NOVEMBER/DECEMBER 2015
Volume 20
Number 4

southern african wireless COMMUNICATIONS

For communications professionals in southern Africa

Reach can be the difference between success and failure

- Is fibre now best for backhaul?
- Testing and optimising LTE networks
- Vietnam launches its third African network

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Vietnam launches its third African mobile operation

Viettel says Halotel's network infrastructure was built in just a year. It adds that the introduction of the service has created more than 22,000 jobs in Tanzania.

State-owned Vietnamese operator Viettel has now launched its mobile network in Tanzania. Under the brand name 'Halotel', the company is offering 2G services as well as what it claims is "competitively priced" 3G connectivity to the most remote parts of the country.

Viettel gained its license in Tanzania towards the end of last year *(see News, Nov-Dec 2014)*. It says the country is East Africa's second-biggest economy, and represents its tenth international market outside Vietnam. This latest launch on the continent follows the rollout of services in Burundi (Lumitel) and Cameroon (Nexttel) earlier this year, and in Mozambique with Movitel in 2014.

With an initial investment of USD736m, Viettel says the build out and installation of Halotel's network infrastructure was completed in just one year. It comprises 18,000km of fibre and more than 3,000 BSTs, and is claimed to have created more than 2,000 direct and 20,000 indirect jobs.

Viettel says the network has enabled services to all 26 provinces in Tanzania. It covers 81 per cent of the population across rural and urban areas, and 1,500 villages are now connected for the first time.

The company will also provide free internet connectivity to 450 public schools over the next three years. In addition, Viettel provided optical cable to 150 committees, 150 public hospitals, 150 police stations and 65 post offices during the first half of the year.

Nguyen Manh Hung, general director of the Viettel Group, says Halotel's vision is to provide every Tanzanian with a mobile phone and bring ICT to all parts of society.

"When telecommunications services are accessible to everyone and become a part of everyday life, they can be a driving force contributing to socio-economic development for the country as a whole," says Hung.

SSA mobile industry worth billions – p6

ICASA to investigate dynamic spectrum management

The Independent Communications Authority of South Africa (ICASA) has proposed developing a regulatory framework for dynamic spectrum assignment (DSA). It believes this will enable the emergence of new technologies and techniques that promote more intensive and efficient use of spectrum.

ICASA's proposal broadly reflects recommendations made in *SA Connect*, South Africa's national broadband policy. In a public discussion document issued in September, the authority further proposes the adoption of DSA on a geolocation basis as one of the techniques to achieve the policy's priorities.

In particular, it advocates regulations that would enable broadband services on a secondary-user assignment basis in the 470-694MHz UHF band. This includes the TV white space (TVWS) spectrum currently used exclusively for terrestrial broadcasting and would constitute the first phase of DSA in South Africa.

According to ICASA, DSA is an umbrella term used to describe a set of technologies and techniques that enable radio devices to opportunistically transmit on available spectrum. It says this will greatly relieve the problem of spectrum shortage for broadband in the license-exempt bands below 1GHz.

To meet booming demand for wireless broadband capacity, the authority points out that future generations of wireless technology and services will not only have to increase their efficiency in terms of bits per second per Hertz, they will also need new approaches to network architectures and spectrum management.

ICASA is expecting all comments to be submitted by 18 December.

South African cellcos fail QoS tests – p8

Tigo goes live with first mobile 4G network in Rwanda


Millicom's Africa division EVP Cynthia Gordon shows Rwandan president Paul Kagame the benefits of 4G at a recent launch event in Kigali.

Tigo has become the first mobile operator to launch 4G services in Rwanda using the wholesale LTE network built by Olleh Rwanda Networks (ORN).

The cellco says it has so far invested in excess of USD310m in the country where it now has more than 2.9m customers. Over the last few weeks, the company says it was "first in line" to introduce mobile 4G services tailored specifically to post-paid users using the Samsung *J1 Ace* which it recently launched in Rwanda. Tigo subscribers with 4G-enabled smartphones can now upgrade their SIMs for RWF1,000 (USD1.34).

ORN is the only 4G infrastructure company in Rwanda. It was setup by the government with backing from Korea Telecom for the exclusive and wholesale provision of a universal broadband network using LTE technology.

Han-Sung Yoon, CEO of ORN, says that since the network went live with the launch of commercial LTE services last year, its mission has been to grow. "The 4G network is expanding towards our target coverage of 95 per cent of the country by 2017. This is on track with partnerships such as with Tigo Rwanda."

Rwanda's other mobile operators include Airtel and MTN.

■ Tigo's parent company Millicom has launched an online remittance service enabling *Tigo Pesa* subscribers in Tanzania to receive money in real-time from friends and family in the European Union and Canada.

Millicom says *sendmoney.tigo.com* offers the same security standards as banks, with payments processed via Verified by Visa and MasterCard SecureCode. It claims the service has one of the lowest transaction fees in the market.

The company plans to extend *sendmoney.tigo.com* to include *Tigo Cash* wallets in other African countries.

MTN Rwanda connects with Safaricom's M-PESA – p8

Rahiel Nasir, Editorial director

ON THE NETWORK

Too much tech too soon?

Over the last 20 years, this magazine has carried thousands of reports about how CSPs have been working tirelessly to build the wireless networks needed to bridge the digital divide.

And yet despite all their best efforts, countries in sub-Sahara Africa still have most of the world's lowest levels of internet access with only one in nine households connected, according to the ITU's latest *State of Broadband* report *(see News, Sep-Oct issue)*.

Why is that? It's certainly not for want of technological solutions – I have lost count of the number of times I have written about how innovation is the very reason why the unconnected have been connected on the continent.

But could it be that technology is now part of the problem rather than the solution? That may across as somewhat counter-productive from someone who has both a personal and professional interest in ICT. But I have often said that the technology industry at large has a tendency to run while users are still learning how to walk.

By its very nature, the industry is all about innovation and creating the 'next best thing'. But that presents a dilemma for customers: should they invest in new kit today only to have it superseded the following year? Or should they defer a product purchase as they wait for the latest version?

While all that is probably more applicable to the B2C rather than the B2B market, I do see some overlap. For instance, while many MNOs are still expanding their 3G networks they also need to plan for 4G and will no doubt be aware that their counterparts elsewhere are gearing up for 5G.

Of course, I am not advocating the end of innovation. I just wonder if there's 'too much' technology too soon creating a distraction for operators who end up focusing more on what they can use to build the networks of tomorrow, rather than how they can expand the ones of today.

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Eutelsat unveils new HTS for African broadband

Eutelsat Communications has revealed the next step in its broadband strategy for Africa with the order of a new-generation high-throughput satellite (HTS) from Thales Alenia Space (TAS).

To be launched in 2019, the all-electric spacecraft will be the first to use Thales' new *Spacebus Neo* platform, and Eutelsat claims it will offer "unprecedented" operational flexibility.

The firm says its baseline mission will be to provide 75Gbps of capacity across a network of 65 spot beams that together provide "quasi-complete" coverage of sub-Saharan Africa.

The satellite will address direct-to-user consumer and enterprise broadband services with dishes sized from approximately 75cm. It will also be used for community networks connected to Wi-Fi hotspots, mobile backhauling and rural connectivity.

During the coming months, Eutelsat has the option to upscale the satellite to significantly increase overall throughput and service areas. The company adds that its African broadband business, including sales, will be managed by a newly created London-based affiliate.

TAS claims *Neo* offers a fully modular platform with a smart Ka HTS payload for "unrivalled flexibility and maximum throughput". It says the all-electric version of the platform combines high efficiency and light weight, and will also mean Eutelsat benefits from more cost-effective launch options.

The all-electric *Neo* is currently capable of carrying payloads weighing more than 1,400kg, and with power exceeding 16kW. Starting in 2016, TAS says the platform will be able to handle payloads up to 2,000kg, with record power of 20kW.

EcoCash enables MoneyGram remittances

Econet Wireless has teamed up with MoneyGram to enable *EcoCash* users to transfer funds from more than 200 countries and territories worldwide.

According to the Zimbabwean cell-co, the new service means more than 4.9m *EcoCash* subscribers and Money-Gram users can receive funds across its mobile money network. It adds that consumers can access MoneyGram's services at more than 20,000 *EcoCash* sites across Zimbabwe, or at any one of MoneyGram's worldwide agents.

EcoCash is said to be the second-fastest growing mobile money solution in Africa after *M-PESA*. Econet CEO Douglas Mboweni says working with MoneyGram will help reach more consumers who rely on *EcoCash*'s domestic and international remittance services for their daily financial needs.

"In-wallet remittances are becoming more topical, not only in driving access to international remittances for the previously unbanked but also driving further financial inclusion as we link the diaspora and home," says Mboweni.

MoneyGram services are available in more than 50 African countries, and the company says it is working to support economic development across the continent through expanded alternative channels like *EcoCash*.

Econet Wireless CEO Douglas Mboweni says the partnership drives financial inclusion.

Mobile contributing USD102bn to SSA

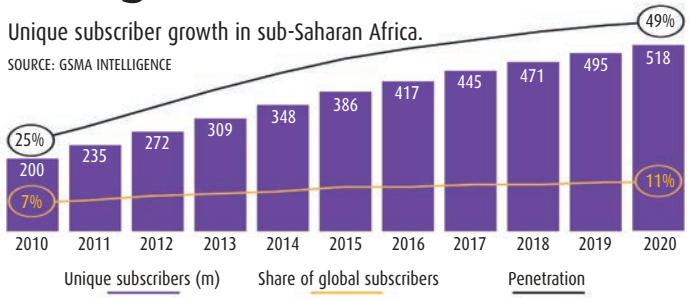
The mobile industry contributed USD102 billion to the sub-Saharan African (SSA) economy last year, according to the latest GSMA study.

In its *Mobile Economy – Sub-Saharan Africa 2015* report published in October, the association said the contribution was equivalent to 5.7 per cent of the region's GDP, with mobile operators directly contributing 1.7 per cent or USD31bn.

The GSMA forecasts the industry to contribute USD166bn in value to the region by 2020 which will be equivalent to eight per cent of expected GDP. Acting director general and CTO Alex Sinclair said: "Despite revenue and margin pressures, local mobile operators continue to invest heavily to extend network coverage to serve unconnected communities and accelerate the migration to high-speed 3G/4G mobile broadband networks."

Unique subscriber growth in sub-Saharan Africa.

SOURCE: GSMA INTELLIGENCE



SSA continues to represent the world's fastest-growing mobile region. The GSMA predicts it will have 386m unique mobile subscribers by the end of 2015, equivalent to 41 per cent of the region's population. It adds that total connections are on track to reach 722m by year-end, with 3G/4G accounting for almost a quarter of connections.

The study also found that the region's operators invested USD9bn in network infrastructure development in 2014, a 16 per cent increase compared to 2013. The GSMA said ongoing investment in mobile broadband networks will reach USD13.6bn by 2020.

In 2014, the SSA mobile ecosystem directly employed around two million people, with the majority working in the distribution and retail sectors and approximately 325,000 employed by operators. It is forecast that the industry will grow to support more than six million jobs by 2020.

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MTN opens mobile money corridors in East Africa

MTN Rwanda has opened a mobile money corridor with Kenya, enabling its *Mobile Money* customers and Safaricom *M-PESA* users to seamlessly send and receive remittances between themselves.

"We are determined to strengthen the path we are taking towards financial inclusion in Rwanda, and I believe this new partnership will be a powerful driver of economic growth," says MTN Rwanda CEO Gunter Engling.

MTN Rwanda's announcement made in mid-October came just a month after it introduced cross-border transactions with MTN Uganda. Speaking at the time, Uganda's ambassador to Rwanda Richard Kabonero said: "Regional remittance will greatly reduce the cost of doing business across our borders as well as ease other challenges including sending money to students in Uganda. It's a welcome development which we hope will be implemented across the five East African Community partner states."

MTN says interconnecting its mobile money system with Safaricom's *M-PESA* will drive economic growth.

Both services are supported by mobile wallet aggregator MFS Africa. MTN Rwanda customers can easily send remittances via their mobiles and are shown the equivalent amount to send based on prevailing forex rates. Safaricom has a transaction limit of KES70,000 (USD680) for *M-PESA* users.

Rwanda currently has a mobile penetration rate of 72.6 per cent and more than 8.1m subscribers, according to July 2015 data from the Rwanda Utilities and Regulatory Agency.

Kigali FTTH now live

Liquid Telecom Rwanda's FTTH service is now available to homes and businesses in Kigali. With speeds of up to 100Mbps, it's claimed the service offers the fastest-ever internet access available in the country. Liquid is investing more than USD35m in laying Rwanda's first FTTH network which will continue in Kigali and expand to other cities in the future. It says more than 15,000 homes will be passed by the network by the end of next year. The service will also be available from mobile operators and ISPs in the country using wholesale access from Liquid.

Illegal SIMs in Zambia

The Zambia Information and Communication Technology Authority (ZICTA) has discovered illegal SIM cards being sold in Masala townships in Ndola, the country's third largest city and commercial centre for its copper mining region. Working with local police, ZICTA's compliance officers confiscated an unknown number of pre-registered MTN and Airtel SIMs. The authority said they were being sold to the public contrary to Zambian legal regulations which state that purchasers submit a completed SIM card registration form to the seller.

Airtel shares interest

Airtel Tanzania has distributed more than TZS5 billion (USD2.3m) from its *Airtel Money* trust account to active mobile money customers and agents across the country. The amounts paid were based on the subscriber's end-of-day balances available for the period from March 2014 to April 2015. The operator claims that by sharing the interest accumulated on its trust fund, it is boosting the use of mobile money services in Tanzania where the unbanked population is about 85 per cent.

South African cellcos fail call retention test

Cell C, MTN and Vodacom all failed to meet call retention targets as part of the latest QoS tests carried out by the Independent Communications Authority of South Africa (ICASA).

In its latest quarterly monitoring test report published in October, the regulator looked at the networks and services provided by each operator in the Mpumalanga Province. Various test areas were selected to represent rural and semi-urban locations.

Using Ascom's TEMS investigation tool, ICASA's drive-test focused on network performance measured in terms of call setup success rates (CSSR) and retention of voice calls (drop call rates). The results showed that the three operators did not meet the target in terms of call retention, whilst Vodacom met the CSSR target.

The regulator said its test methodology excluded roaming which is why Telkom Mobile was not included in its report as it currently roams on MTN's network in most areas. Similarly, it noted that Cell C does not have continuous coverage in some of the areas tested as it relies on roaming on Vodacom's network. As a consequence, ICASA said Cell C's actual customer experience is expected to be better than the measured result.

Following the publication of ICASA's findings, Vodacom said it would improve retention rates through strategies such as site optimisation, sectorisation, re-planning, and new sites.

Meanwhile, Cell C has initiated discussions with Vodacom on seamless call handovers. These will initially be implemented on the edges of Cell C's coverage areas. ICASA did not mention any remedial plans for MTN.

Testing 4G networks – feature pp29-31

Operators sign Crisis Connectivity Charter

Seven of the world's leading satellite companies have agreed to work together to enhance connectivity during humanitarian emergencies.

Eutelsat, Hispasat, Inmarsat, Intelsat, SES, Thuraya and Yahsat signed the Crisis Connectivity Charter in mid-October under the umbrella of the EMEA Satellite Operators Association and the Global VSAT Forum (GVF). The UN Office for the Coordination of Humanitarian Affairs (OCHA) and the Emergency Telecommunications Cluster are also signatories.

The charter formalises terms and protocols designed to accelerate the ability of emergency response teams to access satcoms when local networks are affected, destroyed or overloaded after a disaster.

UN emergency relief coordinator Stephen O'Brien says satcoms is "immune to natural disasters".

It also includes increased coordination to prioritise access to bandwidth for humanitarian purposes during disaster operations, and pre-positioned satellite equipment and transmission capacity during disasters in 20 high-risk countries in Africa, the Middle East, Asia and Europe. Additionally, the signatories will support training and capacity building for the humanitarian community across all continents.

Stephen O'Brien, OCHA's under-secretary general and also the UN's emergency relief coordinator, said the agreement was a significant move for the humanitarian community, as well as a "step change" in the way it has worked with satellite operators in the past.

"The humanitarian community relies on satellite communication as it is the only technology that is immune to natural disasters and can be immediately deployed, regardless of constraints such as geography."

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COMESA and Microsoft promote connectivity

The Common Market for Eastern and Southern Africa (COMESA) will work with Microsoft to promote access to technology to improve regional trade, develop public sector ICT skills, and foster local innovation for better service delivery.

Microsoft says the deal is in line with the three focus areas in its *4Afrika* initiative: world-class skills, access and innovation. Under an MoU signed in Lusaka in early November, the company says it will promote access to technology to COMESA's 19 member states based on a trusted cloud infrastructure that concentrates on the secure deployment of modern IT operations.

The partners also expect their collaboration to accelerate and promote the adoption of innovative, high-speed and low-cost connectivity initiatives. This will include new policy approaches to frequency management

COMESA's secretary general Sindiso Ngwenya (right) says business technology has revolutionised the way countries and firms conduct business. Also pictured is Microsoft's Antony Cook.

such as dynamic spectrum access. It will also encourage the use of cloud technologies through the adoption of important enabling policies in the areas of cybersecurity and data protection.

"Through this collaboration, we will bring policymakers and businesses together and empower them to take advantage of the cloud-first, mobile-first world," says Antony Cook, associate general counsel, legal and corporate affairs for Microsoft MEA. "With the right policies and regulations in place, people will be encouraged to use cloud technology, develop their own IP and ultimately participate in trade and e-commerce across borders."

Cook adds that the partnership will also mean e-government services, enabling citizens and businesses to benefit from safe online transactions, open borders and efficiency, as well as increased foreign investment.

The implementation of the MoU will be the responsibility of the COMESA Business Council which acts as the voice of the private sector in the region.

Botswana highway towers

Radio Network Solutions (RNS) has been awarded a contract to supply and install telecoms towers in Botswana.

"In an effort to improve road infrastructure for faster connectivity in the country, we are erecting multiple towers along the route," says RNS sales director Richard Hill. "The aim is to give road users uninterrupted connectivity, thereby empowering them to make instant contact with the office, family or even emergency calls if necessary."

Eleven towers, each 56 metres in height, are being erected on the road between Gaborone and Ramokgwebana. The 506km (315 mile) route forms part of the A1 highway that runs from the Zimbabwean border, located close to Ramokgwebane, through Francistown and Gaborone, all the way to the border with South Africa.

Telkom's new wholesale division to connect a million homes by 2018

Openserve, the wholesale division of South Africa's incumbent operator Telkom, says more than 10,000 Pretoria East homes will have access to fibre by the end of this year.

At the end of September, the operator announced fibre rollouts in Bryanston as well as across multiple additional suburbs of Johannesburg, Pretoria, Durban, Cape Town, Bloemfontein, Kimberley and Port Elizabeth.

"Openserve is committed to Telkom's goal of reaching one million homes with fibre access by 2018, and already has the largest fibre network in the country," claims Openserve MD Alphonzo Samuels. "We want to significantly impact broadband in South Africa, and fibre offers the best internet experience."

Telkom created its separate wholesale division earlier this year with the formal launch of Openserve in October. Speaking at the time, Samuels – who was previously Telkom's CTO – said the business will operate within the Telkom group but "without discrimination" and on the basis of open access. "Open access for us is about offering all our clients equal access to our pervasive network, and providing a service at any point they desire."

He added that it will be another six months before the final structure of the new company is settled on. It will however inherit both the wireless and fixed infrastructure of Telkom's current wholesale division, but not the LTE capabilities which will stay with the consumer and mobile division.

Alphonzo Samuels says Openserve will offer clients equal access to Telkom's network.

Wi-Fi in Rwandan schools

Balton CP has deployed a high-speed Wi-Fi solution from Alvarion in more than 15 higher learning institutions throughout Rwanda.

The project, funded through the Rwanda Board of Development, means tens of thousands of students and teachers now have ubiquitous access to high-speed internet and intranet services via any connected device.

The network features Alvarion's latest version of its complete Wi-Fi package, and is mesh-enabled for what the vendor claims is "superior" coverage, both indoors and outdoor. It says the network provides secure connectivity throughout each institution's campus, and in some cases across multiple locations.

UK-based Balton CP aims to develop business in Africa via its subsidiaries in Ghana, Kenya, Nigeria, Rwanda, Tanzania, Uganda and Zambia.

Fighting the mobile clones in Africa

Operators could lose billions in revenues as a growing number of counterfeit phones end up on the continent's markets.

It's been revealed that 10-20 per cent of mobile phones currently coming into African networks are cloned or counterfeit, with Nokia and Samsung being the favourites for the fraudsters.

Over the next five years, Mobilethink predicts that more than 52 million smartphones activated on African networks will be fake. If banned, the firm says these devices could cost MNOs a cumulative loss of around USD6bn (based on 10 million new users each year with an ARPU of USD10 per month), or even higher given that smartphone users tend to generate higher revenues compared to feature phone users.

Mobilethink is part of the device intelligence business of test and measurement specialist Spirent Communications. It says the region's governments are becoming increasingly concerned about cloned and counterfeit devices due to issues of parallel importing, the risk they present to mobile payment systems, and their use of potentially hazardous materials. For instance, the company cites the Communications Authority of Kenya (formerly the Communications Commission of Kenya) which said sub-standard components are often used in manufacturing cloned devices. It warned that these have not been put through safety checks and might emit higher than recommended radiation levels.

MAKE	MODEL	CONFIGURATION	NUMBER OF SUBSCRIBERS
Simi	S40D	Manual	16,7832
DXD	S332	Manual	10,606
VINKO	Mini M9i	OTA	14,550
KGTEL	GX1i	OTA	14,775
G Vill	G8	OTA	26,664
DARAGO	i6	Manual	20,154
ENESMobile	220	Manual	9,567
Gresso	108	No data	14,506
Volte	E1105	Manual	10,074
S-Mobile	G6153	Manual	3,804
VELL-COM	TV205	Manual	35,763
KGTEL	Asha 210	Manual	57,830
T-com	T800	Manual	79,038
DKTORM	JOY	Manual	18,897

The above list of low-cost handsets were added to Mobilethink's database during September-October. Some of these devices support over-the-air settings, but most need to be manually configured by customers using guides sent to them by operators' customer care teams. This adds complexity for users.

Some countries such as Kenya and Nigeria have introduced legislation ordering carriers to trace and block cloned and counterfeit devices. But Mobilethink points out that the sudden blocking of masses of devices is not only inconvenient for consumers, but could also be dangerous for those who rely on their mobiles for critical applications such as health, well-being, personal safety, etc. It adds that carriers will also suffer as the sudden shutdown of a device creates a significant churn threat and subsequent loss of income.

Device intelligence

As a result, the company has developed the *Device Intelligence Suite (DIS)*. It comprises various solutions for device management and customer engagement, and also includes a device database together with handset guides for customer call centres and over-the-air (OTA) self-care.

Mobilethink says its device management solution contains a unique algorithm for detecting and configuring up to 80 per cent of cloned and counterfeit handsets on the market. It also features a unique live IMEI pattern detection mechanism for differentiated handling of the activation of such devices.

The firm says its solution also gives the operator an opportunity to upsell. For instance, when blocking a particularly harmful cloned device, an operator can simultaneously allow services for a more benign type of cloned device for a limited period if the customer agrees to return the counterfeit handset in exchange for an original product.

In addition to the *DIS*, Mobilethink also offers a certification scheme where manufacturers can submit their phones for testing APN settings for networks. These settings are added to the company's library which is claimed to be the largest database of its kind in the world.

Around 20 African mobile operators are currently using Mobilethink's services in countries such as Congo, Ghana, Lesotho, Nigeria, Rwanda, South Africa, Uganda and Zimbabwe. The firm says the simple answer to prevent the problem of counterfeit phones on the continent is for end-users to think twice before buying "cheap" phones online.

But that's not going to happen, according to Mobilethink's head of marketing Mikko Nurmimaki. He adds that the problem is further exacerbated by the fact that of the 350 million smartphones expected to come onto Africa's market by 2020, around 20 per cent will be low-cost models that do not support OTA configuration.

"If you ask a device manufacturer about customer care issues, it will almost certainly reply that this is the responsibility of the network operator," says Nurmimaki. "So when a subscriber signs up for a service and can't get online, the immediate reaction is to call an operator's care centre for support. The care centre can only send the subscriber a guide for self-configuration – this process is very long, detailed and challenging for most device owners.

"So the customer's experience in using a network is very poor. Until such time as end users understand the settings issue, Africa's cheap device dilemma will not go away."

Mobilethink's Mikko Nurmimaki says the simple answer to the problem of counterfeit phones is for end-users to think twice before buying "cheap" phones online.

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Airtel closes IHS tower sale – but Eaton Towers deal is terminated

IHS Holding has completed the sale and lease back of 949 towers from Airtel Zambia following long-term contracts that were originally announced last December. The company says it will now upgrade the towers and roll out renewable energy solutions across the operator's African networks.

Over the last two years, IHS says it has spent USD500m in the continent on power systems that feature advanced generators, batteries and alternative power solutions to reduce diesel consumption. The company adds that by the end of 2016, up to 80 per cent of its towers will be run on hybrid solar solutions.

According to IHS, by outsourcing its tower infrastructure Airtel will be able to deleverage through debt reduction and will "significantly" reduce its ongoing capex on passive infrastructure.

IHS Group CEO Issam Darwish says: "Our partnership is designed to further promote network sharing, and deliver higher quality and reliable mobile services. This acquisition will enable us to eventually upgrade these towers and continue to roll out innovative energy saving technology throughout the continent."

Meanwhile, Airtel Africa's deal to sell more than 3,500 of its towers to Eaton Towers has expired. In a regulatory filing made in mid-October, the operator stated: "The agreements for the sale of tower assets in Africa between Bharti Airtel Malawi Holdings and Eaton Towers (Lilongwe) has lapsed and therefore stands terminated."

IHS Group CEO Issam Darwish says the acquisition will enable the roll out of energy saving technology throughout Africa.

The two companies originally agreed a deal in September 2014. The value of their transaction was not disclosed but as part of the agreement Airtel was to sell and lease back more than 3,500 towers to Eaton in six countries across its African operations under a 10-year contract.

This latest setback with Eaton follows the termination of two other agreements with Helios Towers Africa (HTA) that were originally signed in July 2014 for the sale of 3,100 towers in four countries. Earlier this year in June, Airtel announced that the deals with HTA covering Chad and Tanzania had been terminated. According to reports, the agreements for Congo and DRC remain intact.

Airtel has around 15,000 towers on the continent which have been on the market for some time now.

MTN Group CEO quits following trouble in Nigeria

MTN Group CEO Sifiso Dabengwa has resigned. In a press release issued on 9 November, he stated: "Due to the most unfortunate prevailing circumstances occurring at MTN Nigeria, I, in the interest of the company and its shareholders, have tendered my resignation with immediate effect."

His decision follows the Nigerian Communications Commission (NCC) imposing a fine equivalent to USD5.2 billion on MTN Nigeria. The penalty relates to the timing of the disconnection of 5.1 million MTN subscribers who were cut off in August and September 2015. It is based on NGN200,000 (around USD1,000) for each unregistered subscriber.

Around 33 per cent of the MTN Group's total earnings come from Nigeria, making the country the operator's biggest market. Nigeria's government is fighting Boko Haram militants, and says the use of unregistered SIMs hampers its ability to track potential terrorist activities.

According to reports, shares in the group fell more than 12 per cent following news of the NCC's fine.

On 30 October, MTN issued a statement which said that Dabengwa was engaging with the Nigerian authorities on the regulatory aspects of the matter. It added that company executives were also in talks with the Johannesburg Stock Exchange, and shareholders were advised to "exercise caution" when dealing in MTN's securities until a further announcement was made.

The operator has now appointed Phuthuma Nhleko as executive chairman in a temporary capacity. "I will assume responsibility as executive chairman for the next six months as I proactively deal with the Nigerian regulator and will continue to work with them in addressing the issues around unregistered subscribers as a matter of urgency," said Nhleko. "Together with the MTN board, my second priority will be to find an appropriate chief executive officer to take MTN forward. I will then revert to my non-executive chairman role."

Moody's stabilises outlook for EMEA telecoms companies

Moody's has changed its outlook for telecommunications service providers in EMEA from 'negative' to 'stable' on the expectation of a 1-2 per cent revenue growth into 2017.

The international investment analyst and ratings agency says this will largely be driven by increasing demand for broadband and consumers' ability to spend more.

Moody's says KPIs including ARPU will be "solid and sustainable" and churn rates lower. The firm believes this will be supported by price increases across the board as customers increasingly demand bundled product offers including broadband and TV.

However, it says there are some exceptions as some companies have not fully adapted to the lower pricing in their domestic market and/or because of limited international diversification.

In its industry outlook for the sector, Moody's expects capex to remain broadly stable but says this will depend on the stage that a telco is at in the cycle.

For example, it says increased capex for operators such as Orange (rated 'Baa1 stable') to differentiate its offering will offset any increase in free cash flow resulting from higher revenues and improved margins. However, others such as Vodafone Group (Baa1 stable), are nearing the end of their capex cycle.

"We also expect telcos to benefit from efficient operating leverage, such

INVESTMENTS, MERGERS & ACQUISITIONS

Date	Buyer	Seller	Item	Price	Notes
17/9/15	IMImobile	Archer Digital	Company	$5.6m	Johannesburg-based Archer specialises in mobile engagement solutions for banking & government customers across South Africa.
23/09/15	Westfield Capital Management & Bain Capital Ventures	SevOne	Financing	$50m	Brookside Capital, HarbourVest, VT Technology Ventures, & Osage Venture Partners also participated in this round of series C funding. SevOne will use the financing to accelerate growth in markets such as the mobile economy & IoT.
22/10/15	Ruckus Wireless	Cloudpath Networks	Company	NA	US firm Cloudpath specialises in certificate-based Wi-Fi security & has developed automated self-service software.

that their average EBITDA increases by around four per cent in 2016, underpinning an average improvement in adjusted EBITDA margin to 35.4 per cent from 34.8," says Moody's.

With specific reference to Africa, the Middle East and Turkey's telecoms markets, the analyst says the outlook is now stable as revenue growth moderates, driven by an expectation of low single-digit revenue growth on average in the next 12-18 months.

However, it expects negative pressure on revenue growth to build in some commodity-driven markets where GDP growth is slowing – Nigeria, South Africa and Zambia are cited as examples in Africa.

"We expect commodity prices to remain lower for longer, driven by a strengthening US dollar driving prices lower in dollar terms, and unfavourable market fundamentals which could curb consumer demand or spending," says Moody's.

The company adds that operations with revenues in domestic currencies but which have dollar-denominated debt will also remain under pressure as financing costs and debt obligations increase in their currency of operation. Examples here include some of MTN Group's (Baa2 stable) operations (38 per cent of total debt), and Turkcell Iletisim Hizmetleri (Baa3 negative with 82 per cent of total debt as of June 2015).

"Operations with revenues in currencies other than dollars across Africa and Turkey will face increasing imported equipment costs, which will put pressure on margins and capex spend," says Moody's. "These operations' free cash flow will also suffer as the price of equipment for 3G and 4G/LTE rollout will also increase."

Orange returns to growth

The Orange Group reported 3Q15 revenues of EUR10.284bn, an overall increase of 0.5 per cent following falls of 0.2 and 0.9 per cent in the second and first quarters respectively.

The telco reported that the trend of continued improvement reflects the "favourable" change in mobile services across all regions, which saw growth of 1.2 per cent in 3Q after declines of 1.6 in 2Q and 2.8 per cent in 1Q. However, enterprise revenues continued to rise with an increase of 0.5 per cent in the quarter.

Excluding the impact of regulatory measures, group revenues rose 0.6 per cent in 3Q after an increase of 0.4 per cent in the second quarter and a decrease of 0.3 per cent in the first.

Orange said its mobile customer base in Africa and the Middle East grew steadily, with 10 million net additions year-on-year on a comparable basis (+9.8 per cent). 15.5 million *Orange Money* customers were reported as at 30 September 2015 (+37 per cent year-on-year). The increase in regional subscribers was helped by the full consolidation of Méditel in Morocco.

"Our return to growth in revenue and restated EBITDA validates our strategy of differentiation through quality and investment and confirms the positive momentum generated over almost two years," said group chairman and CEO Stéphane Richard.

He added that business performed particularly well during the quarter, especially in France, Spain, Belgium, Central Europe, Africa and Middle East, and the enterprise market.

"This commercial momentum is supported by high levels of investment in very high-speed fixed and mobile broadband, in line with our *Essentiels2020* strategic plan," said Richard. "We have now exceeded 263 million customers worldwide with 111 million in Africa and Middle East."

Michel de Rosen to step down as Eutelsat CEO

After six years as Eutelsat's CEO, Michel de Rosen will step down from the position in March 2016. He will remain in the role of non-executive chairman of the board until the end of his current mandate in November 2016. After that, de Rosen's tenure will be submitted to the annual shareholders' meeting for renewal.

Rodolphe Belmer joins Eutelsat from Groupe Canal where he was CEO.
© RÉMY CORTIN

Rodolphe Belmer has been elected as de Rosen's successor. He will take up the position as from 1 March 2016 but will join Eutelsat as deputy CEO on 1 December as part of the transition process. Belmer will work alongside Michel Azibert, Eutelsat's current deputy CEO and chief commercial and development officer.

Belmer has worked at Groupe Canal since 2001 where he was appointed CEO in 2012.

Born in 1969, he is a French national, and after graduating from HEC in 1992 he began his career in the marketing department of Procter and Gamble France before moving onto McKinsey in 1998.

Internet Solutions expands with new CEOs and new networks

Pan-African CSP Internet Solutions (IS) has named Salvador Adriano as CEO of its Mozambican operations. He succeeds Hermann Woithe who has been appointed to the newly created role of CCO.

NEW APPOINTMENTS

Date	Name	New employer	New position	Previous employer	Previous position
15/9/15	Dr. Stephen Collins	VimpelCom	Group chief corporate & regulatory affairs officer	Microsoft EMEA	VP of corporate affairs
16/9/15	Salvador Adriano	Internet Solutions Mozambique	CEO	MoRENet	Executive director
22/09/15	Raymond de Graaf	Cambium Networks	SVP worldwide operations	Ixia	SVP operations
14/10/15	Tinus Neethling	Digitata	Group CEO	Rorotika Technologies	CEO
14/10/15	Matthew M. O'Connell	OneWeb	CEO	GeoEye	President & CEO
16/10/15	Yemi Lalude	TPG Growth, Africa	Managing partner	Adlevo Capital	Founder
19/10/15	Michel de Rosen	NA	NA	Eutelsat	CEO – steps down March 2016
19/10/15	Rodolphe Belmer	Eutelsat	CEO	Groupe Canal	CEO
19/10/15	Michael McDonnell	NA	CFO	Intelsat	CFO
19/10/15	Amrote Abdella	Microsoft 4Afrika	Regional director	Microsoft 4Afrika	Director of startup engagement & partnerships
20/10/15	Carsten Brinkschulte	Core Networks Dynamics	CEO	BlackBerry	SVP enhanced network services
20/10/15	Andreas Hipp	NA	NA	Epsilon Global Communication & Cataleya	CEO & co-founder – stepped down
20/10/15	Jerzy Szlosarek	Epsilon Global Communication	CEO	Epsilon Global Communication	COO
20/10/15	Jay Jayasimha	Cataleya	CEO	Epsilon Global Communication	CIO
5/11/15	Brian Jakins	Intelsat	Regional VP of sales, Africa	Aviat Networks	VP sales & services Africa


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Salvador joins IS from Mozambique Research and Education Network (MoRENet). During a career that has so far spanned more than 15 years, he has held senior leadership roles at TDM, Mozambique's fixed line operator, as well as Mcel, the country's first mobile operator.

According to IS, Adriano was instrumental in defining Mozambique's telecoms policy in his role as head of the telecom unit and advisor to the Minister of Transport and Communications.

Meanwhile, Richard Hechle has taken over from Jonathan Somen as CEO of IS Kenya. Somen has taken a non-executive board position.

Hechle has more than 15 years experience in leading and managing organisations across East Africa, and was previously with Finlays Horticulture where he was MD.

Johannesburg-based Internet Solutions is a division of Dimension Data and subsidiary of NTT. These latest appointments follow a major growth plan that includes investing USD15m over the next three years to expand its fibre network in Ghana.

In an announcement first made in July earlier this year, IS said the first phase of deployment will be in Accra, with future phases including Kumasi, Takoradi, Cape Coast and a number of other commercial hubs.

The company says the network is fully compliant with the ITU-T SG15) standard for fibre optics build, as well as with MEF 2.0 for metro and carrier grade Ethernet networks.

IS has partnered with Tejas Networks and Infratele Solutions Ghana for the expansion. Infratele will build a metro network covering all the commercially viable areas in Accra, while Tejas will install its flagship core optical transport equipment, *TJ1600*. IS says this supports WDM, carrier Ethernet and TDM in a single core, and connects five PoPs in Accra to allow for easy connectivity and termination to all organisations within the city.

The company adds that the network will complement the country's existing undersea cable systems, and will have an initial capacity of 400Gbps in a self-healing fibre optic ring for resilience against network outages. It will be expandable to 3.2Tbps.

LPWANs to provide around a quarter of total IoT connections by 2020

The dominant position of traditional cellular networks in the market for M2M connectivity is about to change, according to Beecham Research. In a report published in October, it said that as well as reduced energy consumption, low power wide area networks (LPWANs) also offer low cost, long range, and enable a far wider variety of M2M and IoT applications currently constrained by budgets and distance from a power source.

From a standing start in 2015, Beecham expects that by 2020 LPWANs will provide 26 per cent of the total IoT connectivity market with 345 million connections, marking an end to the near monopoly of traditional cellular networks for M2M connectivity.

It says there's a growing variety of LPWAN technologies, such as Sigfox as well as those developed by the LoRa Alliance. It says most of these solutions utilise the ISM bands better known for use by short range wireless technologies such as Zigbee, Wi-Fi and 6LoWPAN.

However, the firm says recent advances have enabled LPWANs to be established using the ISM bands over longer distances, up to 50km in rural areas and 5-10km in urban areas. It adds that TV white space (TVWS) technology also promises connectivity over distances of 10km and with "superior" in-building penetration compared to 3G or 4G.

Beecham Research CEO Robin Duke Woolley believes LPWAN is ideally suited to the African IoT/M2M market.

Beecham Research CEO Robin Duke Woolley adds that LPWAN is ideally suited to the African IoT/M2M market, where long range, low power and low data rates are typical requirements.

"There are vast areas in Africa where it is not cost effective to install cellular but where LPWAN can be," he says. "For example, LoRa can be installed either as part of a public network available to all, or as a private network available only to one company's remote devices. There is also nothing to prevent a private LoRa network from being used by other companies through agreement with the owning party.

"We expect all of that to develop in Africa, particularly for smart farming, land security, tracking and possibly smart metering purposes."

LATEST COMPANY RESULTS

Date	Company	Country	Period	Currency	Sales (m)	EBITDA (m)	EPS (units)	Notes
3/10/15	Sandvine	US	3Q15	USD	27.9	NA	0.019	2% decline in revenues compared to 3Q14, but results were within targets & company remains profitable. EMEA is its biggest market & accounted for 37% of earnings.
13/10/15	IDT Corporation	US	4Q15	USD	405.8	12.4	0.05	4Q15 revenue down compared to $420.7m in 4Q14. Fabrix, which was sold in 1Q15, contributed $5.9m in revenue in 4Q14. Core businesses performed to overall expectations, according to CEO Shmuel Jonas.
22/10/15	Orange	France	3Q15	EUR	10.284 (bn)	3.557 (bn)	0.6	QoQ revenue increase of 0.5% reflects favourable change in mobile services across all regions.
22/10/15	Millicom	Luxembourg	3Q15	USD	1.64 (bn)	560	0.17	Overall revenues down 2% due to currency volatility. Africa fell 5.3% to $241m & EBITDA was $48m, a y-o-y fall of 12% largely due to stronger currency movements in Tanzania & Ghana plus continued difficult trading conditions in Chad.
23/10/15	Ericsson	Sweden	3Q15	SEK	59.2	NA	0.94	10% y-o-y sales growth in sub-Saharan Africa was driven by continued development of professional services business as operators focus on network quality and efficiency. Mobile broadband business was stable.
28/10/15	Eutelsat	France	1Q16	EUR	387.7	NA	NA	Earnings up 2.0% at constant currency. On track to achieve target of revenue growth of 2-3% for FY 2015-16 at constant currency, excluding non-recurring revenues.
29/10/15	Intelsat	Luxembourg	3Q15	USD	580.8	452.0	0.66	CEO Stephen Spengler: "Results are in line with our overall expectations for 2015." Firm now has high hopes for launch of next-generation *Epic* satellites which is just months away.
29/10/15	Alcatel-Lucent	France	3Q15	EUR	3,429		(0.07)	Group revenues, excluding managed services and at constant perimeter, grew 7% y-o-y. At constant exchange rates, revenues down 5%. Proposed merger with Nokia now in its final stages.
30/10/15	SES	Luxembourg	3Q15	EUR	493.5	366.5	NA	International revenues year to date were EUR439.7m – up 11.1% but 7.3% lower in constant forex terms. This was partially offset by growth from new agreements, notably with StarTimes in sub-Saharan Africa and *YahLive* venture.

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Block upconverters feature built-in testing

AnaCom has created a new XKu-band block upconverter (BUC) in the 12.75-13.25GHz spectrum. The new *ELSAT* BUCs are available in transmitter output levels up to 100W, and in single or redundant configurations.

MANUFACTURER: AnaCom

PRODUCT: ELSAT

MORE INFORMATION: www.anacominc.com

AnaCom says the units are rugged for continuous outdoor duty in all types of environments, and are particularly suitable for SCPC, MCPC and DAMA applications.

The upconverter, power amp, monitor, control and power supply are included in a single enclosure, and AnaCom says the only cabling required to indoor equipment are IF connectors.

The firm adds that an 'ovenised' high stability crystal oscillator is used to lock the TX synthesiser. Additional temperature and aging compensation are provided by an onboard microprocessor.

The BUC features a monitor and control (M&C) system that can be used in combination with its internal metering function to monitor operational parameters. The M&C system also enables users to monitor and control the converter on the same M&C bus as most indoor equipment, such as modems and multiplexers.

The *ELSAT*s have built-in test facilities for improved maintenance and reduced dependence of external test equipment. To improve and simplify maintenance routines, they can be connected to an external computer to monitor critical parameters such as transmitter power output and IF levels, power supply and TX synthesiser voltages, alarm details, and internal temperature.

Other features include remote configuration and access via Ethernet and serial protocols, and a flash memory so that the BUC can be restarted with the same settings.

CommScope first with "intelligent" RRU power supply

CommScope reckons *PowerShift* is the first intelligent, plug-and-play DC power supply solution for RRUs at macro and micro cell sites.

MANUFACTURER: CommScope

PRODUCT: PowerShift

MORE INFORMATION: www.commscope.com

With increasingly more powerful RRUs being distanced from the power distribution points, the company says delivering power efficiently becomes challenging and costly.

PowerShift aims to help operators re-utilise existing power cable infrastructure, eliminate the need for deploying higher gauge conductors when installing new cabling, and increase the usable length for cables by over four times. CommScope says it can also extend RF battery uptime by up to 35 per cent by taking full advantage of the existing battery backup system.

The solution is designed to automatically deliver the most efficient voltage to the RRU, leveraging technology developed with General Electric. CommScope adds that no manual calibration is required when managing power supply.

PowerShift also enables the use of smaller diameter power cables, resulting in reduced capex as well as less weight and wind load on towers.

Other advantages are said to include decreased opex due to lower overall power consumption, more efficient inventorying, standardised installation, and lower shipping costs.

Sepura enhances TETRA picture messaging solution

Sepura has launched *IMAGE 3.0*, an enhanced version of its critical comms application that allows the transfer of pictures from a control room to field personnel using TETRA mobiles.

IMAGE now has a new modern interface that is said to be intuitive to use and includes drag and drop functionality. Sepura says this reduces training time, and crucially increases the speed at which an operator can react in an emergency.

MANUFACTURER: Sepura

PRODUCT: IMAGE 3.0

MORE INFORMATION: www.sepura.com

The application also supports a wide range of languages via a custom import process which can be easily managed by the user.

According to the company, the app is scalable for use in any sized network, and can be accessed simultaneously by multiple client apps and multiple users in different geographic locations.

IMAGE 3.0 can be used from a client app provided by Sepura, or integrated into existing command and control systems via an API.

xStats correlates LTE metrics from third-party OSS

SevOne has unveiled six new *xStats* adapters for use with third-party OSS platforms. The digital infrastructure performance monitoring specialist says its technology incorporates any time-stamped metrics into the *SevOne Performance Monitoring Cluster*. These can then be automatically correlated with other metric, flow and log data at scale.

As a result, the company says operators gain vital end-to-end visibility into the performance and availability of LTE and IMS networks and services from access to core.

SevOne offers a number of ways to incorporate third-party data, processing that information with the same analytics applied to out-of-the-box data sources. For standard and custom data sources, the firm says it automatically establishes baselines of normal performance, generates alerts when actual performance deviates from those baselines, and then feeds the data into reporting analytics.

The six new *xStats* adapters can be used with platforms from Accedian, Alcatel-Lucent, Cisco, Ericsson, Mitel, and Nokia. Each adapter offers various functions depending on which vendor's platform it is used with.

MANUFACTURER: SevOne

PRODUCT: xStats

MORE INFORMATION: www.sevone.com

Centralised power system allows faster network rollouts

Eltek has unveiled its *High Voltage DC (HVDC)* for powering remote broadband telecoms equipment.

The firm says high bandwidth applications such as streaming video are driving a need for service providers to install many new remote broadband equipment cabinets. The *HVDC* aims to offers these service providers an alternative power feed solution that allows faster rollout and reduced TCO.

MANUFACTURER: Eltek

PRODUCT: High Voltage DC

MORE INFORMATION: www.eltek.com

The solution begins with the existing 48VDC power system and battery at the central site. The *HVDC* system then converts this mains DC power to 380/400VDC. Eltek says these voltage levels can be transmitted across long distances with very low losses.

The power is converted through the vendor's *Flatpack2* HE DC/DC converters *(pictured)* and then passes through a distribution box providing the necessary protection and safety functions, before being distributed to the load in the remote location. Here, a second voltage conversion

takes place as the DC/DC converters transform the 380VDC/400VDC back down to 54VDC /48VDC for the telecoms equipment.

Depending on the number of remote locations connected to each 380VDC/400 cable and their individual power consumption needs, Eltek says the distance between the central and remote sites can be up to five kilometres.

Lightening the load for body-worn cams

Motorola Solutions has launched a three-in-one body-worn video camera, radio speaker and microphone to reduce the amount of equipment safety personnel need to carry.

The end-to-end solution includes the *Smart Interface Si500* and *Si300 Video Speaker Microphone (VSM)*. The compact *Si500* integrates voice communications, real-time video, still images and emergency alerting. It extends the mission-critical performance of Motorola's *APX* radios and is said to include a number of innovative features to meet the needs of first responders.

MANUFACTURER: Motorola Solutions

PRODUCT: Video Speaker Microphone

MORE INFORMATION: www.motorolasolutions.com

For example, the device is equipped with a 210° motion camera lens that has been designed to provide optimal field of view and flexible wearing positions. Users can wear the *VSM* with the display facing in or out.

There's also a full-screen tempered-glass display which has an intuitive user interface that presents only vital information within three panels. Users have the ability to control radio channels and talk groups, view recorded video and photos, tag videos and listen to audio recordings.

The *Si500* also has Motorola's new adaptive audio engine that automatically adjusts audio settings based on the user's wearing position and environment. Other features include five integrated microphones, a 0.5W speaker, and Wi-Fi connectivity.

Turning customer data into revenue

With end users expecting always-on connectivity, carriers, managed service providers and enterprises are looking for new ways to better monetise network services.

ADTRAN reckons it's come up with the solution with *ProCloud Analytics*. It says this enables providers and organisations to capture customer demographics and translate that data into actionable business intelligence.

MANUFACTURER: ADTRAN

PRODUCT: ProCloud Analytics

MORE INFORMATION: www.adtran.com

The company says the first natural application for *ProCloud Analytics* is in the wireless network. After a patron logs onto a Wi-Fi network, the software enables the authorised collection of the user's email, name, age, gender, home town, type of device used to connect, birth date and more.

What's described as a "sophisticated" built-in marketing platform within *ProCloud* is said to make it easy for network owners to push targeted emails or text messages and incentives

based on a wide range of criteria. For example, ADTRAN says retailers can automatically welcome a first-time customer with a coupon, or reward frequent visitors with a free gift.

Analytics is part of the firm's range of *ProCloud* managed services. It says this provides an "easy" solution to layer on top of a service provider's existing offerings for a wide range of customers and vertical markets.

ALSO LOOK OUT FOR

DMR standard is enhanced

The European Telecommunications Standardisation Institute has released a new version of the Digital Mobile Radio (DMR) standard.

The DMR Association (DMRA) says *v.1.7.1 of the Tier III Trunking Part TS102 361-4* standard has major additions requested by users.

These include dynamic group number assignment (DGNA), MS to MS duplex for voice and data, transmit interrupt routines, and an additional mode for application data over an IP bearer service.

DGNA, talk group subscription and talk group attachment handling over the air interface were added to increase the flexibility of one of the key advantages of narrowband PMR, namely efficient group call communication. The DMRA says 'one-to-many' communication is imperative, and DGNA therefore improves the flexibility of group call modes offered by DMR Tier III.

MS (mobile station) to MS duplex for voice and data required the introduction of additional timing modes for the trunked system control channel (TSCC), specifically when used on single RF carrier base stations.

According to the DMRA, the addition of the duplex speeds up data transmissions, and increases convenience for users, allowing them to exploit the deployed infrastructure in lower traffic areas more efficiently without losing functionality.

The addition of transmitting application data over a defined IP bearer service enables DMR system users to integrate their wireless infrastructure more tightly into IT infrastructure. It also offers manufacturers the possibility to provide a bearer service for customer specific data.

DMRA chairman Mario Micheli says the new standard is a "true sign" of widespread adoption of DMR technology. He says: "Users are asking for more capabilities, because they wish to use DMR in their business critical applications in a wider variety of use cases."

Hughes has worked with Telma in Madagascar on a GSM backhaul project that extends 2G and 3G connectivity to remote and rural areas.

Setting new sights on backhaul

As mobile networks continue to expand and carry ever greater levels of traffic, the need for effective backhaul has never been more critical. So with more fibre now available in Africa, is this the only solution operators need? RAHIEL NASIR finds out.

The number of submarine fibre optic cable systems that now surround Africa and have been landing on its coastlines over the last few years has certainly been a fillip to broadband connectivity in some parts of the continent. But as well as being used for broadband, what about fibre's promise of backhauling mobile networks? Here, it could be argued that submarine systems are not enough as operators need more terrestrial cable deployments that reach further inland. But all that now looks set to change.

In 2014, Liquid Telecom announced it had created Africa's first fully redundant regional fibre ring. Spanning 20,000km, the East Africa Fibre Ring runs from Kenya to Uganda, Rwanda, Tanzania and back into Kenya, connecting these countries to each other as well as to the rest of the world. Built at a cost of USD20m, it is said to be Africa's largest single fibre network and also connects to the region's five main subsea cable systems: WACS, EASsy, SEACOM, SAT3 and TEAMS.

Although Liquid uses wireless technologies and satellite to complement its network, it believes that only fibre will be able to provide the speeds and capacity needed by LTE base stations. Ben Roberts, CEO of the company's Kenya operations, says: "In Africa, most people access the internet over their mobiles, and so LTE networks are already commercially deployed with more being built. LTE base stations need mega amounts of bandwidth that can only be provided by fibre. We have already started laying fibre to LTE base station sites that have been built by a variety of operators and independent tower leasing companies. This fibre then interconnects with our pan-African fibre backbone."

Roberts admits that cell sites in remote areas are unlikely to be connected by fibre as it is just "too costly and time-consuming" to lay for smaller populations in such communities: "These BSTs will continue to be served by wireless and satellite but will not be able to provide LTE speeds and capacity."

However, he goes on to suggest that one option to reduce costs can be to run fibre on the electricity poles that supply mains power to the base stations. Liquid has already carried out large deployments of optical ground wire (OPGW) and all-dielectric self-supporting (ADDS) fibre in Zambia and Zimbabwe, and is considering the cost benefits for LTE base stations.

Wireless reaches where fibre cannot

What are often regarded as fibre's weaknesses is where wireless technologies such as satellite come into their own. As the number of mobile subscriptions in Africa continues to climb skywards, Intelsat believes much of the demand for increased connectivity will come from rural areas, where terrestrial infrastructure is either unable to meet demand or is simply non-existent.

Contrary to Roberts' view, Intelsat's EMEA VP Jean-Philippe Gillet believes satellite is meeting the needs of MNOs in rural areas. He says Intelsat is providing 2G and 3G networks through the combination of its satellite fleet and the *IntelsatOne* terrestrial network.

"The introduction of high throughput satellite (HTS) will deliver the additional capacity that will enable the expansion of 4G networks as well," says Gillet. "This will lead to an increase in mobile network operators utilising satellite backhaul and satellite-based rural telephony extensions, as it allows them to cost-effectively increase their customer base in areas that were previously inaccessible.

Northern Sky Research (NSR) forecasts that HTS will propel the global market for satellite backhaul in the coming years. In its *Wireless Backhaul via Satellite* report published in April, the analyst predicts that current and next-generation solutions will generate revenue streams from USD1.7bn in 2014 to USD5.3bn by 2024.

According to the report, traditional FSS capacity in C- and Ku-bands has so far been the most prevalent solution used for backhaul and trunking in land areas, and has begun to address the need for 3G services. But it adds that less expensive and higher throughput capacity is challenging the economics of traditional FSS where erosion of the revenue base is leading to an 'HTS play' by operators that own traditional FSS transponders. "GEO HTS capacity is making a big push on land, air and sea where a clear migration in the fixed land towers backhaul and trunking markets is under way," says NSR.

The satellite cost question

While non-geosynchronous HTS is still in its infancy, NSR says it promises better latency with the likes of O3b making inroads in backhaul, trunking and mobility platforms. And it says that if one or two LEO, or low Earth orbit, HTS programmes (*such as OneWeb – see News May-Jun*) are launched, total capacity will increase manyfold leading to price pressure for all offerings.

"Non-GEO HTS equipment pricing, specifically antenna systems, will have to come down dramatically compared to current O3b pricing in order to address capex considerations," says report author Jose Del Rosario.

Dave Rehbehn, Hughes Network Systems' VP of marketing, international division, agrees. As far as the prospect of non-GEO systems is concerned, he also says O3b's capex is driven by the cost of antennas, and because this is currently too high they are really only suitable for very high capacity sites. "But what most people seem to think is that there is going to be a new generation of antenna technology for the remote earth stations that are going to enable cost-effective LEO and MEO installations. And this will have huge impact, not just on cellular backhaul, but on regular VSATs."

Rehbehn goes on to say that backhaul is a very important application for Hughes for two key reasons: "Number one, it is a very high value service offering on the part of satellite service providers; and number two, it is an area where there is very good potential as we see more HTS systems deployed. We think we can change the equation of satellite backhaul for cellular systems with the new generation of high throughput satellites. What they will enable is a lower cost per bandwidth capacity, and that has always been one of the key issues with satellite backhaul for cellular systems."

Until then, he says satellite will continue to be viewed by MNOs as the backhaul solution to use when there is no other option available. "Talk to the cellular operators and they will tell you that if they can get fibre, that's going to be their number one choice. And if they can get microwave with a reasonable number of hops, that's going to be the next choice. The fact is satellite, historically, is the option when you don't have anything else."

Having said that, Hughes has been working with Telecom Malagasy (Telma) for a number of years. The operator had already been using the company's NOC and broadband satellite terminals to deliver rural telephony and internet access in the country. In 2012, Hughes supplied additional *HX System* remote terminals and an *HX* hub to expand Telma's GSM backhaul project – that's despite the telco investing USD70m since 2005 in a 3,300km national fibre optic backbone network, and also being the first contributor to the EASsy submarine cable.

Nonetheless, Gilat Satcom, which provides both fibre and satellite capacity for cellular backhaul, supports the view that solutions in space come second to solutions underground when it comes to backhaul options for mobile operators. The company's marketing and business development director Eran Yoran says: "I can describe the needs of MNOs in a very precise way. Whenever there is a fibre option it will be the first choice as it is the most cost effective, and a great deal of demand can be met.

"In the absence of a fibre solution, satellite will be the number one choice for the very long distance backhaul as it is easy to deploy and maintain, and is extremely stable. The disadvantage is the latency and price. Prices are going down on the GEO satellite but the latency is fixed."

For short distance links, Yoran believes microwave will be the default option. But he adds that while it has low latency and is relatively affordable, the engineering side is complex, and adding more towers between two locations means the reliability of the link drops and the price rises.

Big opportunities with small cells

Microwave radio specialist Aviat Networks says although some countries such as South Africa have supported initiatives that have improved the national fibre backbone and metropolitan fibre penetration, the access (last mile) fibre penetration remains "appallingly" low with most areas having "zero" access to fibre.

But according to the company's technical marketing manager Siphiwe Nelwamondo, there is a solution to connect back to the terrestrial metro fibre – a licensed wireless microwave radio system. "This will bridge the connectivity gap, keeping businesses connected and running effectively. This microwave radio last mile solution will cost effectively bring access to a community's doorstep.

"We are all aware of fibre's prowess and capabilities. However, little is understood about microwave radios systems and their capabilities, and hence they remain the underdogs."

Nelwamondo continues by saying managing backhaul traffic that is showing double digit annual growth and dealing with increasing

Dave Rehbehn, VP marketing, international division, Hughes Network Systems

"The fact is satellite, historically, is the option when you don't have anything else."

numbers of cell sites are well-known challenges for most MNOs. Quoting Heavy Reading's *Ethernet Backhaul Market Tracker, April 2014*, he says the number of cell sites globally will rise from around four million to more than five million over the next three years.

"Coupled with this growth is the fact that newer public small cells are imminent in the near future. The reality quickly sets in as to how daunting a challenge this is for operators, leaving many to ask questions such as how do I deploy and provision all these sites quickly and within budget? And how do I continuously adjust my network to continuously deliver in an efficient way these new applications and services to my end-users?"

When it comes to using small cells for rural deployments, satellite also has a part to play according to Spacecom which operates the *AMOS* fleet. The company's South Africa representative Kevin Finlay says: "People in these more remote areas need and want connectivity. So the question is simple: how do these potential users get good service at the same price as the other GSM users without placing the burden unfairly on the end user or on the operator? The solution lies in small cells with a lower cost satellite backhaul. Many equipment vendors are capable of providing equipment to handle this."

But as Finlay goes on to point out, how is this backhauled, for example, from a remote village in the DRC, Kenya or Zambia? While satellite offers the solution, he says C-band is too costly based on equipment capex and monthly opex, and lower cost Ku-band platforms can cover some basic voice communications needs with limited data in some villages. The answer is therefore Ka-band.

"By using Ka-band, the base cost is lowered for remote areas because the opex and capex are lower in orders of magnitude than Ku and thus high capacity can be provided for the same or lower cost. This immediately opens a whole new market of voice and data services to those areas because the cost base is reduced to less than half the typical Ku-band platform. Small cells can also be self sufficient as the power usage is very low and so can be driven by solar and/or wind power while using smaller masts which are quicker, easier and less costly to implement."

Hughes' Rehbehn agrees and says he is seeing

more infrastructure vendors developing small cells that can help save the costs of deploying high-cost and high powered macro sites.

"While these small cells don't perhaps have a huge amount of capacity, they are very cost-effective and can be solar powered. So from the infrastructure side we see small cells enabling more cost-effective rural deployments, and from the satellite side we see the HTS enabling a lower cost of bandwidth. Together, we think this really does create some significant opportunities for satellite backhaul and cellular traffic.

"Ericsson, Huawei, Nokia, Alcatel-Lucent – all of those guys have very good small cell products that are optimised and have an IP interface. Our view has been to integrate effectively with those products as opposed to trying to force fit our solution onto a operator. That's just our approach to the market."

Gilat Satellite Networks (GSN) has developed a small-cell-over-satellite solution to provide mobile operators with a 2G/3G cellular infrastructure solution to better serve remote regions *(see Wireless Solutions, May-Jun)*. The company has teamed-up with Intelsat to deliver its *CellEdge* solution. Earlier this year, the two companies announced a deployment for Canada-based RuralCom's mobile network along the 1,000 mile-long Alaska Highway and British Columbia North Coast. Here, a *CellEdge 3G* network is leveraging Intelsat's global fleet through its *Horizons 1* satellite and *IntelsatOne* terrestrial network. GSN says its small cell is optimising space segment usage via a hub located at an Intelsat teleport.

Microwave – still Africa's hottest backhaul option?

Ceragon Networks remains sceptical about the use of both satellite and fibre for backhaul. The company has provided its microwave systems in many African countries such as DRC, Kenya, Nigeria, South Africa and Tanzania, and its mobile operator customers include Airtel, Globacom Nigeria, Vodacom, amongst others.

Amit Ancikovsky, the company's Africa and Latin America president, says: "Satellite is an option for wireless backhaul but falls short if you are trying to deliver bandwidth intensive multimedia services such as video or applications like *Facebook*, as less content gets to the user due to issues with uplinks. It is also cost-prohibitive and often used when in geographic areas where microwave or fibre can't reach.

"Microwave is a viable alternative to both satellite and fibre as it is able to be deployed rapidly and provides an opportunity to accommodate the needs for more capacity and features – from basic links to up to 4Gbps. Microwave can also work on a pure software mechanism where software upgrades can be done remotely through a network operation centre. Carriers are picking up on these advantages."

Microwave technology is certainly evolving beyond the 'QAM wars' that were grabbing the headlines just a few years as vendors launched radios with higher amplitude modulation rates. Now, there is a much greater focus on offering customers higher capacity.

Ceragon has come up with an alternative approach to scaling its microwave products. Earlier this year it launched *Advanced Frequency Reuse* for its *IP-20* microwave platform that is designed for heterogeneous network hauling. This enables the use of a single frequency channel where multiple channels are often needed to meet wireless backhaul demand. The vendor claimed the results include a saving of at least 50 per cent of the wireless spectrum required, and also allows for doubling the capacity of the wireless backhaul network.

Ceragon explains that *Advanced Frequency Reuse* works by requiring far smaller angular separation between wireless backhaul links that utilise the same frequency channel. Instead of employing a separation of at least 90° as required today, it reduces the needed separation to just 15°. The firm said this leads to flexibility in network deployment and a significant reduction in opex and capex.

"As capacity demands grow, microwave will provide a significant runway for growth," says Ancikovsky. "This is only the beginning, and LTE hasn't yet taken hold. Current customers are utilising approximately 100 megabits to 500 megabits. The capacity needed for LTE will increase to a range of between 500 megabits and one gigabit. By 2016/2017, we will see the need for one gigabit to the access sites."

Forget the traditional solutions

Free-space optics (FSO), a technology that uses light propagating in free space to wirelessly transmit data, has been around for quite some time now but its use in Africa is fairly rare. However in April, Nigerian ICT solutions provider WaveTek announced it had successfully deployed AOptix's Laser-Radio Technology (LRT) in Lagos. A seven kilometre link has connected capacity from submarine fibre cables to a distribution point in the city.

US-based AOptix describes itself as a "pioneer" in ultra-high capacity wireless communications. Its *Intellimax* platform uses LRT that was originally developed for deep space imaging and later further developed for military applications. The company reckons LRT breaks new ground by integrating FSO with millimetre wave RF technology to provide reliable, ultra-high bandwidth capacity (2Gbps) with carrier-grade availability up to 10km.

According to AOptix, the deployment of *Intellimax* in Nigeria has proved the system's ability to provide high-bandwidth connectivity between the country's mobile carriers and the rest of the world.

Lagos, the largest city in Africa with a population of more than 20 million, is the landing point for four major submarine systems that connect Nigeria to Europe: SAT-3/WASC/SAFE; ACE; GLO-1; and Main One. With the undersea cables largely in place, AOptix says the challenge now is to pull that network capacity into the continent's population centres and bring connectivity to under-served markets. But it adds

WaveTek is using AOptix's backhaul technology in Lagos. It integrates FSO with millimetre wave RF.

there is currently not enough infrastructure in the region to transport the optical bandwidth.

"In Nigeria, and across Africa, fibre is simply not viable in most situations – it is too costly to deploy given the challenges of the terrain," says WaveTek CEO Ken Spann. "On the other hand, microwave doesn't provide the bandwidth and range needed and can't stand up to our humidity and heavy rains. The *Intellimax* link has weathered our rainy season, delivering 100 per cent uptime."

AOptix and WaveTek conducted the Lagos validation using an E-band (70-80GHz) trial license granted by the Nigerian Communications Commission. They have also been working closely with the commission to open up E-band spectrum for full use in the country. AOptix hopes the release of the frequencies will allow widespread deployment of its *Intellimax* system.

As Spacecom's Finlay says, backhaul capacity cost remains a major concern for all MNOs, so reducing this substantially while increasing the number of subscribers will be a natural growth point as the operators expand further into rural areas. But many commentators agree that no single technology will provide operators with a backhaul solution – fibre, satellite and microwave each have their own advantages and disadvantages.

Semir Hassanaly, market director of cellular backhaul and trunking at Newtec, says the choice between fibre, microwave or satellite is pragmatic and driven by three parameters: "Availability (fibre is most ideal in urban regions and easily available in coastal regions where the undersea cables land); economics (fibre is expensive which makes satellite or microwave, if line of sight allows a limited number of hops, the most cost-effective solutions); and marketing (satellite provides quick go-to-market).

"Capacity requirements can be very acute and in the end it is these three parameters which operators will consider when making the decision on which backhaul method to choose." ■

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Next generation testing

Commercial LTE services have so far been launched in around 20 countries in Africa since 2012. In Rwanda, Tigo (pictured) has just gone live with the country's first mobile 4G service – see News, page 5. Operators in several other nations across the continent are either currently trialling networks or have plans to launch 4G in the near future.

Testing and optimising LTE networks often presents a number of unique challenges to operators. So what are the issues and how can they be addressed? RAHIEL NASIR finds out.

What's the most critical factor for mobile engineers to look out for when they need to test and optimise their LTE networks? While the test and measurement specialists we spoke to identified various issues, there was one particular area many of them agreed upon: Quality of Experience.

For instance, Rohde and Schwarz (R&S) believes a key challenge for MNOs is to ensure continuing QoE for subscribers in a dynamic market that is characterised by evolving demand, the use of new network services (especially video), and the adoption of new features of the 3GPP standard including VoLTE. Jeremy Carpenter, the firm's marketing manager for mobile network testing, adds: "There is an ongoing need [for MNOs] to be aware of the performance of their own network and to differentiate themselves from their competition."

Many experts agree, saying that given the highly competitive markets cellcos operate in, it's critical for them to have an objective view of the performance of their LTE services and devices – and not just compared to local rivals but even benchmarked against successful operators elsewhere. Bruno Poisson, regional director for Anite's network testing division, believes this is vital for them to gain customers and increase ARPU.

"MNOs should conduct a regular and repeatable programme of competitive testing and analysis in order to understand their relative user experience ranking in the market, particularly as the number of subscribers connecting to their services increases, and capacity issues that may not be immediately apparent start to emerge. Failure to do so, will mean that the MNO may not be aware of potentially significant degradations in overall service performance and user experience relative to key competitors."

Poisson says some operators still use solely FTP testing to assess the performance of 4G data services. While this makes sense for throughput testing, he says other tests to ensure QoE need to be performed. "For example, close to 40 per cent of mobile data traffic comes from streaming video, notably *YouTube*. Network testing solutions should enable operators to fully assess the performance of *YouTube* as well as other social media services."

What needs to be tested?

Many commentators point out that LTE increases complexity across the mobile communications ecosystem. For example, Paul Gowans, director of marketing, RAN solutions, for Viavi Solutions (formerly JDSU), says: "Although LTE has a flatter architecture, it also has more inherent complexity – new frequencies to deal with, interference, more complexity in the eNodeB with hand-offs handled locally, MIMO, etc."

Carpenter says that because of the complexity of the LTE wireless interface, testing the performance of the RAN is critical to ensuring optimum operation of the network. For example, engineers should drive- or walk-test network coverage using parameters such as voice and video MOS, throughput, call completion rate and handover success rate.

"These results can be used to make strategic adjustments and enhancements to the network, optimise the coverage benchmark performance against competitors, and ensure compliance with regulatory obligations," says Carpenter.

Gowans believes operators should also be aware that there is no such thing as a 'typical' 4G customer: "It all depends on what network coverage is available, plus phones are moving from one network to the other all the time. It is this that defines the customer experience. So solutions are needed that can cover all technologies – 2G, 3G and 4G."

Clearly, there is complexity associated with ensuring interoperability between LTE and legacy 2G and 3G, as well as increasing complexity

associated with ensuring the quality of, and interoperability between, a whole host of new and legacy devices. It is therefore vital to ensure that all elements of the network, including the radio/air interface and backhaul, devices, services and applications work together effectively.

According to Carpenter, there is a need to design a network that ensures performance in an efficient way, thereby balancing QoS against financial objectives. "Correct testing of LTE devices, network infrastructure and the wireless channel during the planning phase increases the predictability of the network from planning to deployment, avoiding expensive design changes. During deployment, fast installation and commissioning of network infrastructure reduces costs and shortens the time when revenue streams start to generate income."

Keysight Technologies adds to this by saying the challenges of optimising LTE networks become much more intensive from the outset. "Multiple types of cells – such as macro, micro, pico and even femto – will co-exist in such networks, so an increasing number of parameters need to be taken into account in network optimisation," says Mayca Avila, the vendor's EMEA field market development manager for mobile broadband operation.

She also says many operators are realising too late that the transport backhaul is a critical consideration in 4G: "It is very important to deploy a core network solution that is flexible enough to offer smooth migration from centralised (longer backhaul) to distributed (shorter backhaul) core network nodes."

Having said that, Avila believes the operator's main goal must be to look for strategies and solutions that will improve its existing 2G/3G networks without requiring a complete equipment upgrade as they deploy their 4G networks.

"The solutions that are already deployed in the market might include many of the elements required of the 4G network, such as: integrated intelligence; simplified network architecture; high bandwidth performance capabilities with on-demand scalability; and enhanced mobility."

Nokia Networks supports this when it says the basic challenges of testing 4G networks remain the same as 2G/3G. However, when it comes to LTE specifically, the company says it is very important to optimise network coverage and reduce interference for the best user experience and optimal usage of radio resources.

Jeremy Carpenter, Marketing manager for mobile network testing, Rohde & Schwarz

"Correct testing of LTE devices, network infrastructure and the wireless increases predictability of the network."

Mounir El Aichaoui, the firm's head of market unit North Africa, reckons LTE network optimisation is more inclined towards a capacity driven quality improvement approach. "Initial optimisation is basically about taking care that L1 (antenna azimuths and downtilts) are adequate. In the case of LTE, this only becomes visible as interference and reduces spectral efficiency under higher loading."

He advises operators to ensure that their L1 design is right from the outset, and that they should not just "blindly use" what already exists such as their GSM1800 antennas, for example.

"Across the globe, LTE is currently handled like 'business as usual'. Rules such as monitoring of traffic load and end-user experience, and preparation for mass events also apply to LTE rollouts as they did with 3G rollouts. Many operators are operating on multiple LTE frequencies – load balancing and equalisation therefore play a very critical role."

El Aichaoui adds that new services such as VoLTE should be thoroughly tested before being introduced across the network. "Operators are recommended to prepare and optimise the radio network at least one year prior to the launch of a VoLTE service. By doing so, they will be able to ensure the optimum user experience once it is launched."

Anite's Poisson is in agreement here, and says that before VoLTE is introduced, operators should optimise the quality of their voice service paying particular attention to circuit switched fall-back (CSFB) performance. "In practice, early LTE deployments often led to poor CSFB performance (6-10 seconds typically). Optimisation work is needed to ensure that this is brought as close as possible to three seconds, or even less."

For data testing, Poisson reiterates that MNOs need to abandon legacy systems such as FTP. Instead, he says they should use smartphones to test widely used social media services and focus their optimisation efforts on enhancing customer experience based on real usage patterns. He also advises cellcos to ensure services are maintained when on the move: "This means not only performing drive tests but also on-train and in-building measurements."

How to test

R&S says some 2G and 3G test tools can be reused for LTE. But because of the technology's increased bandwidth, higher data rates and frequency channels, test tools often need to be upgraded. "This becomes more prevalent when complex RAN features need to be tested such as MIMO and Carrier Aggregation," says Carpenter.

For Keysight, physical layer testing is essential as this seeks to determine conformance with the vital parameters essential for the successful transmission of a signal over the air. Avila says transmit power, the quality of the TX waveform, and the accuracy of the TX frequency, are all key to a mobile station's performance. For transmission quality, she says the emphasis should generally be on the maximum power measurements since these typically present the biggest challenge for high power circuits.

Paul Gowan, Director of marketing, RAN solutions, Viavi Solutions

"Interoperability between vendors' equipment is needed more in LTE, so ensuring services run end-to-end is a fundamental requirement."

"On the receive side, the ability of the mobile to successfully decode the signal at the lowest and highest signal levels defines its successful operation in the network. Also, a mobile responding linearly to power control commands is critical to network performance."

Avila continues by saying that since it is known that most distortions will be at their worst at high power, the emphasis will be on high power testing with probably only a single sample from the mid and low power settings. "The most complex modulation rate will be the most sensitive to distortion. We also recognise that maximum modulation will be used when the mobile is closest to the base station, so max rate modulation is suitable for testing at the low power setting."

Viavi believes operators should "never underestimate" the importance of testing in the lab prior to deployment, particularly emulating real world conditions. "Interoperability between vendors' equipment is needed more in LTE, so ensuring services run end-to-end is a fundamental requirement," says Gowans. "Also, more sites have fibre now in the fronthaul, so being able to test fibre and RF in one instrument to save time, cost and tower climbs will help the operators' business."

Nokia has already pointed out that interference plays a more significant role in LTE networks, and controlling it can be more delicate due to frequency reuse. Gowans adds: "Identifying sources of interference can be a major headache, but with new spectrum for LTE and constant re-farming, efficiently hunting for interference will eliminate customer service issues and reduce opex."

Network infrastructure specialist CommScope says that because LTE is a high throughput technology spanning larger spectral bandwidths, it's susceptible to a number of issues. Dr. Mohamed Nadder Hamdy, the company's director of wireless network engineering, says

these can include sensitivity to RF path elements, sensitivity to SINR ratios, and degraded PIM performance.

Earlier this year, the vendor launched its *Optical PIM Tester* and claimed that for the first time ever, a single technician could now use a handheld device to connect directly to the base band unit at the bottom of the tower and perform a 'truly active' PIM test over the CPRI. CommScope says the tester utilises an interface that is not susceptible to creating PIM and thus prevents testing from becoming part of the problem. Using the CPRI, it injects signals into the downlink and looks for PIM products in the uplink, making it easier to identify interference.

While eliminating PIM addresses one aspect of LTE network testing, others argue that what's actually needed is for operators to completely re-think their approach to optimisation.

"LTE has enabled bandwidth hungry services and mass adoption of social media services on smartphones," says Poisson. "Investing more effort on enhancing the service performance is key. This is a profound paradigm shift that results in the deployment of different testing methodologies. Operators need to recognise this and implement the necessary updates so that this is fully understood and supported."

Given the fact that LTE is IP-based, does that facilitate testing solutions that offer greater functionality in terms of remote management capabilities and future scalability?

CommScope's Hamdy says LTE's all IP system has made the core network less complicated by eliminating the circuit switched part. "It has also simplified and improved the radio access by cancelling base station controllers and embedding their functionality in the base stations themselves for better latency. This has opened the door for NFV adoption in the EPC and cloud-RAN."

But here, R&S' Carpenter adds a warning: "With the migration of network architecture away from dedicated physical elements towards NFV, test tools deployed in the cloud must be compatible with operation in a virtual environment."

With so much emphasis on data services, Gowans believes solutions are needed today that can manage the scale of deployments. "Networks can very quickly run out of capacity and the operator must deal with the need to optimise the network to cope with customer demand."

Viavi reckons its *ariesoGEO* platform can help here. According to Gowans, this locates, stores and analyses data from billions of mobile connection events, and gives operators a "rich source of intelligence" to help boost network performance and "enrich" user experience. "This solution can provide intelligence on more than 130 million subscribers on a single network, and can be processing 35 billion events per day – that's eight times more than the number of Google searches in a day," he claims.

Keysight's Avila agrees that cellcos must address the challenge of integrating intelligence at the access edge: "As a greater variety of services and user types cross the mobile network, it is critical to increase network and subscriber intelligence."

Of course, the faster data rates enabled by LTE also mean cellcos are experiencing significantly greater competition from over-the-top players. It is therefore critical for them to be able to compare the performance of their new IP-based voice services against the OTT offerings.

But as Carpenter points out, a fully IP-based network also brings the possibility to monitor subscriber traffic in the core in near real-time. This not only makes awareness of issues such as congestion more immediate, but also opens up opportunities for MNOs to gain greater insight into traffic and subscriber profiles: "This can be used for intelligent management of the network and targeted marketing to protect revenue in the face of erosion by OTT players." ■

HARDWARE FOR TESTING & OPTIMISING LTE

Rohde & Schwarz (R&S) says it's reached a significant milestone in the commercial evolution of LTE-A. Working with load testing solutions specialist Prisma Telecom, it has successfully completed RF tests for LTE FDD four component carrier aggregation (4CC) in the downlink.

Their solution consists of two R&S *CMW500* wideband radio testers *(pictured below)*, the R&S *CMWC* controller, and Prisma's *UeSIM* multi-terminal simulator which features one eLSU and two SDRv3 units. Each *CMW500* generates two component carriers with 20MHz bandwidth and 2x2 MIMO, while the *UeSIM* terminates the traffic. R&S says the entire setup can provide downlink rates of 600Mbps – the performance required for testing 3GPP category 11 devices.

In a separate development, R&S claims it has successfully verified combining various frequency bands in TDD and FDD carrier aggregation (CA). During a test that once again featured the *CMW500*, the company simulated an LTE network and says data was successfully transferred to the device under test on multiple aggregated carriers in different duplex modes. R&S says this makes the *CMW500* the only platform to support RF and protocol tests for CA in line with 3GPP Release 12 for TDD/FDD joint operation.

Anite has enhanced its *Propsim F32* LTE-A MIMO radio channel emulator (*pictured right*), enabling users to test new 3GPP features (Release 13 and beyond) in multi-mode base stations and mobile devices Frequency range support has been extended up to 6GHz so that users can test mobile devices and network equipment for any LTE or LTE-U band, as well as for WLAN frequencies above 5GHz. *Propsim F32* also supports testing of all LTE-A CA schemes defined by 3GPP.

Anite reckons the unit offers the industry's highest RF output power levels and the widest RF signal dynamic range. It says this reduces the need for expensive and sizeable external RF power amplifiers in MIMO OTA anechoic and reverberation chamber installations.

Cobham Wireless' *TM500* range of testers now also support CoMP (coordinated multipoint) transmission/reception, a major feature of 3GPP LTE-A Release 11. The vendor says one of the primary reasons for operators seeing a degraded quality of service with hetnets is poor cell-edge performance due to lack of traffic coordination and interference management between small and macrocells.

The *TM500* already features eICIC to address cell edge interference issues. With the addition of CoMP, it can now coordinate transmission and reception between different cells through the use of load balancing, coordinated scheduling, and the management of signal power and interference.

In the downlink, it's claimed each terminal sees improved data throughput, especially near the cell edges, due to less interference and an increase in received power. For the uplink, RX signal quality and cell edge coverage is improved by simultaneous coordinated reception from different points on the network side.

Late last year, **Keysight Technologies** announced it had verified three component carrier (3CC) end-to-end IP data throughput with its *E7515A UXM* wireless test set (*pictured below*). The *UXM* supports multiple cells, downlink and uplink CA, MIMO up to 4x2, and integrated fading. Utilising three 20MHz component carriers in the downlink for a total aggregated bandwidth of 60MHz, the firm said it had successfully demonstrated 450Mbps downloads/50Mbps uploads (category 9) data rates.

Separately, Keysight's *Signal Studio* LTE software tools now support key features of 3GPP Release 12. The company says they include the latest generation of metrology-grade 256QAM reference signals needed to test physical downlink shared channel and physical multicast channel implementations.

The updates also support the downlink shared channel with limited data rate channel coding for the new category 0 UE as defined by Release 12.

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Embracing OTT

The trend towards over-the-top services is not a short-term change but a fundamental one. Lindsay Servian explains how mobile operators can deal with it.

Throughout the world Telcos and MNOs have a similar question… "My network and my network investment is increasingly devoted to my customer's love of OTT entertainment. How can I benefit from it?"

"The trend towards OTT is not a short term change, but a fundamental one" said Lindsay Servian, Head of ONTAPtv.com™ with PCCW Global.

We are seeing a convergence of three key trends:

1. Higher speed, and lower cost, bandwidth as new technologies grow apace,

2. Increasingly sophisticated mobile devices such as smartphones and tablets at affordable pricing, and

3. Apps that bring the freedom for customers to watch what they want, when they want and where they want.

The market is enormous:

1. For most entities, video is already accounting for around 80% of data traffic; whilst data traffic is a main driver of business growth,

2. Informa Telecom & Media sees the OTT video entertainment industry to be worth US$ 29.8 bn in 2016. We see daily articles identifying that OTT viewership is not just growing rapidly, but eating into traditional TV markets, and

3. In developing markets – just as "mobile services" leap-frogged "fixed line services" to bring cost-effective connectivity to the mass of the people, so OTT video entertainment services are positioned to bring low cost premium content to the mass of the population who seldom have access to affordable Pay TV.

> **"It's a perfect opportunity for Telcos and MNOs" added Lindsay Servian. "They have tremendous assets they can leverage such as their brand, their customer base, their local delivery platforms, their retail chains, and their billing and customer systems."**

ONTAPtv.com™ – a flexible tailored service – a 1, 2, 3:

1. ONTAPtv.com™ has a comprehensive and compelling content proposition including content from leading international studios - such as Warner Bros, Metro-Goldwyn-Mayer (MGM) and BBC Worldwide - and local content from providers such as SABC. It has also sponsored local content. In its content arrangements, PCCW Global has leveraged its expertise in the content industry, and deals directly with studios to gain maximum marketing flexibility, content rights suited to its needs, and best possible pricing.

2. ONTAPtv.com™ is the first in South Africa to offer á la carte packaging. This enables customers to pay only for the content they want to watch. For example, if a customer just wishes to have the African ONTAPtv package, then they can do so. There is no obligation for them to buy other packages as well. Of course, this also enables pocket beating pricing.

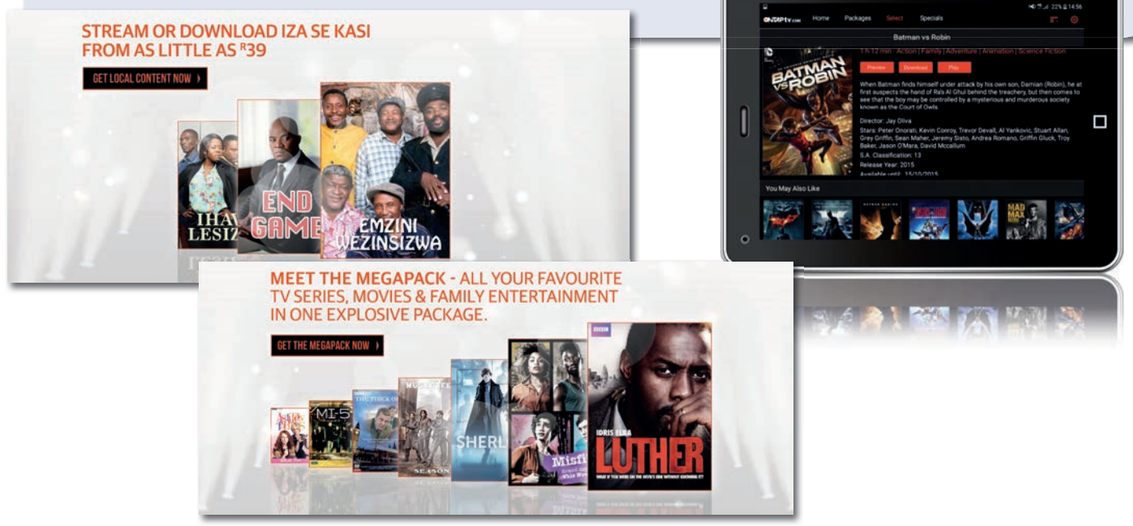
3. ONTAPtv.com™ is easy to use. The interface is intuitive, and has an advanced and innovative search engine that includes standard and advanced gene based search enabling customers to look, for example, for content based on a book, or containing dry humour, etc.

ONTAPtv.com™ is the first in South Africa to bring customers the ability to download content onto smartphones and tablets for off-line viewing. It brings:

- A highly cost-effective service - customers can manage their costs by downloading the content they wish to watch via WiFi, or in off-peak periods, and watch off-line later.

- The ability for customers to watch their content when and where they want; even when they're travelling or in areas with poorer data coverage,

- The ability for high quality viewing to TVs - customers can download content in high resolution for a greater viewing experience for TVs, or cost-effective standard resolution for smartphones and tablets.



Most Telcos and MNOs now recognize video entertainment services as a key component of their triple or quad plays to both: (i) maintain core business ARPU, reduce churn, and grow their customer base; and (ii) as a business in its own right.

However the question arising is how to do this with a new unknown world of complex content rights on one hand, and many OTT specialists offering either little to no revenue share, or expensive platforms without on-going support on the other.

"In Hong Kong we've been running one of the world's most successful media businesses as part of our quad-play" said Lindsay Servian. "And in South Africa, ONTAPtv.com™ is an OTT video entertainment service bringing premium content at affordable pricing, and tailored for local market conditions." Lindsay Servian added "The service is flexible, cost effective and we're delighted to discuss innovative business models ranging from a full end-to-end managed service that we operate together on a long term basis and including strategic and business planning, people and content skills through to components of our integrated ONTAPtv.com™ platform."

Lindsay Servian,
Head of ONTAPtv.com,
PCCW Global

World's first 5G "network slicing" technology demonstrated

South Korea Telecom (SKT) and Ericsson say they have succeeded in creating different virtual network slices optimised for various applications in 5G networks.

At a demonstration carried out at the operator's R&D centre in Bundang in mid-October, the two companies showed how 5G network slicing technology could be used for super multi-view and augmented/virtual services, "massive" IoT services, and enterprise solutions.

SKT and Ericsson say they were able to completely isolate and protect these virtual network slices from one another, thus successfully resolving one of the biggest challenges that can arise when multiple virtual networks share one physical network.

5G network slicing enables a single physical network to be partitioned into multiple virtual mobile networks, allowing operators to provide optimal support for a variety of 5G applications on an 'as-a-service' basis.

SKT hopes it will enable it to secure a "strong edge in the 5G era" through enhanced network operational efficiency and reduced time-to-market for new services.

"Network slicing is one of the key enabling technologies for [our] all-IT based 5G architecture," said SKT CTO Alex Jinsung Choi. "The successful demonstration is a significant step forward to achieve the world's first deployment and commercialisation of the 5G network system."

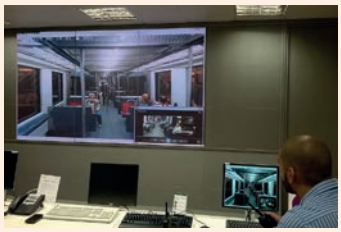
As part of their ongoing collaboration, Ericsson and SKT are also working on building the world's first cloud-based, hyper-scale data centre system for 5G early next year.

Public safety LTE added to Bilbao Metro communications network

Teltronic has completed the latest phase of its security-boosting communications network for the Bilbao Metro which is being deployed in conjunction with ITELAZPI, the operator of the Basque Country's regional communications network.

Bilbao Metro's highly advanced security infrastructure is also used by public safety agencies and transportation entities such as Euskotren and ETS. In May 2014, city authorities decided to use the network to pilot LTE technology based on Teltronic's *Nebula* platform.

The LTE system provides uninterrupted, highly available video monitoring. Used in combination with the mission-critical capabilities of the existing TETRA network, it's hoped it can significantly boost security in the rail network, and help facilitate a coordinated response in an emergency situation.



The fully integrated TETRA-LTE system provides real-time video between the control centre in Bilbao and personnel on board trains and in stations.

Encompassing voice and data, the fully integrated TETRA-LTE system provides real-time video transmission between trains, 41 stations and the control centre in Bilbao, as well as from portable devices carried by security staff. Real-time video from cameras at stations can also be displayed.

Ricardo Lizundia, TETRA systems manager at ITELAZPI, says: "This is an excellent platform on which we can easily build our professional broadband services. It is also a cost-effective solution since we are able to layer LTE technology onto the existing network, alongside existing PMR voice and narrowband data services."

He adds that LTE opens up a range of possibilities for the network and promises "significant improvements" in the public service communications within the Basque Country.

StarHub demos 600Mbps LTE-A using MIMO

In what's claimed to be a first for South East Asia, StarHub has demonstrated 600Mbps data transmission speeds as part of an LTE-A trial in Singapore.

StarHub CTO Mock Pak Lum says: "4G is still on the evolution path, and we are readying ourselves to meet the ever-growing demand for bandwidth-heavy applications and services on faster, more advanced smartphones."

The 600Mbps data transmission speeds were achieved through combined 4x4 MIMO technology along with Carrier Aggregation (CA). StarHub carried out the technical demo at its headquarters using technology from Nokia Networks which included the *Flexi Multiradio 10* base station.

CTO Mock Pak Lum says StarHub is preparing to meet booming demand for bandwidth on more advanced smartphones.

In addition, the two companies say they have also successfully tested three band CA using a commercial mobile device. They claim the successful trials of 4x4 MIMO and multiband CA pave the way towards even faster mobile broadband in future.

LTE-A 4X4 MIMO doubles download speeds using four transmit and four receive antennas for communication between a mobile device and the base station. According to Nokia, future mobile networks will need to use massive MIMO technologies to address hundreds of thousands of data applications sharing the same network, each with its own requirements.

Ray Owen, Nokia Network's Singapore head says: "With this trial, we have proven that our technology is suitably equipped to help StarHub in coping with the forthcoming data deluge, a scenario wherein networks have to be ready to deal with download demands of gigabytes per person per day."

U Mobile to develop 'pre5G'

U Mobile and ZTE will work on the development of 'pre5G' mobile broadband technologies in Malaysia.

Under a deal signed earlier this year, U Mobile plans to make significant network upgrades using ZTE's proprietary pre5G technologies including MIMO. The two firms will also collaborate on the research and development of fifth generation mobile technologies.

Mobile data demand is soaring in Malaysia, and 70 per cent of U Mobile's subscribers are said to be smartphone users. According to a consumer behaviour study earlier this year, the country has South East Asia's highest internet usage with the public spending an average of 219 minutes each day browsing the web.

ZTE says 5G research is key to its strategy of becoming a global leader in next-generation network technology. In 2014, the company says it was the first to propose the pre5G concept, and at *Mobile World Congress* in March 2015 it launched a pre5G base station featuring an integrated BBU and RRU

ZTE says the base station enables carriers to emulate the behaviour of future 5G networks on existing LTE network infrastructure. The vendor also claims that it enhances spectral efficiency of current LTE networks between four to six times by using massive MIMO technology.

Highest ever C-band transmissions

Long distance fibre links records have been broken as part of two separate field trials that took place earlier this year.

In France, engineers from Orange, Coriant, Ekinops, Keopsys and Socionext say they successfully demonstrated the highest ever C-band transmission capacity using various modulation techniques ranging from 24Tbps and DP-16 QAM, to 32 x 1.2Tbps (38.4Tbps) and DP-64 QAM.

The record was achieved in a live environment across the Lyon-Marseille-Lyon fibre optic link in Orange's transport network. It covered a distance of 762km which is said to be more than twice that of any previous field records for 32 QAM, and the first ever regional transmission for 64 QAM.

The transmitters and receivers used to establish the record were based on ultra high speed digital-to-analogue and analogue-to-digital converters developed by Socionext Network using standard 28nm CMOS technology.

The converters cover a broad sampling range with a maximum rate of 92GSa/s. Socionext says their high effective resolution and analogue bandwidth characteristics greater than 20GHz makes scalable architectures for multiple wavelengths and high modulation formats on a single device possible.

Meanwhile in China, optical networking specialist Xtera Communications worked with State Grid Information and Telecommunication of China to demonstrate 100G and 10G transmissions over 627km and 645km respectively, with no active equipment between the end points of the links.

The record unrepeatered transmission distances were achieved by combining Xtera's *Wise Raman* optical amplification and Corning's *Vascade EX2000* optical fibre.

Xtera says ultra-long, low-capacity unrepeatered transmission systems provide a cost-effective and simpler solution over repeatered solutions for many applications. These include subsea links connecting sparsely populated islands, as well as communication links to offshore oil and gas platforms, and over power utility grids to remote areas.

Turkish operator set for Pakistan?

Pakistan's government reportedly plans to conduct a new 3G/4G auction and wants to attract foreign bidders.

According to local media, ICT minister Anusha Rahman has held talks with the Turkish ambassador to discuss the high demand for new spectrum in Pakistan.

Rahman apparently told officials at the meeting that she wanted Turkish mobile companies to participate in the spectrum sale which would include 850MHz which the government has reserved for a new market entrant. As yet, there is no confirmed date for a new auction although reports suggest it could be held soon.

Following years of delay, the Pakistan Telecommunication Authority finally conducted a 3G auction last year and also included the sale of 4G frequencies. The country's five existing cellcos – Mobilink, Telenor, Ufone and Zong – were all awarded licenses.

But the auction brought in much less than the USD1.5bn the government was expecting in revenues, and the sale failed to attract any new foreign interest as hoped.

ICT minister Anusha Rahman has reportedly held talks with the Turkish ambassador.

Vodafone deploys mini 4G network

Vodafone New Zealand has developed what is literally a mobile network in its quest to connect remote locations.

The operator says its network covers 98 per cent of the country's 4.5 million people, but only reaches around 55 per cent of its geography. "Telecoms operators in every country are wrestling with how to connect the remotest areas with mobile coverage," says Tony Baird, technology director for Vodafone New Zealand. "This is perhaps even more challenging in my country where we have more remote area than many other places."

Baird says Vodafone been working for a number of years on how to make its network more portable so that it can quickly deliver reliable temporary connections to any area, particularly during emergency situations. As a result, it has developed a working prototype of a mobile network on wheels dubbed the *Z-Car*. The name is from a 1970s British TV series in which mobile police units provided help to new communities.

The *Z-Car* has a 4G small cell built into its boot which provides mobile coverage even in motion.

Baird says the *Z-Car* has a 4G small cell built into its boot which provides coverage over a two kilometre radius, even as the vehicle is in motion. A low profile satellite antenna on the roof connects the vehicle to Vodafone's global network, enabling download/upload speeds of 10Mbps/2Mbps.

The *Z-Car* can also communicate with the digital trunked radio systems used by New Zealand's emergency services. It can therefore be used as a comms hub to help first response teams rapidly establish 4G connectivity within minutes of arriving on-site, or provide temporary remote coverage.

Baird says more testing will be done with the *Z-Car*, and adds *Z-Boats* and *Z-Planes* are also potential possibilities.

Verizon helps boost U.S. networks from rural counties to an urban icon

In mid-October, U.S. telco Verizon announced that all the participants in its *LTE in Rural America* (*LRA*) programme have now fully met their original goal of deploying LTE technology across rural counties.

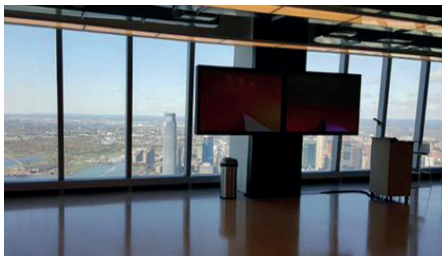
The operator launched the *LRA* initiative around five years ago with the aim of helping rural wireless companies across the US drive innovation through advanced 4G technology.

225,000 square miles of Verizon's spectrum is now leased by *LRA* participants across 169 rural counties in 15 states. The company says more than 1,000 LTE cell sites have been activated, covering 2.7 million people across an area larger than Colorado.

In a separate development, Verizon says it has built a new distributed antenna system (DAS) in the One World Trade Center, offering what's claimed to be fast and reliable speeds to tenants, visitors and tourists.

The operator is so far the first and only carrier with activated service in the building, and worked with the developer to design the DAS.

New York City is said to be one of the most challenging wireless markets in the world, with a diverse urban landscape featuring skyscrapers and subways, as well as high density areas such as Times Square and Yankee Stadium. Verizon reckons it has been able to overcome these challenges and consistently looks to enhance its wireless networks, investing more than USD830m in the New York-New Jersey region in 2014.



Verizon users can now upload selfies from the 104th floor at New York's One World Trade Center.

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Caribbean microwave

Advantech Wireless has revealed that it has been successfully operating a 95km point-to-point microwave link over the Caribbean Sea for the last two years without any interruption or degradation. The vendor's *Transcend 800* system is carrying native SDH (STM-1) and native IP traffic simultaneously. The link is operating in 6GHz and in a space diversity configuration with Advantech's 1.8m high performance microwave antennas.

Argentina IoT services

Telecom Personal, Argentina's largest MNO, has launched an Internet of Things platform with the help of Jasper. It's claimed the operator can now offer a turnkey solution for customers in any vertical industry, which can be easily configured for the unique needs of their specific business models. Jasper says users will benefit from real-time control and visibility of their connected devices, in addition to the mobile service management, support diagnostics and flexible billing required to grow a successful connected services business.

LTE roaming extended

Syniverse is providing Dialog Axiata with a single-connection access to its IPX backbone network. The firm claims the Sri Lankan operator's reach has now been expanded across the world's LTE networks. Syniverse says its IPX Network currently serves more than 1,000 LTE roaming routes and includes more than 100 LTE direct connections, all of which makes it possible for it to deploy LTE and VoLTE around the globe. Dialog and Syniverse have been partners for 10 years and have worked together on data clearing, roaming fraud protection, text and multimedia messaging, and Wi-Fi roaming.

Smart City networks go live using Weightless

Nwave Technologies has rolled out Denmark's first Smart City networks across Copenhagen and in the southern port city of Esbjerg using the *Weightless-N* open standard.

Nwave specialises in hardware and software for the IoT and M2M communications. Its network solutions are based around an ultra narrow-band communications protocol operating in license-exempt ISM sub-1GHz spectrum. The company claims its *NWave* platform allows long-range, low-power, low-cost communications, and enables the penetration of the IoT into areas poorly served by traditional cellular or short-range technologies.

Nwave worked with accelerator organisations Accelerace Management and Next Step City for the deployments in Denmark. "*Nwave*'s open standard approach is of critical importance to both commercial and municipal adopters," says Christian Hvashøj Schaarup from Accelerace Management. "The Weightless open standard model provides reassurance to users that the technology will not lock them into dependence on a single vendor."

The Weightless Special Interest Group (SIG) published *Weightless-N* earlier this year *(see Wireless Solutions, May-Jun)*. It claims the standard offers "best-in-class" signal propagation characteristics leading to a range of several kilometres, even in urban areas. According to the SIG, *Weightless-N* is designed around a differential binary phase shift keying digital modulation scheme to transmit within narrow frequency bands using a frequency hopping algorithm for interference mitigation and enhanced security.

It says the technology supports mobility with the network automatically routing terminal messages to the correct destination. "Multiple networks, typically operated by different companies, are enabled and can be co-located. Each base station queries a central database to determine which network the terminal is registered to in order to decode and route data accordingly," states the SIG.

Indigo project boosts Euro satellite industry

New technologies to help fully exploit the capabilities of the next generation of high-throughput satellites (HTS) will be developed under a public–private partnership between the European Space Agency (ESA) and Intelsat.

The *Indigo* project will develop new ground segment innovations that maximise the capabilities offered by Intelsat's *EpicNG* satellites. It aims to maximise the throughput delivered to customers and offer the flexibility to adapt to advances in satellite technology and services.

The project partners believe these benefits will improve the quality of service and lower the total cost to customers, pave the way to markets not economically previously viable, and enable new services across multiple sectors.

ESA says *Indigo* will give all partners and subsystem suppliers the opportunity to expand their product and service portfolios, and capture a greater share of a highly competitive market. "[The project] is an excellent example of how ESA can help boost innovation and strengthen Europe's position in the global market," says Magali Vaissiere, ESA's director of telecommunications and integrated applications.

Intelsat has chosen Newtec's *Dialog* platform to deliver numerous services on its *EpicNG* HTS system and *IntelsatOne* terrestrial network. With ESA's backing, *Indigo* partners will be able to further improve their Newtec modems, hubs and network management system to exploit the capabilities offered by Intelsat's HTS which are expected to enter full commercial services by early 2018.

TVWS used to broadcast live biking event

TV white space (TVWS) technology was used to enhance the spectator experience at the Enduro World Series (EWS) mountain biking event held in Glentress Forest, Scotland earlier this year.

The network was designed by wide area infrastructure specialist Boston Networks which worked in partnership with Scottish Enterprise, Microsoft, IndigoVision and a consortium of technology leaders.

Their aim was to trial TVWS technology at various points throughout Glentress Forest to allow live footage of the riders to be transmitted to spectators at the venue's headquarters in the nearby town of Peebles.

Hardware from ADAPTRAN and InfinetWireless was used for the white space network in Glentress Forest.

Boston deployed ADAPTRAN's radios for the TVWS system. IndigoVision's Ultra 2K cameras with *SMART.core* technology were used to stream full HD video over the network to a large screen at Peebles Green.

The firm believes the success of the trial will raise the profile of Glentress as a venue for future events. It adds that TVWS technology has significant potential to not only transform the outdoor sports and events market, where access to broadband can be challenging, but to boost the wider tourism industry and bring long-term economic benefits to rural communities.

Boston Networks' chief executive Scott McEwan said: "Glentress is fairly remote and mountainous, so designing and delivering a system to enhance the visitor's experience, and that could have a transformational effect for both the event and the local area, was an exciting opportunity for us."

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