demands. Claude Sassoulas, the firm's MD of Europe and Americas, says: "On current 2G systems, there is not a big issue with bandwidth, so microwave backhaul systems can easily cope with it. However, once we look to 3G systems, its more difficult. The increased bandwidth means microwave backhaul systems need to be upgraded in order to cope."

He agrees with Dhliwayo that high-capacity wireless hardware is expensive and adds that spectrum availability also becomes an obstacle. Such problems are not applicable to fibre. "That is why we will continue to see more operators move from wireless systems to fibre. Another important factor is that once fibre has been deployed, it offers almost limitless bandwidth capacity thanks to its unrivalled flexibility. For example, fibre which was originally installed to handle 100Mbps can easily be re-configured to 10Gbps. In the long term, there is no reason to choose microwave over fibre."

This rings alarm bells with wireless transmission specialist Aviat Networks. It dismisses some industry views that microwave technology will not be able to provide sufficient capacity to meet rising data demands of 4G/LTE, and that only fibre is able to meet the capacity needs. In a recent white paper entitled *Is The Backhaul Really The Bottleneck For LTE?*, the vendor says: "This apprehension is being capitalised on by some optical network providers who argue that fibre connections are needed to provide gigabit levels at each base station. Although a gigabit connection in each base station is desirable, high costs, slow deployment, and inflexibility of fibre optic networks prevent this from being a viable option for operators who are capex and opex constrained."

Aviat says that according to its studies, which are based upon its early involvement in some of the

largest LTE network deployments, an average of 100 to 200Mbps of backhaul capacity per LTE cell site is more than adequate, and that this is "easily achievable" with current microwave technologies.

The company reckons that rather than focusing on the congestion of backhaul spectrum for urban environments, a more pressing issue to address is LTE spectrum access. However, it adds that while operators grapple with these spectrum issues, there is still the need to upgrade the capacity and flexibility of their existing backhaul networks. Unlike Corning, Aviat believes that microwave and millimetre-wave frequency bands support numerous options to provide backhaul bandwidth. They also offer new improvements such as multi-channel link aggregation, header compression, co-channel dual polarisation, and adaptive coding and modulation.

"These advances, added cost effectiveness, flexibility and speed of development, make microwave transmission systems an ideal backhaul solution for new LTE networks for many years to come," it concludes.

Africa's high fibre diet

Others take a more balanced view. Orange is one of the region's big name wireless operators, but it is also a key player in the consortiums behind the ACE (Africa Coast to Europe) and LION (Lower Indian Ocean Network) fibre systems. Yves Bellego, director of technology strategy for the Orange Group, agrees that fibre is the "ultimate" backhaul technology, providing the highest capacity and the lowest latency. But he adds that satellite and microwave still offer some unique advantages: "Satellite remains unrivalled to reach isolated sites and for broadcast of TV. Microwave is easy and fast to deploy for the last mile, connecting the radio site to the backbone. From a performance viewpoint, fibre is the best option. From a deployment point of view, it is much more complex and time consuming than satellite and microwave, and the upfront investment is huge."

Even Corning and Tata agree here and accept that microwave does offer relatively low installation costs compared to the huge initial outlay demanded by fibre. And de Wet adds that fibre does have a slight disadvantage in that it provides a symmetrical link whereas broadband internet services are mainly asymmetrical in nature.

De Wet goes on to dismiss some commentators who argue that the benefits of fibre in Africa are a long way off from being realised as the networks have not reached further inland or landlocked states. "This is a general comment that is not very close to the reality on the ground. Terrestrial networks are well developed, and even countries like Zimbabwe are very well connected via multiple international cable networks."

Corning concurs with this and points out that over the past decade, around 600,000km of cable (most of which it supplied) has been installed to link the submarine landing points to landlocked communities throughout the continent. "By the end of 2012, each of Africa's coastal cities will be connected via ten submarine cables with capacity of over 20Tbps, representing a massive turnaround in a relatively short space of time," says Dhliwayo. "Currently, around 22 per cent of Africans live within 10km of a fibre optic cable and this metric is improving by the day."

More than half a million kilometres of cable may sound like a lot but it is still very small for a continent larger than China, Europe, and the US combined. There's still a lot of work to be done, and the vendors continue to rise to the challenge.

"At least two of our customers are taking advantage of our fibre for their mobile backhaul," says Dhliwayo. "In Angola, after deploying fibre deeper into the metro network, one operator is now deploying fibre directly to the base station. As the operator is planning to deploy LTE, it has to transmit 1Gbps between the central office and base station and found fibre to be the most appropriate solution. By first deploying fibre deep into the metro network, the operator ensured that the distances between the central offices and the base stations are no longer than 1km, making fibre backhaul deployment an easy process."

He goes on to explain that another operator in South Africa is planning its future backhaul deployment by taking a multi-layered approach in its backbone networks: "A high-capacity DWDM express layer carries traffic between long-distance nodes; a one-channel SDH layer carries traffic between nodes, typically spaced 80-100km apart; and an access layer is used to pick up and drop traffic at mobile backhaul central offices. Once a network is designed this way, the deployment of mobile backhaul becomes seamless and can take full advantage of backbone networks."

The 17,000km ACE system will eventually connect around 20 countries on Africa's west coast to Europe. It currently extends from the northern tip of the continent to Gabon and Sao Tomé and Príncipe and is scheduled to enter service in late 2012. It will be the first international submarine cable to reach Mauritania, Gambia, Guinea, Sierra Leone, Liberia, Equatorial Guinea and Sao Tomé and Príncipe. And while Senegal, Côte d'Ivoire and Cameroon are already served by the SAT3-WASC-SAFE cable (also co-owned by France Telecom-Orange), it's hoped that ACE will help make their traffic more secure and cover their future capacity needs. Orange's other cable interests in Africa include LION, which connects Madagascar to the worldwide broadband network via Réunion and Mauritius, and the 2,700km LION2 extension to Kenya, via Mayotte.

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

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Tata has been involved in the SEACOM, TEAMS and EASSy cable projects on the east coast, as well as SAT-3 and WACS on the west coast. Through its South African partner Neotel, the Indian firm claims it has been instrumental in implementing a "massive" backhaul fibre network which also covers Kenya, Tanzania and Nigeria. Sassoulas says that Neotel has been one of the key drivers of domestic fibre into South Africa with a national backbone of 13,000 km, and 6,500 km within the major cities, as well as cross-border routes into all of the neighbouring countries.

Scrapping the assets

Migrating a backhaul network from wireless to fibre can be challenging. As Sassoulas explains, operators that have a legacy system with microwave will typically have to replace all their existing equipment, resulting in the scrapping of assets or cancellation of existing services.

Neotel's fibre networks are being increasingly lit with Ethernet. According to Sassoulas, this gives it the advantage of flexibility and scalability, offering a wide range of bandwidths, easy upgradeability, and simple interfacing. "Ethernet has become the common bearer for many different types of traffic, including internet, voice, and video. Most new mobile networks support Ethernet as the basis for backhaul."

Scalability is also key for Corning which says that it has consistently urged operators to build fibre optic networks that will be easily upgradeable to cater for greater capacity requirements in the future. "In the past, we have seen that some of the fibres that were deployed for low-capacity networks (e.g. STM16 and 2.5Gbps) had a high polarisation mode dispersion value, in some cases preventing an upgrade to bitrates beyond 2.5Gbps," says Dhliwayo. "However, with the recent advances in coherent detection technology, it has become possible to re-use legacy optical fibres for 40Gbps and even 100Gbps transmission. This means that from a capacity standpoint, fibre is a future-proof transmission medium."

So is this the end of the road for wireless backhaul? Not quite. De Wet explains that in his experience, satellite and fibre have a "symbiotic" relationship. Where there is fibre, there is a high concentration of bandwidth that needs to be distributed. "One service that will always be very difficult for fibre to do in Africa is the access network in a point-to-multipoint configuration. Although we have seen fibre-to-the-curb projects in Africa, the majority of the last-mile access is wireless in cities and satellite in the countries." For de Wet, this means fibre needs satellite (or wireless) to act as an access medium to concentrate the services to the fibre network nodes. "In principle, fibre is a point-to-point technology and satellite is point-to-multipoint technology – these networks should be deployed in synergy to provide the most effective deployment." ■