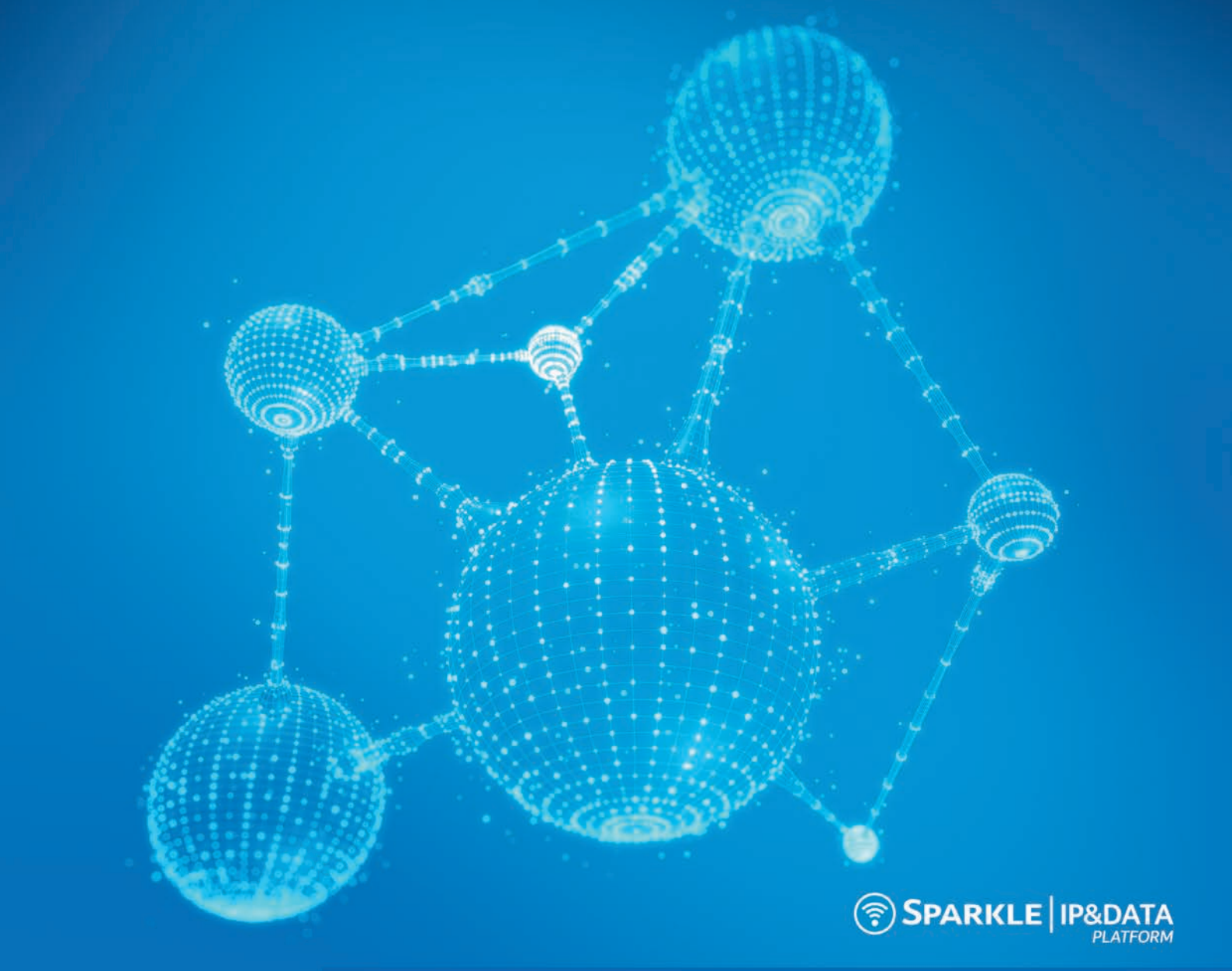
SEPTEMBER/OCTOBER 2016
Volume 21
Number 3

southern african wireless COMMUNICATIONS

For communications professionals in southern Africa

- Creating energy efficient cell sites
- Wireless users: connecting the carriers
- Time to face up to the IoT standards reality



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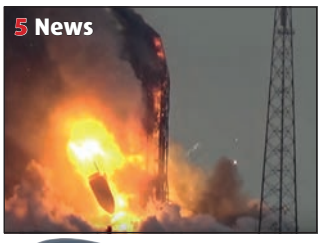

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So far, the "anomaly" that caused SpaceX's *Falcon 9* rocket to explode on the launch pad is not yet known. Both the vehicle and its cargo – Spacecom's *AMOS-6* – were lost in the inferno that rapidly engulfed the rocket just moments after it was cleared for lift-off.

Spacecom's *AMOS-6* lost as *Falcon 9* rocket explodes on launch pad

At 9.07 EST on 1 September, Spacecom suffered another blow as the SpaceX *Falcon 9* rocket that was due to carry its *AMOS-6* satellite into orbit exploded on lift-off.

While the launch vehicle and the satellite were both lost, the pad was clear and no human injuries were reported.

Spacecom is currently determining the cause of the anomaly that resulted in the explosion, but at the time of writing in September it had yet to make any further announcements regarding the investigations.

In the meantime on 5 September, the company issued a press statement which said that it was developing a plan of action following the loss of the satellite.

CEO David Pollack says: "Our programme includes, among other measures, exploring the possibility of procuring and launching a replacement satellite. Working quickly and efficiently, management is engaging with current and potential partners to move forward."

He pointed out that Spacecom will serve all of its current and future financial commitments. Some of the company's current Ku-band clients on *AMOS-2* that were to be relocated to *AMOS-6* will now be moved to *AMOS-3*. For others, the company says it is planning to help find capacity on other satellites or possibly on a satellite that will be relocated, either permanently or temporarily, to 4°W.

In collaboration with Facebook, Eutelsat had contracted a multi-year agreement to lease *AMOS-6*'s Ka-band payload covering sub-Saharan Africa, with a view to launching broadband services from early 2017 *(see News, Oct-Nov 2015)*.

Following news of the loss, Eutelsat said it remained committed to growing broadband in Africa and will explore other options to serve the needs of key clients ahead of the launch of its own full high throughput African broadband satellite in 2019. Facebook is also looking at alternative connectivity options.

Compensation claims

In papers filed with the Tel Aviv Stock Exchange, Spacecom stated that it was pursuing its rights for the return of money paid plus interest and agreed compensation for the delay in completing the construction of *AMOS-6* from Israel Aircraft Industries (IAI). The total, including a USD10m compensation fee, amounts to around USD205m.

In addition, the company said it had insured *AMOS-6* for USD330m, but the policy only covered the satellite for various periods after its launch while it was in orbit. As the loss occurred prior to the moment of launch, these policies were not used and were cancelled. As a result, Spacecom stated that it was entitled to a full refund of all sums paid by the insurers in respect of the satellite. These amount to about USD39m.

Furthermore, since SpaceX failed to provide its contracted services, Spacecom called for either the return of its USD50m fee or use this for a future satellite launch.

Meanwhile, the successful launch and operation of *AMOS-6* was one of the conditions attached to Spacecom's proposed merger agreement with Luxembourg Space Telecommunication *(see Wireless Business, p15)*. Spacecom said that together with LST, it is now examining the option to "repair the agreement and adapting it to the new situation".

AMOS-6 is the second satellite loss Spacecom has suffered since last year. On 21 November, the company lost all contact with *AMOS-5* which was launched in 2011 and served Africa from 17°E *(see 'Rocket Power' feature, Dec 2015-Jan 2016)*.

Orange to accelerate mobile money services in Africa

With the recent receipt of Electronic Money Establishment (EME) licenses in Senegal, Mali, Côte d'Ivoire and Guinea, Orange claims it has further strengthened its position as a major player in Africa's mobile financial services (MFS) sector.

In 2015, the Central Bank of West African States published an update of the regulatory framework related to MFS. With the significant growth of mobile money services within the Economic Community of West African States, it encouraged telcos to obtain a license to operate as an EME in order to conduct their mobile money activities within a broader framework of responsibility.

Each EME is licensed by the Central Bank of its territory but remains an autonomous subsidiary controlled by the local operator.

Orange says its EME ensures the issuance, management and distribution of electronic money for *Orange Money*, and manages the compliance policy (previously, Orange's partner banks were responsible for the latter). The EME also coordinates requests to the Central Bank for the launch of new functionalities and monitors overall activity.

According to Orange, its licensed EME status gives it more autonomy and agility, enabling it to offer customers increasingly innovative services in a shorter amount of time.

The group has also set up a dedicated organisation to provide risk management for the business scope of the EMEs. Based in Côte d'Ivoire, the Orange Money Compliance Expertise Centre (CECOM) reports to the Orange Group and provides second level control for the *Orange Money* business. It serves Orange's EME subsidiaries, which provide first level control.

The operator added that CECOM will be staffed by a multidisciplinary team of experts with "advanced" skills in banking, telecoms and IT.

Ericsson and *M-Pesa* simplify water payments

Grundfos' automated and connected water kiosks – known as water ATMs – dispense safe, clean water (left) and now accept payment via *M-Pesa* (above). PHOTO: GRUNDFOS

Ericsson says its M-Commerce Interconnect (EMI) service will simplify mobile money payments and cash collection between mobile wallet provider Vodafone *M-Pesa* and businesses.

The first deployment under the deal will connect the mobile money platform with the growing network of Grundfos safe water kiosks throughout Tanzania and Kenya. Implementation in some of the other countries where *M-Pesa* is available will follow.

Grundfos' automated and connected water kiosks, also known as water ATMs, dispense safe drinking water in the developing world. But across rural Africa, 50,000 water supply points have failed, mainly due to lack of funds and capacity for operations and maintenance.

Peter Todbjerg Hansen, MD of Grundfos Lifelink, says Ericsson and Vodafone have addressed this critical challenge: "It is now possible to pay for water with mobile money, and water revenue collection is safe and automated."

Ericsson's head of mobile financial services Peter Heuman says Grundfos' use of *M-Pesa* simplifies the payment process by taking cash out of the equation, and that the solution removes the need for water service providers to integrate with every mobile wallet provider used by people in the country.

He adds that with EMI, any mobile wallet service from any service provider in any region can be used to provide payment.

"Breaking down the walls that exist in the mobile money ecosystem represents a significant leap forward in creating much-needed connections between wallet providers and enterprises," says Heuman. "When digital payments become pervasive in cash-based societies, new opportunities that were previously unimaginable become reality."

Zantel invests billions in Zanzibar network upgrade

Zantel has announced a "huge" project to modernise its entire network in Zanzibar. The operator, which is now under the ownership of the Millicom Group, says the USD10m programme is one of the biggest it has undertaken at one time.

Speaking at a press conference in Zanzibar during September, Zantel's chief technical and information officer Larry Arthur says the operator's current mobile infrastructure was installed progressively between 2007 and 2015.

"The network comprises 154 GSM sites, 111 3G sites, and 4G sites in Stone Town," he says. "Some of the elements are now reaching end-of-service date. This project aims to replace all sites in Zanzibar with the latest model equipment and add new equipment where required."

Arthur added that all the required equipment is already in the country, and work has therefore started. He says Zantel's technical team together with Ericsson and Huawei are working around the clock to make sure that the job is completed within the planned time of three months.

Arthur also pointed out that customers might experience some glitches and network slowdowns in places during the implementation. He says: "The technical team is working hard to make sure these hiccups will not happen and they are working to make sure we get a permanent solution.

"After completion, the cellco's 3G network will cover all major areas in Zanzibar and improve 4G coverage within Stone Town, some major tourist centres, and urban areas in Pemba."

GIN launches *Satmotion* auto-provisioning VSAT service

It's claimed *Satmotion* enables installers to point and adjust antennas and streamline the overall commissioning of VSAT solutions.

Gondwana International Networks (GIN) says it will enhance the delivery, commissioning and maintenance of VSAT services, while also minimising opex, time and interferences.

The pan-African communications service provider has launched the *Satmotion* auto-commissioning tool from network monitoring systems specialist Integrasys.

GIN claims to be one of the continent's largest VSAT operators through its *AfricaOnline* and *iWayAfrica* brands.

Guy Schalker, the company's CTO, says the *Satmotion* rollout will empower installers to autonomously point and adjust users' antennas and streamline the overall commissioning of VSAT solutions.

"By simply installing an app on a smartphone, whether Apple or *Android*, the VSAT installation capabilities are simplified making installation easy regardless of the installers' level of experience. This not only reduces the installation time and associated costs, but more importantly means the customer is installed accurately first time with optimised polarisation."

Schalker says the big benefit for GIN is not only providing customers with Africa's first auto-provisioning VSAT solution, but also one that ensures the installation is right first time.

"Our customers will have guaranteed cross-polarisation that will mitigate XPOL interference, as well as the provision of valuable QA data and limited requirements for site returns."

Satmotion is described as a "scalable solution that delivers optimal line-up with minimum interference". Schalker adds that GIN is introducing the tool together with Hughes Network Systems' *JUPITER* platform to ensure the customer experience is "enhanced".

Yahsat and iDirect launch satellite VNO service – p8.

INCM moves to blocks millions of unregistered SIMs in Mozambique

The National Institute of Communications of Mozambique (INCM) has begun to block millions of unregistered SIMs in the country.

At the start of September, the regulator said three million phone numbers issued by Mcel, Movitel and Vodacom would be affected as part of a phased deactivation that would run until November. It said that the move was in compliance with the provisions of the Rules of Registration and activation of Subscriber Identification Modules Mobile Telephone Service that was approved in August 2015.

The INCM said that despite joint industry campaigns carried out over the last to make consumers aware of the importance of SIM registration, many subscribers are still not "regularised".

As a result, each MNO has been ordered to lock a million SIMs that have not been properly registered. "This action is critical to [ensure that] the entire telecommunications system is regulated and operates safely," stated the INCM.

According to local reports, Mozambique's government first demanded SIM registration in the wake of the Maputo riots against price increases in September 2010. It is unclear how many cards have been registered so far and how many subscribers Mcel, Movitel and Vodacom have registered since then. Earlier this year in March, the three operators said they had disconnected one million unregistered accounts.

Telkom targets saboteurs

Following criminal damage to its network earlier this year *(see News, Jul-Aug)*, South Africa's incumbent operator Telkom has increased its reward to up to ZAR1 million for information leading to the arrest and prosecution of saboteurs.

The company said that since the start of a strike by members of the Communication Workers Union (CWU) in July, it has experienced an increase in acts of sabotage on its network, especially in Gauteng, Limpopo and the KZN province.

In late August, Telkom said more around 85 of its street cabinets had been damaged in the past few weeks and fibre and copper cables cut. It added that most of the infrastructure has now been fixed, and that its technicians were working around the clock to ensure that those that remain damaged are brought back online.

Telkom has issued an apology to customers for the inconvenience caused, and said that its expects to be able to announce a number of arrests shortly. But it urged members of the public to remain vigilant and come forward with any information that could lead to an arrest.

Yahsat and iDirect launch Virtual Network Operator satellite service

Yahsat and VT iDirect are working together to introduce VNO services across the existing footprint of *YahClick*, Yahsat's satellite broadband service.

Based on what's claimed to be the "industry changing" capability of VT iDirect's *Evolution* platform, Yahsat says the VNO offering will leverage the "high-speed and economical capacity" of *YahClick*'s Ka-band network.

It says service partners will be able to purchase their own bulk capacity which they can then fully manage and configure themselves to offer differentiated services. They will also be able to commission, control and monitor their own remote sites, while designing and configuring their end to end IP network.

The new service is targeted to meet the high QoS demands of corporate and government customers. Yahsat says partners are empowered to create private networks, offer higher uplink speeds, and address market needs such as cellular backhaul, rural telephony, distance learning, etc.

The service partners across *YahClick*'s markets, along with the Yahsat and iDirect teams that are training them.

It says that as well as benefiting from high throughput capacity using its *Y1B* coverage area, partners will not be required to pay any capex or upfront costs in order to operate as a VNO.

Other advantages are that partners receive capacity either as simple Mbps or Msps (mega symbols per second). In addition, Yahsat says the service is supported by a "simple" pricing structure that covers all aspects of the offering, including the provision of VT iDirect line cards, round-the-clock support, teleport charges, access to high-speed internet backbone, as well as satellite capacity.

ESA backs *ECO* Wi-Fi concept

As part of its ARTES Partner programme, the European Space Agency (ESA) will contribute up to EUR10.7m in funding to support satellite operator Avanti Communications in bringing rural communities across Africa online.

ESA aims to provide affordable satellite broadband connectivity to 1,400 community sites across sub-Saharan Africa over the next two years using Avanti's recently launched *ECO* Wi-Fi hotspot initiative.

The solar-powered hotspots will be hosted at schools that will benefit from subsidised internet access. Consumers and local businesses within range of a hotspot will use the newly developed *ECO* mobile payment app to make micropayments for broadband credits which convert to data usage.

Avanti will partner with Newtec and a group of leading service providers, combining satellite, Wi-Fi and solar power, to deliver the programme. *ECO* MoUs have been signed with South Africa's Sentech and Ministry of Communications; Wananchi, Intersat and Imarasat in Kenya; and the Tanzania Education Authority.

Other governments, service providers and partners are said to have also expressed support for the initiative.

"Through product innovation and a partner strategy we have found an economically viable way to deliver broadband to low income customers," says Avanti CEO David Williams. "Working with governments and local service providers, and with support from ESA, this first project is a significant step towards creating something that will address a need across the entire continent."

C&WS 'tools up' for video-on-demand

Cable & Wireless Seychelles (C&WS) has launched a new video-on-demand platform with the help of VUBIQUITY. As part of the deal, it will be responsible for licensing, preparing and delivering all the video content for C&WS' recently launched *SinémaX* service which will be available via multiple platforms including mobile.

VUBIQUITY says it has licensed a broad catalogue of more than 2,000 pieces of content from many of the top Hollywood and independent studios for the service which was launched at the end of June.

Customers will be able to buy individual movie titles on an on-demand basis via the *SinémaX Store*. Or they can subscribe to the *SinémaX Play* service, which is bundled with top-tier pay-TV packages from Cable & Wireless, to access all the movies and TV series available on the platform.

Nick Ruczaj, Senior Vice President, Commercial at VUBIQUITY International, says: "The telecoms market is increasingly competitive and fast-moving, as more end-users than ever look online and elsewhere for the latest, top-quality movies and TV series," says Nick Ruczaj, SVP, commercial at VUBIQUITY International.

"VUBIQUITY is tooling up operators to compete in this new world by providing them, and their customers, with quick and easy access to critically acclaimed and latest-release movies from the top Hollywood studios."

The company adds that the deal in the Seychelles follows a raft of recent launches in South Africa.

AU supports Johannesburg exchange as regional IXP

The African Union (AU) is backing the Johannesburg internet exchange to become a regional IXP.

Working with the South African Department of Telecommunications and Postal Services, as well as the country's Internet Services Providers Association, the AU Commission's Infrastructure and Energy Department says the move will mean intra-regional internet traffic is kept within the region.

According to the commission, through its African Internet Exchange System (AXIS) project the number of member states with internet exchange points has risen from 18 to 32.

The AUC added that it has also provided grants to eight IXPs to become regional exchange points. This includes a grant the Johannesburg Internet Exchange (JINX) which will enable it to setup multi-locations to facilitate its expansion to become a regional hub.

"Africa has been paying overseas carriers to exchange intra-continental traffic on our behalf," says Dr. Elham M.A. Ibrahim, AU commissioner for Infrastructure and Energy. "This is both costly as well as inefficient. With regional IXPs in Africa exchanging intra-regional traffic locally, this will reduce the latency and save costs by eliminating the international transit through overseas carriers."

The launch was officiated by telecoms minister Hon. Dr Siyabonga Cwele (centre), and African Union commissioner H.E. Dr. Elham Ibrahim (left).

South Africa's telecoms minister Dr. Siyabonga Cwele added that internet exchange points for African countries are currently hosted in the countries that colonised them, and described AU's support as "another continental milestone of the journey towards self-emancipation".

Cwele expects the launch of the SADC Internet Exchange Point to lead to faster downloading times and ultimately contribute in lowering internet connection costs.

Combating device fraud

The GSMA and the World Customs Organisation (WCO) will partner in the fight against the counterfeiting and fraudulent trading of mobile devices. The GSMA's mobile device database and the WCO's IPM mobile platform will be integrated. This will give customs officers global, real-time product information on devices, enabling them to assess the authenticity of device shipments as they cross borders. The move is intended to improve cross-border trade procedures, assist with the rapid detection of counterfeit goods, and secure the international trade supply chain.

Port license

Johannesburg-based rail, port and pipeline company Transnet has applied for a license to use the 1800MHz band centre gap at South African ports and harbours. It intends to use a total of 5MHz of this band. The use of the frequencies will be confined to Port Elizabeth, Cape Town, Durban Port, East London, Saldanha Port and Richards Bay. The Independent Communications Authority of South Africa has invited all interested stakeholders to submit written comments in respect of Transnet's application.

No voice for Vodafone

Zambia's regulator has confirmed that Vodafone will not be entering the market as a voice provider. ZICTA (Zambia Information and Communications Technology Authority) says that there had been "rising speculation" and that it had received "numerous enquiries". In a press statement issued earlier this year, ZICTA says: "The Authority wishes to dispel the perception that Mobile Broadband Zambia, trading as 'Vodafone Zambia', is entering the market as a voice provider". It said the company's license was only for providing data services to the public.

"One stop shop" MEA backbone solution

Networks in Africa and the Middle East that peer on the Marseille or Paris internet exchanges will now be able to peer remotely in each city in the most cost-effective and direct way.

The move follows a strategic partnership agreement between France-IX and international wholesale solution provider BICS.

Carriers, ISPs, CDNs and other networks based in Paris or Marseille looking for fast and secure internet connectivity to the MEA region can utilise France-IX's convergence hubs and connect seamlessly through BICS.

France-IX says it offers peering services to more than 320 networks in Paris and Marseille, while BICS claims its network offers a "truly" global footprint with 112 POPs worldwide in addition to local support. BICS adds that it also has full access to 20 submarine cables covering all key international routes including EIG, AAE-1, SeMeWe-3, SeMeWe-4, SAT-3/WACS and SAFE.

The companies claim their partnership provides increased bandwidth granularity with increments as small as 100Mbps, deployment times as fast as two business days, and cost savings of up to 50 per cent per month. They say this is because customers will only need a single cross-connect to a single France-IX port, and the activation of one service with BICS.

App puts telephony in "palm of the hand"

What's claimed to be a new and innovative telecoms solution for enterprise users will also be distributed in Africa.

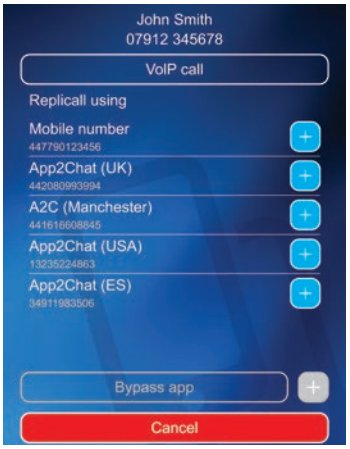
App2Chat was unveiled by UK-based The Pink Telephone Company at the end of last year. So far, it has been launched in Spain, Cyprus and Germany, and is claimed to have proved popular with more than 3,500 businesses. The expansion into Africa will be the first time it has been distributed outside of Europe.

App2Chat is an office telephone system on a mobile. Pink Telephone claims the service has all the features of a PBX system, and offers the full functionality of a desk phone including voicemail, call forwarding and transfer, recording, conferencing and more.

App2Chat is compatible with all smartphones running *Android* and *iOS* smartphones. Pink Telephone says it works over 3G and 4G mobile networks worldwide, and offers optional Wi-Fi connectivity for office working and overseas roaming.

According to the firm, what sets *App2Chat* apart from other enterprise class telephony apps is its "unique" ability to place the power and functionality of a traditional office desk phone into the palm of the hand.

Price is also said to be a differentiator. Pink Telephone says the service costs around GBP0.30 per day and does not require any upfront investment.



App2Chat works over 3G and 4G networks worldwide, and is claimed to have all the features of an office PBX system.

Internet Society reveals why African internet growth is slow

Simply having internet access and availability are not enough to get people online, according to research carried out by the Internet Society.

In its *Promoting Content in Africa* report published at the end of August, the society said that while significant improvements have been made in internet infrastructure, especially in mobile networks, internet adoption rates are slowing in many countries because users lack compelling reasons to connect.

The study revealed that content and services are the main factors in making the internet desirable, especially when the subject matter is relevant and in a language that users can easily understand. It said that in sub-Saharan Africa in particular, local language content is key to bringing new users online, as many are not comfortable reading in English or French.

The sub-Saharan countries studied by the Internet Society included Rwanda, Kenya, Tanzania, Nigeria, Senegal and Ghana. It found that the majority of international and locally developed content is hosted outside these countries, typically overseas in Europe and the US, resulting in slow internet speeds and higher access costs. In Rwanda for example, the study said that of all websites using the .rw domain name, only a small fraction are hosted locally in the country.

The society also pointed out that monetising mobile content remains a major challenge. It said the region faces a combination of barriers, including the inability to pay and receive payments for mobile apps, which serve as a major channel for content distribution in most African countries.

Bastiaan Quast, Internet Society fellow and co-author of the report, says: "Faster and better internet access can help entrepreneurs create new local content including services and apps, but developers face barriers when it comes to payment mechanisms in order to monetise content."

With a lack of a payment mechanisms, the society says users may not be able to purchase content, and even if they could, the developer may not be able to receive the payments. Such restrictions extend further to an ability to receive payments for advertising and for local entrepreneurs to raise funds to develop new innovations.

Furthermore, it said problems with advertising payouts are exacerbated by the fact that most major advertising platforms do not support any African languages (except Arabic). In some cases, the study found that even the placing of ads in a supported language such as English or French on pages that are primarily in a different language (e.g. Swahili) is expressly forbidden.

Bastiaan Quast said entrepreneurs face barriers when trying to create local content.

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Wireless Business Solutions plans new South African LTE-A network

Wireless Business Solutions (WBS) plans to invest billions in a new high-speed LTE-A national data network in South Africa.

The move follows a statement made earlier this year by finance minister Pravin Gordhan who says that the country's economy needed an investment of 30 per cent of GDP to achieve the growth stated in the National Development Plan. Investment is currently at 20 per cent of GDP.

The internet network will use WBS' existing spectrum assignments at 1800MHz and 2600MHz. The company says it will be ready for 4.9G when standardisation on release 14 is completed in March 2017, and also enabled for when this technology starts rolling out internationally during the next five years.

WBS says it has the advantage of not having to invest in legacy networks such as 2G and 3G, and will consequently deploy cutting edge LTE-A Pro (4.5G) technology.

The new network will be deployed on some of the company's 400 sites but will be extended up to an additional 10,000 through leasing sites from independent tower companies and other telcos. To this effect, WBS has concluded a transaction with Vodacom to lease some of its passive infrastructure as it expands the network.

The network promises to provide superfast broadband to consumers and businesses alike. WBS says it will be "superior" to copper/ADSL offerings, and an "attractive alternative" to FTTH. It claims speed and performance will be comparable to fibre, with the added advantages that it can be deployed without the cost of digging up streets or the delay in eventually reaching all residential areas.

A limited number of sites are already in operation. WBS said existing customers will be converted to the new network, and that a national rollout will begin in the coming months. Once completed, WBS says it will be able to offer mobile broadband on smartphones, tablets, and other devices supporting the IoT.

According to veteran banker and WBS chairman Paul Harris, what South Africa needs is investment in productive capacity in order to tackle its economic challenges.

He believes WBS was investing in one of the most crucial areas for competitiveness. "The multiplier effect of broadband is transformative for economic growth, and therefore in meeting the challenges of employment, poverty and inequality," says Harris. "Nothing can be gained by sitting on the sidelines. WBS' investment is a manifestation of its confidence in South Africa and its desire to contribute."

WBS was recently acquired by network management company Multisource. Some of its other shareholders and directors include former MTN CTO Phumlani Moholi, Design Indab CEO and founder Ravi Naidoo, and former FNB CEO Michael Jordaan.

The firm has a 30 per cent BEE (Black Economic Empowerment) shareholding which will be maintained after the planned capital raising.

MTN launches new billion rand BEE transaction

The MTN Group will implement a new ZAR9.9bn Broad-Based Black Economic Empowerment (BEE) transaction when its existing special purpose investment vehicle, *MTN Zakhele*, contractually unwinds.

It's claimed *Zakhele* has created "exceptional value" for its 124,000 black investors. Notwithstanding an extremely difficult nine months, the company said shares had almost quadrupled from ZAR20 per share at inception in 2010, to around ZAR77 per share in mid-August 2016. MTN pointed out that that equates to a total return of about 400 per cent and a CAGR of around 26 per cent.

The operator added that the mandatory unwinding of *Zakhele* on 24 November 2016, combined with the creation of the new *Zakhele Futhi* scheme, will see MTN not only maintain its BEE targets as set out in the Information and Communication Technology Sector Code (the ICT Charter), but also adhere to the B-BBEE Act, allowing the firm to further "embed empowerment and transformation in the DNA of its business".

Zakhele Futhi will hold approximately four per cent equity in the MTN Group and exist for an eight-year period. Its launch in September took the form of a public offering where qualifying black participants were invited to subscribe for ordinary shares with a minimum investment amount of ZAR2,000.

Shares were issued at ZAR102.80, a 20 per cent discount to the 10 day volume weighted average price per MTN share on 17 August 2016 of ZAR128.50. Shareholders also have the opportunity to re-invest a portion of their *Zakhele* shares in *Zakhele Futhi*.

MTN Group executive chairman Phuthuma Nhleko says: "This new transaction, together with the continuing contribution of the MTN *Zakhele* transaction, will translate to an effective indirect 'see-through'" black ownership in excess of 30 per cent of MTN's South African operations."

In addition to the BEE scheme, MTN's board has proposed the introduction of a new employee share ownership plan which will not require equity from eligible participants. The company will issue approximately 0.1 per cent of its issued share capital to be held in a trust for the benefit of its staff.

In two other developments, the MTN Group and MMI Holdings have setup a micro insurance joint venture firm. By utilising their respective resources and capabilities, the partners claim aYo will be able to improve insurance penetration across Africa, and offer relevant, accessible and easy to use solutions. They expect to rollout services in a number of countries from the end of 2016.

The move to develop its mobile financial services comes as MTN follows in the footsteps of rival South African operator Vodacom by shelving its mobile money platform in the country due to what it said were "prohibitive" operating costs *(News, May-Jun 2016)*.

Meanwhile in Nigeria, MTN has issued an official statement following various media reports alleging that it has improperly taken money out of the country. In September, senator Dino Melaye told the Nigerian senate that MTN had illegally repatriated USD13.92bn out of Nigeria from 2006 to 2016 "through four Nigerian Banks and a serving minister of the Federal Republic of Nigeria".

While the senate agreed to investigate the matter, MTN Nigeria CEO Ferdi Moolman says: "The allegations made against MTN are completely unfounded and without any merit."

Profits warning for Ericsson

Ericsson's woes continue as it announced its preliminary Q316 earnings and issued a profits warning.

In October, the company said business result for the quarter will be "significantly lower" than expectations. "Negative industry trends from first half 2016, with weaker demand for mobile broadband, especially in markets with weak macro-economic environment, have further accelerated," stated the vendor.

Sales fell by 14 per cent YoY to SEK51.1bn (SEK59.2bn for Q315), driven by slower development in Ericsson's Segment Networks division where sales plummeted by 19 per cent. Ericsson said the decline was mainly driven by markets such as Brazil, Russia and the Middle East, impacting both coverage and capacity sales in those markets. In addition, it said capacity sales in Europe were lower following completion of mobile broadband projects in 2015.

The company's operating income dropped to SEK 0.3bn (SEK5.1bn for Q315), including restructuring charges of SEK1.3bn.

"Our result is significantly lower than we expected, with a particularly weak end of the quarter, and deviates

from what we previously have communicated regarding market development," says president and CEO Jan Frykhammar.

"Continued progress in our cost reduction programs did not offset the lower sales and gross margin. More in-depth analysis remains to be done but current trends are expected to continue short-term. We will continue to drive the ongoing cost program and implement further reductions in cost of sales to meet the lower sales volumes."

Frykhammar was appointed CEO following the immediate departure of Hans Vestberg earlier this year *(Wireless Business, Jul-Aug 2016)*.

Earlier in October, Ericsson announced job losses for around 3,000 employees in Sweden as part of its 2106 restructuring target of SEK4-5bn.

The company employs around 16,000 people in its home country, and proposed cutbacks will see redundancies of approximately 1,000 positions in production, 800 in R&D, and 1,200 in other operations such as sales and admin. Ericsson added that the lay-offs will be a combination of voluntary and "forced reductions", as well as other measures such as outsourcing.

Flexenclosure has already worked in Mozambique. For example, the company built one of its prefabricated data centres for Vodafone in Maputo.

Kambeny orders *eSite* to power remote telecom sites

Mozambican telecoms distributor Kambeny has ordered 28 *eSites* from Flexenclosure.

It will use the solutions from the prefab data centre and energy management specialist to supply stable and reliable power to remote telecom sites in the country.

The hybrid *eSites* will supply both DC and AC power for loads up to 11.4kVA. Flexenclosure says they will also be equipped with solar panels to maximise the use of renewable and environmentally friendly solar power, while also minimising diesel-related costs and carbon emissions.

"Having already built two of our *eCentre* prefabricated data centres in Maputo and Matola, we're pleased to be bringing our *eSite* product to Mozambique now too," says Flexenclosure CEO David King.

Rising economies help to drive growth in cellular IoT connections

APAC, headed-up by China, along with Brazil and Russia are now driving the market for M2M and IoT connections, according to Beecham Research.

In its recently published Global Assessment of the Cellular IoT Connectivity Market report, it says that cellular IoT connections – from 2G to 5G – reached almost 261 million at the end of 2015 and predicts they will approach 1.22 billion in 2021.

The study also points to strong growth in the Arab states and sub-Saharan Africa, but for different reasons. While Israel and the Arab states are developing smart city, energy and environmental IoT applications, it says the focus in Africa is on remote payments as well as healthcare, water systems and agriculture. The IoT vision is also starting to take shape in countries such as India, Indonesia and Vietnam due to government initiatives across urban and rural areas.

"The speed of adoption of cellular IoT connections is increasingly diverse among regions and even among countries in the same region," says report author and Beecham Research principal analyst Saverio Romeo.

"This is due to different stages of development, but also different regulatory regimes, government policies, cultures and the dynamics of regional and national economies."

While the report shows that the US market is now the second largest after China, it continues to grow with major interest in areas such as smart homes along with the industrial IoT.

In Western Europe, Beecham says projects such as smart metering are driving the market in countries such as the UK and Netherlands, while attention on other forms of connectivity such as LPWANs (Low Power Wide Area Networks) is also having an impact.

The study points out that connectivity remains an important part of the IoT market and says that it is becoming evident that no one size fits all.

Rome says: "Low-data IoT will be increasingly dominated by LPWAN solutions that will contribute to the erosion of 2G IoT connections, while operators will push the move towards 3G, 4G and eventually 5G for more data intensive applications. But we

NEW APPOINTMENTS

Date	Name	New employer	New position	Previous employer	Previous position
6/9/16	Mark Daniels	Intelsat General	VP, new technologies & services	Intelsat General	VP, engineering & operations
6/9/16	Rory Welch	Intelsat General	VP, engineering & service delivery	Intelsat General	Director of space services & business development
6/9/16	David Agatston	Intelsat General	VP, business operations	Intelsat General	VP, finance & accounting
29/9/16	Paul Brown-Kenyon	–	–	MEASAT	Stepped down as CEO. Simon Cathcart appointed interim CEO
4/10/16	Zunaid Bulbulia	Kirusa	Member of advisory board	–	Bulbulia was one of the founding members of the MTN Group. He is currently non-executive director of the Huge group.
5/10/16	Simon Harvey	FibreCo Telecommunications	Interim CEO	FibreCo	CCO. Takes over as interim CEO from Arif Hussain who is leaving to "pursue other interests".

will also see multiple connectivity types used for the same application where they complement each other."

Spacecom and Luxembourg Space Telecommunication to merge

Spacecom, the operator of the AMOS satellites, has announced that it will merge with Luxembourg Space Telecommunication (LST), a Luxembourg company and subsidiary of Beijing Xinwei Technology Group.

Following the signing of the agreement in August, Spacecom says LST will acquire, by way of triangle reverse merger, the full share capital of the company for USD285m. It said the price reflected a premium of 41 per cent to Spacecom's average stock price during the past month.

The company added that the deal was "structured carefully" with safeguards to ensure that Spacecom's US business, including prospective procurement of US satellites, is and will not be affected. Under the terms of the deal, Spacecom's satellite fleet will remain owned and exclusively under the control of Spacecom in Israel, with satellites and their traffic operated exclusively from the country. All export control safeguards required by the US Government are in place.

Spacecom was also keen to point out that the Chinese Government will have no role in the company. It said Beijing Xinwei is a publicly traded company in the private sector, and that the merger represents a corporate investment, not an acquisition of technology or operations.

The completion of the merger is subject to shareholder and regulatory approvals, and the avoidance of specific unfavourable material changes in Spacecom's business.

The deal was also dependent on the launch of *AMOS 6* and the completion of its in-orbit tests, and although this has not gone ahead *(see News, p5)* a Spacecom spokesperson says there has been no indication of LST abandoning the deal.

Nina Trantis, head of TMT for Standard Bank, said companies across Africa are considering their stategic options.

Capital restructure for Cell C

Conditional agreements have been signed for the proposed recapitalisation of South Africa's third MNO, Cell C. It aims to reduce the company's net debt to approximately ZAR8bn and enable it to continue to deliver on its growth strategy in a sustainable manner.

Blue Label Telecoms will contribute ZAR5.5bn in a subscription for 45 per cent of Cell C's total issued share capital, which is an increase in its prospective holding from the 35 per cent announced previously.

Cell C's management and staff will subscribe for 25 per cent of the issued capital, and 3C Telecommunications will subscribe for the sufficient new equity to hold the remaining 30 per cent of the total issued share capital.

The recapitalisation proposal is subject to funding of all parties and necessary regulatory approvals. It is expected to be implemented by 18 November 2016.

Standard Bank expects more M&A activity in TMT

Standard Bank says Africa is seeing accelerating investment and innovation in telecoms, media and technology (TMT), and predicts increased M&A activity across the continent.

The bank, which claims to be one of Africa's leading TMT banks as well as the largest by assets, was a partner for the inaugural *TMT Finance Africa* conference that was held in September. The event was held in Lagos which, say the organisers, is widely viewed as the central hub for technology innovation and investment on the continent.

Speaking during the run-up to the conference, Standard Bank's global head of TMT Nina Trantis says: "Investment and M&A in TMT continues to be especially active in Africa, with many companies across the continent considering strategic options, growth along diverse verticals, private debt and equity financing rounds, M&A, and public listings."

She added that the debt markets continue to be supportive for the right companies in Africa. "[This is] despite macro challenges in many countries as well as global uncertainty, though the funding currency and medium will inevitably reflect these challenges."

New partnership for Arabsat and Newtec

Arabsat has expanded its partnership with satcoms technology specialist Newtec in an effort to enable optimised solutions for its broadcast and telecom customers.

Under the new contract, Newtec will provide its Dialog multiservice platform to enhance Arabsat's DTH services, as well as its offerings in government and telecom markets.

The vendor says the platform features three return technologies, MF-TDMA, SCPC and its unique Mx-DMA system, to ensure maximum bandwidth efficiency and return on investment. The solution for Arabsat also incorporates Equalink, Newtec's pre-distortion technology. It's claimed this can provide an additional 15 per cent of data traffic in the same satellite capacity.

The company will also provide training and certification. Newtec says this is run by experienced engineers who are familiar with the challenges Arabsat and its customers face.

Arabsat CEO Khalid Balkheyour (left) says that as well as offering efficient technology, Newtec's training and certification programme meant that it was the "perfect" partner for upcoming projects. Also pictured is Newtec CEO Serge Van Herck.

INVESTMENTS, MERGERS & ACQUISITIONS

Date	Buyer	Seller	Item	Price	Notes
18/8/16	Singtel	Temasek	Shares in InTouch & Bharti Telecom	USD2.47bn	Will acquire 21% of Temasek's shares in Intouch Holdings & 7.39% of its shares in Bharti Telecom. Intouch is biggest shareholder in Thailand's largest cellco, Advanced Info Services (AIS). "Thailand, India and Africa continue to be attractive, high-growth markets for us," said Singtel CEO Chua Sock Koong.
22/8/16	InfoVista	Ascom	TEMS	USD45m	*TEMS* is claimed to be the most widely used mobile network testing, monitoring & optimisation platform. InfoVista, which is now owned by the private equity investment firm Apax Partners, hopes the acquisition will give it the lead in the network performance orchestration software market.
14/9/16	Amdocs	Pontis; Vindicia; & Brite:Bill	Companies	USD260m	Amdocs says the three similarly priced companies were acquired for a combined cash amount of around $260m. Israeli-based Pontis offers "contextual digital engagement solutions"; US firm Vindicia provides SaaS; while Brite-Bill is a BSS specialist from Ireland.

AST claims to save costs by extending GSM offshore

Applied Satellite Technology Ltd claims its new *AST Long Range GSM* system extends the usable data range of GSM services whilst offshore, and helps users save money.

MANUFACTURER:
Applied Satellite Technology

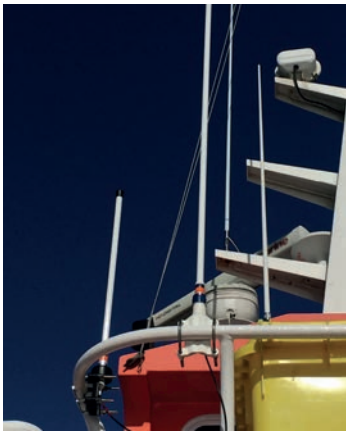
PRODUCT:
AST Long Range GSM

MORE INFORMATION:
www.theastgroup.com

With the evolution of GSM services and the future of 5G, the company says the ability to receive and use these fast data services on a day-to-day basis from anywhere has presented a problem for the maritime industry, with limitations on offshore reach.

While satellite communications can be used when GSM signals become unstable or lost completely, AST's aim was to develop a system that could extend the usable data range of a mobile device further offshore.

The company says it carried out extensive on-board testing in order to increase the offshore range of GSM services using two specialist blue-tipped antennas and an on-board device. During one trial, test data confirmed that the usable data services of GSM failed at 3-4km offshore.



However, by using the *AST Long Range* antenna system, it's claimed usable GSM data facilities were seen to increase to a distance of 25.94km.

Cutting edge features on Hytera's latest DMR radio

Hytera is promising "exceptional audio performance" and "advanced" features with the addition of the *PD98X* to its range of DMR handheld radios.

It says the device's sound quality is enhanced through noise cancellation technology as well as an integrated speaker that offers a maximum audio output of 2.5W.

MANUFACTURER: Hytera

PRODUCT: PD98X

MORE INFORMATION:
www.hytera.com

The radio supports full duplex calls to enable frontline personnel to make calls between other *PD98X*s or fixed line and mobile phones.

It also features single frequency repeater mode. Based on interference cancellation technology, Hytera says the *PD98X* is able to use one slot to receive a signal and another to transmit it in the same frequency using DMO mode to extend the communication distance.

Other features include: built-in Bluetooth 4.0 to support both audio transmit and programming; support for up to a 32GB Micro SD card to record up to 576 hours digital/analogue audio; and IP68 protection against dust and water. Hytera adds that the *PD98X* continues to function after submersion down to two metres for up to four hours.

There's also a *Smart Battery* feature which monitors the battery status and is said to "dramatically" reduce charging time.

Huawei claims world first with BTS testing system

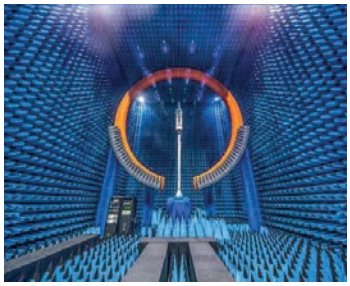
Huawei has launched what's described as the world's first multi-probe spherical near-field testing system. It says the *SG178* supports radiating characteristics testing for BTS antennas during product development.

According to the firm, there are three major testing systems for BTS antenna testing: indoor far field test range, spherical near-field test range, and compact test range. Among these, it believes multi-probe spherical near-field test range can best meet the demands of BST antennas in test efficiency and accuracy.

MANUFACTURER: Huawei

PRODUCT: SG178 test system

MORE INFORMATION:
www.huawei.com



Huawei says its system has 178 probes to achieve the industry's highest sampling density, and doubles test accuracy compared to indoor far field and near field test range.

It claims the *SG178* boasts a 20-fold increase in test efficiency compared to far field test range, supports more antenna types and wider frequency bands, and is the industry's only testing system to support active antenna and massive MIMO OTA tests.

Making new connections with Amphenol

Amphenol RF has expanded its range of *MCX* interconnects.

They include four new 50 ohm connectors (the *919-386P-51S*, *919-387P-51A*, *919-388P-51S* and *919-389P-51A*) that are designed to perform at frequencies up to 6GHz, with VSWR being 1.10 (max) at 2.5GHz, measured for right-angle configurations.

Amphenol says its *MCX* connectors feature a slide-on coupling mechanism interface, and adds that they can be found in many applications including GPS equipment, instrumentation and measurement, handheld radios and wireless network hardware.

The new line-up also includes an extended line of PCB jacks that are available in straight, right-angle, or edge-mount configurations, with options for surface or through-hole mounting. The company says all parts are efficiently manufactured from machined brass, and plated gold or tin for solderability. Centre contacts are made from beryllium copper and are gold plated.

Three new cable plugs have also been added to the *MCX* range. Models that have been designed for RG-178 and RG-174 type cables are included and they are available in both straight and right-angle configurations.

According to Amphenol, each cable's connector housings are made from machined brass, with beryllium copper outer contacts for secure mating.

MANUFACTURER:
Amphenol RF

PRODUCT: MCX

MORE INFORMATION:
www.amphenolrf.com

New dish from Advantech aims to make the most of HTS

Advantech Wireless' *Ka-8200* is a VSAT transceiver-router for the A-SAT-II multi-waveform and multi-access satcom systems.

The ultra-compact, all-outdoor unit features advancements such as software defined radio and direct modulation. It is specifically designed for M2M, IoT, SCADA/telemetry low data rate random access applications over Ka-band high throughput satellites (HTS).

MANUFACTURER:
Advantech Wireless

PRODUCT:
Ka-8200, Ku-8200, WideSAT

MORE INFORMATION: www.advantechwireless.com

Advantech Wireless says the *Ka-8200* can be combined with all its other VSAT terminals within the same A-SAT-II system according to application requirements.

A Ku-band version is also available. The *Ku-8200* has been designed mainly for applications such as VoD, interactive TV and other broadcasting related applications sharing the same satellite as content broadcasting, or in areas where Ka-band HTS is not available.

Separately, Advantech Wireless has launched new HTS widebeam technology. It claims *WideSAT* increases density, versatility and efficiency when utilising wide transponders from 250MHz to 2GHz for high throughput data links.

The firm adds that the technology will also improve integration with SDN, NFV and advanced terrestrial and wireless telecoms infrastructures. It will also support standardised cloud architectures and the deployment of MEC (mobile edge computing) satellite aggregation points.

SiteHawk has eye for antenna problems

Bird Technologies' *SiteHawk SK-200-TC* is a handheld antenna and cable analyser that operates between 300kHz and 200MHz. It is designed to simplify detection of problems in coaxial transmission lines and antenna systems, and pinpoints their source using distance-to-fault measurements.

MANUFACTURER:
Bird Technologies

PRODUCT:
SiteHawk SK-200-TC

MORE INFORMATION:
www.birdrf.com

The device is said to provide all of the measurement capabilities required to evaluate the performance of a communication system's transmission path.

Bird says the distance-to-fault measurement indicates VSWR or return loss at various points from the beginning of the transmission line all the way to the antenna, and identifies the location of a problem with high resolution. The cable loss function measures insertion loss of the transmission line over a given frequency range.

It's claimed the *SiteHawk* makes fast swept measurements at up to 0.25ms per data point of return loss and cable loss as well as VSWR and distance to fault, and allows users to set trace capture using 51, 101, 201, 401, 801, 1,601 or 3,201 data points per sweep.

Weightless launches LPWAN 'in a box'

The Weightless Specialist Interest Group (SIG) has released Weightless-P hardware and announced the pre-launch of a Weightless-P software development kit.

Weightless-P is an open standard for a high capacity, low power WAN (LPWAN) that is designed for performance. The SIG says it is the result of two years work and aims to become the *de facto* standard for public and private IoT networks.

MANUFACTURER: Weightless

PRODUCT:
Weightless Ignition Pack

MORE INFORMATION:
weightless.org

The hardware, dubbed the *Weightless Ignition Pack*, provides Weightless-P network connectivity. The packs include a Weightless-P base station and a full protocol stack to support it, antennas developed by Antenova, an end device plus all associated modules, host, as well as all necessary cabling.

According to the SIG, the pack will enable a Weightless-P IoT network to be deployed 'out of the box', and claims that it will deliver "substantive improvements and competitive advantages over existing IoT connectivity options".

The *Weightless Ignition Pack* (list price USD1,500) will be made available as part of a pre-launch offer on the Weightless website with a limited number offered free to developers – see *www.try.weightless.org/ctia* for details.

ALSO LOOK OUT FOR

'Fog computing breakthrough' for enterprise cell networks

LILEE Systems reckons the combination of its *TransAir STS Series Gateways* and *T-Cloud Management Platform* will bring high-performance IoT innovations to new markets.

Built using an open, standards-based design, the *STS* gateways consolidate broadband connectivity and routing, switching, application server, M2M connectivity, and IoT sensors in what US-based LILEE says is a compact and rugged form.

The firm says the gateways offer multiple wired and wireless connectivity options, and are installed in distributed assets, such as a bus or retail store. They include an onboard application engine that enables enterprise applications to run in so-called "fog" computing architecture, i.e. integrating on-site and in-cloud computing.

Network management, auto-provisioning and the ability for third-party software providers to integrate with the gateways is provided via *T-Cloud*. LILEE says operators can connect to this cloud-based platform using LTE-A, Wi-Fi or Ethernet. This then gives them continuous remote access to IoT data, analytics, and the ability to perform critical asset management functions including zero-touch on-board application upgrades and configuration.

LILEE reckons the combination offers several first-to-market innovations. For example, it claims the *STS* is the world's only router intelligent enough to inform downstream LAN applications when the upstream link is down and that the LAN applications should therefore pause.

The gateways are also said to include the only application server to support both Linux and Windows applications. Furthermore, LILEE says they're the first to incorporate dual Wi-Fi 802.11ac wireless functionality, both upstream and downstream, and the first to provide two dual LTE-A radios.

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Still waiting for the green light

While solar power represents 90 per cent of the green power adopted by mobile operators, only three per cent of cell sites actually use renewable energy sources, mainly in off grid-locations.

PHOTO: ERICSSON

So-called 'green' telecoms technologies have been around for a while now but Africa's mobile operators still face deployment challenges, as DR. NICOLA DAVIES explains.

The availability of electricity is one of the biggest problems facing mobile networks in Africa. And even when operators can plug into the grid, outages and load shedding make electricity supply unreliable. As a result, both off-grid as well as on-grid sites with unreliable power supply rely heavily on diesel generators and, apart from their high running and maintenance costs (up to 46 per cent of opex for MNOs), it is well-known that gensets produce a high level of emissions.

Grid electricity is not much cheaper or cleaner, and according to the GSM Association (GSMA), it amounts to 40 per cent of running costs for cellular networks in Africa. Furthermore, utilities are heavily dependent on coal fuelled power stations – for example, 90 per cent of South Africa's energy comes from coal-fired generation.

Each off-grid site using diesel generator battery hybrid technology burns approximately 13,000 litres of diesel annually, producing 35 tonnes of CO2 emissions. On-grid sites with unreliable power supply produce an average of 18 metric tonnes of CO2 and use 6,700 litres of diesel every year.

Management, engineering and development consultancy Mott MacDonald points out that while there is a degree of variation across Africa depending on the status of each country's national electricity grid, mobile network operators do still heavily rely on diesel generators to ensure good site uptime.

"For example in Burkina Faso and Niger, less than half of sites have grid connection and virtually all have a diesel generator," says David Tanner, the firm's director of technology strategy and design. "By contrast, in Ghana and Kenya, the vast majority of sites have grid connection yet still use diesel generators to provide backup when necessary. Then there are some countries where diesel generators are less frequently used as their grid is more reliable."

There are currently around 145,000 cell sites running off the grid in Africa, and more than 84,000 in areas where grid power is unreliable. This adds up to emissions amounting to 6,587,000 metric tonnes from diesel generators alone – and that's without taking into account emissions from grid power supplied from coal burning power stations.

The green challenges for MNOs

Although Africa is only responsible for a small percentage of the 70 mega-tonnes of CO2 produced by the mobile industry globally, network penetration and the demand for mobile services is growing rapidly. Some countries on the continent only have 10 per cent network coverage and, in many remote parts, the demand for coverage extends beyond the boundaries of the existing basic infrastructure of roads and grid electricity.

Thus, for operators heeding the ever greater call for mobile services in Africa will result in a

considerable investment in cellular infrastructure accompanied by increased emissions in areas which lack grid electricity. With off grid sites expected to reach the 189,000-site mark by 2020 and bad grid sites increasing to 100,000, the emissions from diesel generators powering mobile networks will have an enormous impact on the environment unless green technologies are implemented.

On the surface, going green with renewable energy is highly feasible in Africa. Photovoltaic (PV) power and concentrated solar power (CSP) generation top the list, followed by wind and biomass, while geothermal energy could contribute significantly in East Africa. The GSMA believes solar PV power alone could generate as much as 656,700TWh across the continent. But Tanner believes exploiting these potential power sources could be more complicated than the statistics suggest, and says mobile service providers are deploying renewable options in specific locations that are economically feasible: "In Niger and Mozambique, between 15 and 30 per cent of sites are powered by solar – although this may also be grid backup – while in some countries solar use is virtually nil. Renewable options are specific to each location, both in terms of power and traffic demand as well as available sunshine hours. Hybrid is being more widely adopted as an option to reduce fuel costs and reduce noise pollution."

The GSMA reports that although many operators are already striving to use green technologies – such as solar and wind power, as well as fuel cells and biomass power generation – to reduce reliance on diesel generators, they face several challenges. These include the lack of economies of scale in certain areas owing to the low number of subscribers per site, a shortage of skilled technicians in host countries, and particularly low levels of expertise in renewable technologies. It also warns that without committed local partners to support green power initiatives, the efficiency and success of green alternatives will be limited.

Solar power offers the most promising alternative energy solution so far because it is highly scalable and can easily be adjusted by adding extra modules should load increase.

However, the high capex and space requirements this brings with it presents a problem for mobile operators. While solar represents 90 per cent of the green power adopted by MNOs, only three per cent of cell sites actually use renewable energy sources, mainly in off-grid locations. This low level of adoption can be attributed to the barriers green technologies present which can be summarised as follows:

- A lack of affordable and reliable alternative energy technologies
- A need for high capital expenditure
- The need for accessible technical resources and reliable local partners
- Support from regulators and government policymakers

Solar energy is the most widely implemented form of green energy being used by African cellular networks, with major players such as Vodacom and MTN already using the technology on many of their towers. For example, MTN has 600 solar sites in Zambia alone, while Vodacom has successfully combined solar and wind power on certain sites and previously worked with Nokia to reduce emissions across its operations.

Wind turbines to power cell sites have not gone further than a few pilot projects and face many more hindrances. High maintenance costs and variable wind speeds that impact on reliability, and therefore investment risks, have made this energy option less feasible unless it is adopted in conjunction with other technologies such as solar power.

Hydroelectric power may be feasible for sites near a suitable body of water but small-scale generation is hindered by a lack of available technology and suppliers. The capex needed to use HEP to fuel cellular sites has yet to be fully investigated.

Biomass technology may seem attractive, but in telecoms it presents a set of challenges that include the scalability of power generation plants, the complexities of constructing and running them, and the need for reliable supplies of biomass. In addition, sustainability is of concern. For example, the use of crops or land traditionally used for food production can ultimately impact on food supply and prices.

Fuel cell technology shows promise, and new innovations are being supported by an increased effort to ensure that the supply chain supports reliable operation. For instance, Malaysia's Digi recently claimed it had become the industry's first operator to develop a cell site powered by a self-sustaining system that will not require refuelling.

As part of a proof of concept, the cellco is spearheading an industry initiative that aims to look at the possibility of using hybrid hydrogen fuel cells to reduce or even replace the use of diesel. Earlier this year, it began conducting tests at a pilot base station site in the district of Rompin in Pahang, south east Malaysia. The hybrid system works by extracting water from the atmosphere. It then breaks this down to produce hydrogen which powers the fuel cell and generates electricity for the base station.

According to Digi, currently available hybrid fuel cells are largely dependent on the delivery of hydrogen gas tanks, methanol or other fuel sources to power the cells. But the system it is testing in Malaysia does not require any of these and is therefore able to achieve carbon neutrality – the only by-products of this form of energy are oxygen and water, and no greenhouse gases are released into the atmosphere as a result of the process.

Digi's pilot study is ultimately funded by Malaysia's telecoms regulator, but for most operators around the world, new technologies such as hydrogen fuel cells are costly which creates barriers to their large-scale adoption.

Nonetheless, alternative energy sources do offer significant benefits. While mobile users and the environment gain from the more reliable communications brought about by the technology, the GSMA estimates that green energy will reduce annual opex for MNOs by as much as USD17,000 per tower per year – even when coupled with generators. This figure is based on an emissions reduction of 60 to 70 per cent per tower which would require an investment of USD42,000 per site.

African governments have a strong role to play in making the use of renewable energy more feasible through policies and incentives. With the mobile network industry being among the largest consumers of electricity and diesel, and with public utilities already stretched to the limit, many administrations across the region are either working on or have implemented renewable energy incentives.

These include tax breaks and relaxed import duties, and in Tanzania and South Africa, grants and subsidies are also available. Uganda has now upped the ante with 45 per cent subsidies for green energy equipment which is an increase on the 14 per cent previously offered. Ghana is offering full import tax exemption on green energy imports, while Nigeria has a temporary moratorium on import duties. Kenya offers investment tax exemption, while Tanzania offers sales and income tax exemptions on green energy products and revenues stemming from green energy projects. Senegal offers full tax exemption for green energy initiatives.

Other African countries, including Madagascar and Ethiopia are prioritising green infrastructure developments, but have yet to finalise incentives for the private sector.

In what's claimed to be a first in the mobile industry, Malaysian operator Digi is trialling a zero emissions hybrid hydrogen fuel cell system at a pilot base station site near Rompin, Pahang (pictured).

That all sounds encouraging. However, the GSMA says financial inducements alone aren't enough to ease the telecoms industry's transition to renewable technologies. It states that building technical capacity will also be vital to the implementation of more environmentally-friendly technologies.

Creating more efficient gensets and BSTs

The standard figure for diesel generator efficiency is 20 per cent. That suggests a huge amount of energy wastage, but is this still the case? Greater fuel efficiency and reduced emissions could make diesel generators a greener alternative.

One of the solutions to improve energy efficiency is to allow the generator to power equipment while storing surplus energy in batteries. After all, a lot of the wasted energy from gensets comes from using only 'part load' energy. In addition, the efficiency of generators can reach up to 60 per cent depending on engine types and technologies.

With calls for improved energy efficiency and reduced emissions becoming ever more insistent, generator manufacturers are working to address the problem. According to some big name specialists such as Cummins, renewable energy isn't always reliable. It believes that combining renewable energy sources such as solar or wind power with a gas or diesel generator solves the reliability issues while still reducing emissions.

Cummins is currently working on a project in which municipal waste, agricultural waste, and sewage could be used to produce enough gas to run large generators. The costs and scalability of such an operation are yet to be determined, but the project is just one of the initiatives being tackled by the company's 'Emissions Solutions' arm.

According to Cummins, renewable energy isn't always reliable. It believes combining renewable energy sources with more efficient gas or diesel generator solves the issues while still reducing emissions. For instance, while the QSK95 is the company's most powerful diesel genset to date, it is also claimed to offer best-in-class fuel economy with savings of more than USD400,00 over the course of 8,000 hours of operation.

David Tanner, Director technology strategy & design, Mott MacDonald

"Advances in base station technology will continue to expand the areas where renewables can be applied."

Cummins also notes that by using a combination of strategies, MNOs can cut their energy requirements, subsequently reducing emissions and saving costs. Radio transceivers that are able to handle high temperatures without air conditioning, energy efficient radio equipment and building materials (such as substituting bricks and mortar for plastics), sharing equipment, and using a hybrid between renewable energy and diesel generators will all decrease the dependence on non-renewable power sources for mobile operators.

Eltek shares these views but also reckons that higher efficiency rectifiers, even if they only produce 1-2 per cent in additional savings, will make an enormous impact on an industry-wide scale. According to the firm which specialises in high efficiency power electronics, "tangible advantages" will accrue through using the most efficient rectifier technologies. Emerson Network Power supports this view by stating that the cost of ultra-efficient rectifiers can be recovered in 1.9 years, with a ten-year return on investment of 49 per cent.

There seems to be no single solution to energy efficiency and reduced emissions, and mobile technology company Huawei is among the proponents of a multi-faceted approach. Its 'Migrate Towards Simplicity' strategy specifically targets African telecoms and covers power, environmental monitoring, cooling, batteries, cabinets and security systems. Through the use of shared embedded power, mobile site controllers, and a robust network management system, Huawei claims its approach offers the "highest energy efficient power".

Mott MacDonald's Tanner says: "Advances in base station technology are bringing increasingly efficient electronics into the networks, which will continue to expand the areas where renewables can be applied. The main driving factor behind this will be cost."

Ericsson has been developing base station technologies since the very beginning of GSM. The Swedish company claims it implemented a 40 per cent power reduction in its BSTs as far back as 2008, and its recent focus on the IoT has led to LPWA (low-power, wide-area) applications for operators. Ericsson also says it has supplied solar base stations in Indonesia since 2007, and in keeping with its track record the firm is implementing solar power, which it says is "more reliable" than diesel generators in its efforts to connect the unconnected.

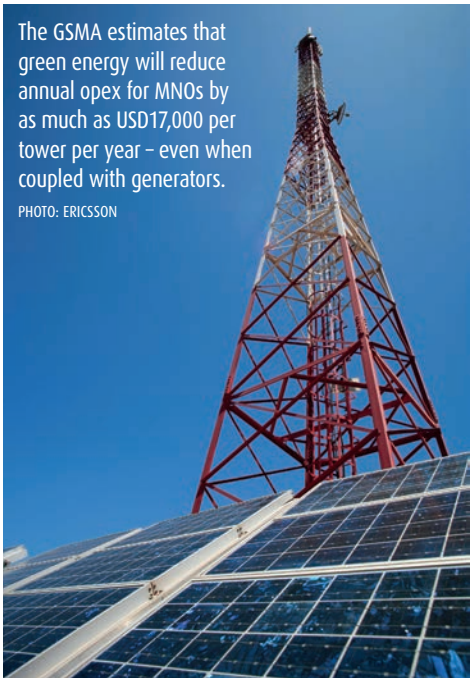
Meanwhile, Ericsson's Scandinavian rival Nokia says it is targeting flat energy consumption despite network growth. It has identified five points that need to be addressed in order to ensure energy efficiency: more productive base stations; site optimisation; network architecture evolution; network management and control; and network modernisation.

Apart from eliminating cooling and feeder losses, Nokia says it aims to reduce "idle" network elements. According to the company's 2020 energy strategy, renewable energy is the future for powering cellular technology, both in areas where power supplies are unreliable, and in countries and continents where this is not an issue. Solar energy is the current focus, but the viability of wind power and fuel cells is also being investigated.

A green and connected future?

Many analysts believe Africa's potential for economic expansion justifies it being dubbed the "new China". Cellular network coverage will therefore be an important enabler for this growth. With infrastructure in place, more companies will be increasingly attracted to investing more in the region – but with electricity providers offering limited or unreliable coverage in many countries, the continent will prove to be the ultimate test for the successful implementation of energy-efficient, 'green' cell sites.

With technologies such as *Watly*, a solar-powered generator that also provides desalinated water and connectivity coming to the fore *(see News, p5)*, people in Africa can expect more than just improved mobile phone coverage. They can also look forward to better work and educational opportunities, and perhaps even access to safer, cleaner water. ■



The GSMA estimates that green energy will reduce annual opex for MNOs by as much as USD17,000 per tower per year – even when coupled with generators.
PHOTO: ERICSSON

www.fgwilson.com

FG Wilson launches new generator set range for telecoms

Diesel generator set brand FG Wilson marks 50 years in business this year and has just launched a new 6.8 – 25 kVA range designed with telecoms users in mind. Michael Milligan, FG Wilson Account Manager talked with us about FG Wilson and the new range.

Founded in 1966, FG Wilson was among the first to bring mass-scale production to generator sets, launching self-contained generator sets which were simple to buy and operate and were easy to install. The brand is now a major player in the global market for generator sets installing over 600,000 since 1990 alone, with a total installed capacity of almost 90GW - more than the total installed mains electricity capacity of a country like the UK.

The new 6.8 – 25 kVA range is among several new products being launched this year, and says Michael, its design and development have been in close partnership with customers: "First and foremost, this is a very customer-defined product. We spent a great deal of time simply talking with our customers and dealers and working through issues together to understand what was important."

"There was a real focus on product operating costs and this has led to a packaged generator product which is ideal for telecoms users, or indeed for any customer who operates at sites which are remote or difficult to access."

The new range is aimed at either hybrid or generator-only applications. To reduce operating costs, site visits for maintenance and fuel replenishment, the range offers 1,000 hours between service intervals, and comes with set-mounted fuel tanks of up to 2,000 litres. The ability to monitor generator sets from the Telecom NOC maximises uptime and allows preparation for site visits minimising servicing costs and ensuring that site visits are effective.

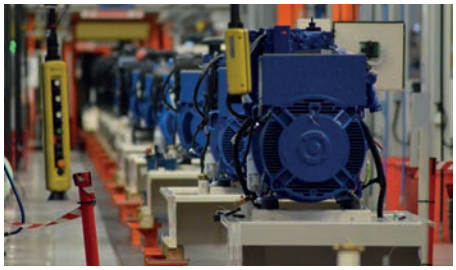
The product options list includes a flexible range of enclosures offering three levels of sound attenuation to help ensure that it meets local noise regulations and also mean that customers can choose the enclosure which is right for their needs.

Control systems played a big part in product design. Michael says, "We have incorporated a great deal of flexibility into control systems and remote communications to ensure that our generator set integrates seamlessly with any hybrid system. And we are partnering with several established hybrid manufacturers to confirm compatibility and ensure efficient and fast deployment of our products on site."

As with all FG Wilson products, the new range has been tested and validated at FG Wilson's Larne facility in the UK, a $26 million Centre of Excellence which also houses Europe's largest Hemi-Anechoic Chamber for noise testing. Here, all FG Wilson products are given intense pre-launch testing which include vibration, engine/alternator cooling, electromagnetic compatibility, noise, water ingress and rating/transient performance.

Michael says this is especially important. "We are a volume manufacturer and we take reliability extremely seriously. We know from past experience that rigorous upfront design, testing and validation lead to superior reliability throughout a product's lifetime and that this can save customers a substantial amount of money over time. That reliability is also underscored by FG Wilson's global network of over 400 dealers who offer automotive industry levels of service starting with product selection through to installation and a lifetime of support. They're trained by us and supported by our parts system which stocks over 11,500 parts and delivers three million parts a year, not only for our current products but also for legacy products."

The new range is now available to order from FG Wilson. You can find out more from www.fgwilson.com or from your local FG Wilson dealer.



Three Tanzanian villages now have GSM and an internet cafe for the first time thanks to MVNO AMOTEL. Local engineers have been trained to manage the cellular and Wi-Fi networks.

Connecting the carriers

While network operators and communication service providers are on a mission to connect their customers, who connects them?

As part of efforts to expand its service offerings to SMBs across Africa, Vodacom has developed a VSAT-based offering that aims to speed up the process of deploying broadband services for enterprises.

The introduction of Vodacom Business Converged Satellite (VB-Sat) has enabled the company to provide ubiquitous coverage, a wide range of service plans, a clear migration path into the future, and a single vendor solution.

The service is designed for corporate and government users with centralised or distributed IT infrastructures across metropolitan or outlying areas.

The network architecture consists of a VSAT installation at a customer's site. This typically includes a 'satellite access point' which is configured with a Hughes broadband VSAT router, 120cm and 98cm antennas, and a 2W radio, connected to the LAN primarily via Ethernet. All this communicates via satellites and the main earth stations where the VSAT hub baseband systems are located and connected to the managed Vodacom Business IP network.

According to the operator, combining technology and spectral efficiencies with uniquely designed service plans make it possible to deliver satellite-based services cost-effectively.

But in order to do this, it needs to provide both managed and broadband services over a common existing infrastructure with varying levels of management and bandwidths.

As a result, Vodacom needed a satellite partner that could not only accommodate its existing service design requirements, but also scale as its customer base increased. Working with Intelsat helped the company transform its existing satellite commitments into a service model that would support a broader range of objectives. As well as the delivery of broadband and a managed satellite services, this also includes offering access to broadband internet, VoIP, as well as MPLS VPN services.

As part of the evaluation process, Vodacom reviewed the TCO that would be required for each of its go to market options including comparing Ku- and Ka-band deployments.

This revealed that the Ka-band option would have required additional investment in new infrastructure or use of out-of-country or third-party teleports. This would have limited network control, increased infrastructure investments, and added to the complexity of integrating Vodacom's OSS and BSS platforms.

Ku-band's higher availability and lower susceptibility to signal degradation and rain fade is said to provide Vodacom with a market edge. Since the *VB-Sat* service was specifically targeting enterprise customers, the operator could rely on the carrier-grade platforms on which it had built its success in other vertical markets.

Augmenting the largest pool of capacity serving the continent, Intelsat adds that its upcoming high throughput *EpicNG* platform will also allow Vodacom to further drive down the cost per bit for services delivered.

Tanzania's first MVNO connects villages

In Tanzania, AMOTEL and its technology partner World Telecom Labs (WTL) have provided a blueprint for building sustainable, commercially viable networks across rural Africa.

Established in 2015, AMOTEL was Tanzania's first licensed MVNO. Its mission is to embrace new innovations and developments to serve low ARPU rural areas with little or no infrastructure. The company estimates that in Tanzania the current mobile subscriber base is only 28 million out of a total population of 50 million.

The company shares the same well-documented challenges in building and maintaining networks in rural areas as all other operators in Africa: low ARPUs, remote communities, lack of trained engineers, equipment developed for rich western markets, long ROIs, etc.

Of course, there are many vendors providing solar-powered base stations, diesel gensets, VSAT, etc., and all the components necessary

to run a rural network. However, there are few that can provide a complete system. After an extensive research period, AMOTEL decided to deploy the award-winning *Vivada (Village Voice and Data)* system developed by Belgium-based World Telecom Labs (WTL).

Vivada has been specifically developed to provide operators with a cost-effective, quick to deploy and sustainable system for providing GSM and data connectivity in rural areas. The system's package includes a micro GSM base station, Wi-Fi routers, backhaul integration, billing and provisioning software, VoIP compression switches, and SMS servers. The entire setup is said to run on less than 200W which can be supplied by solar with battery backup.

In July 2016, the first AMOTEL/WTL networks went live providing voice and data to three villages in the Mwanga District of the Kilimanjaro region, bordered to the northeast by Kenya. They are a two-hour drive along rough road to the nearest modest town and at least seven hours from Dar es Salaam. Each village has a minimum of 1,500 people with ARPUs of around USD2.5, and up until now, they have never been covered by any kind of telephone network.

Local engineers have been trained to manage the networks which provide GSM and Wi-Fi, and have a radius of 12km to cover people living outside the village centres. Traffic from the villages is validated by WTL's real-time charging system and voice calls are then converted into VoIP and compressed using the company's award-winning VoIP SBC. This uses patented technology to minimise the amount of bandwidth required on the satellite backhaul. Calls are transferred to a hub in Dar es Salaam where a WTL switch routes them onwards.

The networks were a hit with users from the start with people queuing to buy SIM cards. And as most villagers do not have smartphones or devices capable of connecting to Wi-Fi, the new AMOTEL cyber café has also provided to be extremely popular.

AMOTEL has identified four key factors that it considers essential for the successful deployment of rural networks by MVNOs, ISPs, and other organisations.

Firstly, it says they should ensure that technology partners can advise on all aspects of the project, both commercial as well as technical. Secondly, they should make sure that any agreements with MNOs are both transparent and comprehensive. Thirdly, a model should be proposed for the MNO which clearly illustrates a win-win situation from day one. And finally, the operator says a focus should be kept on opex and TCO in addition to initial capex.

AMOTEL's deployment was financed as part of the Universal Communications Service Access Fund's (UCSAF) USD9.6m investment to improve connectivity in Tanzania. Following the success of the implementation, UCSAF has agreed to release further funds to build more networks.

Meanwhile following extensive interest from wholesale carriers, WTL says it has invested significantly in developing new and innovative components for its original *Vivada* system to make it suitable for the wholesale market. This includes creating a platform that interoperates with MNOs to allow them to continue running their existing OSS/BSS while enabling them to extend these to shared-infrastructure locations.

It has also developed a wholesale billing system to enable wholesale carriers to track rural traffic onto its operator customers' networks.

In addition, WTL has modified its patented voice optimisation technology on the backhaul. It says this will enable wholesale operators to reduce the required bandwidth and hence the cost which is vital, particularly if satellite transmission is being used.

Largest footprint across Africa

In August 2015, the MTN Group and Liquid Telecom entered into a partnership to extend their footprint across Africa, exploring ways to jointly offer customers access to the largest fixed and wireless footprint across the continent.

Building on this agreement, Liquid has since successfully deployed a long-distance fibre route across South Africa with MTN as an anchor tenant.

The partnership between the two firms covers wholesale, carrier-to-carrier, high-speed broadband, enterprise and fixed data services. It enables both parties to access each other's fixed and wireless networks in countries on the African continent.

The partnership took on a new dimension in South Africa last year when Liquid began a project to connect the city of Polokwane in the north-western province of Limpopo with Centurion, a region located between Pretoria and Johannesburg.

Liquid Telecom has deployed a long-distance fibre route across South Africa with MTN as an anchor tenant.

The company had just 12 months to complete the operation, which included securing the wayleave application approvals required to carry out work on privately-owned land, as well as managing subcontractors. It also had to overcome some issues related to ground conditions for trenching.

Despite all this, in November 2015, Liquid completed the long-distance fibre route connecting Polokwane and Centurion. The project was completed on time and on budget.

The route provides MTN and other anchor tenants with almost unlimited capacity on a national basis, enabling access to two of South Africa's major hubs. As an anchor tenant, MTN has the advantage of owning dark fibre on the route, which now forms part of its wider transmission network across the country.

Liquid is now in the process of deploying another long-distance fibre route with MTN as anchor tenant. The 1,037km route will stretch from Polokwane in the east and southwards all the way to Ladysmith in the Uthukela District of KwaZulu-Natal. It is expected to take 24 months to complete.

Tackling SIM box fraud in Guinea

Fraudulent SIM Boxes are a blight on networks both in Africa and overseas. In its *2015 Global Fraud Loss Survey*, The Communications Fraud Control Association estimated that SIM Box Fraud cost operators USD5.97bn in lost revenue. As a result, governments are also missing out on hundreds of millions in tax revenue from the operators.

In Guinea, a solution from Ghanian Telco vendor Subah is now in place that is generating an extra USD1m in revenue every month for the operators with USD300,000 in extra taxes for the government of The Republic of Guinea.

Fraudsters use the internet and VSAT to convert international incoming voice calls into domestic calls and thereby avoid the higher termination rates. Their illegal SIM boxes can be found in the most innocuous places. They are often operated remotely with locals returning regularly to load credit or insert new SIM cards. In fact, so lucrative is this activity that some SIM box operation sites are protected by armed guards.

For operators, the fraudsters cause network congestion, poor QoS and problems with cell planning due to spectrum management issues. In addition, they deprive the operators of revenue with the knock on effect of reducing tax receipts for governments.

Guinea's regulator ARPT decided to take action. In November 2015 it appointed Subah Telecom which had already developed and deployed a solution to solve similar problems in its home country of Ghana. Unlike other products on the market, it's claimed Subah's system can detect and block SIM numbers, and locate and eliminate the physical SIM box itself.

In Guinea, Subah built a new independent NOC

and trained a local team to manage the process going forward. Since fraudsters can adapt rapidly to avoid detection and prevent blocking when illegal use of a SIM is detected, the company uses a multi-layered approach to tackle the problem.

It has developed a number of innovative features that are being used in Guinea. For example, Subah installed GSM gateways at the ARPT's premises as well as POPs across the world from which test calls are originated and terminated on the gateways at the NOC. This enables the company to detect international calls coming in through SIM boxes and terminating as local calls.

It has also come up with a customised algorithm which automatically inspects, extracts and transmits numbers identified as fraudulent to the respective operators for blocking. The algorithm monitors how long it takes the operators to block a number using a colour-coded system. Detected numbers not blocked after two, four and more than six hours are flagged up as blue, orange and red on the central management system. This enables the regulator to apply penalties to inattentive operators.

As part of the blocking process, Subah ensures that a number of the local SIMs used by fraudsters continue making calls so that the location of the SIM box can be discovered. Operators provide data about these local SIM numbers including information about local networks onto which illegal calls are transitioned including the BTS, MCC and MNC locations.

Subah's custom-built system, which is integrated with satellite maps, collates this information and transmits the findings to a tracking vehicle. A mobile BTS is used to zone in on the MSISDNs and IMEIs of the illegal SIM cards. Once these are detected, they are locked to prevent movement onto another BTS. A handheld signal detector is then used to identify the actual location of the Fraudulent SIM box.

In addition, the system has been configured to give comprehensive reports at the click of a button. These show the volume of test calls per day, bypass numbers detected, originating operator, terminating operator, ageing of numbers detected, and much more.

Since going live in June 2016, the system has helped ARPT identify and disable 18 SIM box operations using thousands of SIMs. The number of international incoming minutes in Guinea was recorded at 20 million in January 2016. As a result of Subah's system, 25 million calls were recorded by July. This equates to an extra USD1.5m in revenue every month for the operator with USD300,000 in extra taxes for the government.

Backing up Bharti and Vodafone

Bharti Airtel has more than 313 million customers across its operations in 20 countries in Africa and Asia. Its global network spans five continents and it has more than 400 interconnect partners.

In order to maintain its global presence, the operator uses Epsilon's *First Line Maintenance* solution in its aim to ensure maximum uptime and network availability in key global communications hubs. It has outsourced network maintenance to Epsilon and relies on it to keep critical interconnection points in London and Paris up and running and operating efficiently.

Since 2010, Airtel has outsourced first-line maintenance to Epsilon's data centre in Paris as well as Telehouse East in London (pictured).

According to Epsilon, global network operators find it difficult to have experts on the ground in communications hubs around the world. For Airtel, the challenge was to find a solution that could cost-effectively serve its needs outside of its home markets in Africa and Asia.

While global connectivity is key to the business, the majority of the company's staff are located in markets where they also have domestic operations. What Airtel therefore needed was a solution that could fill resource gaps in critical interconnection points without needing to invest budget in full-time staff on the ground. In addition, it needed to use the available resource flexibly and address issues as they pop up. This mix of requirements meant it needed a partner with a unique understanding of outsourcing and the ability to deliver.

Since 2010, Airtel has outsourced first-line maintenance to Epsilon's *Telehouse East* data centre in London and *Telehouse 2* in Paris. As part of the programme, Epsilon says it performed a site survey with the client to establish the status quo of the facility and get the team familiar with the operations at the site. Epsilon staff were then added to the permanent access list to allow immediate site access whenever required.

Epsilon says it has delivered a service package tailored to the cellco's specific needs, with the flexibility to scale it up or down as required. The company's *First Line Maintenance* portfolio includes on-site maintenance, network monitoring, spare parts handling, and system integration services.

By outsourcing, Epsilon says Airtel is able to support its infrastructure in more places with a reliable and experienced outsourcing partner. The firm adds that its engineers are able to function as an extension of Airtel's team, and provide a seamless and integrated service which is backed by strict SLAs to ensure maximum uptime and availability.

Vodafone operates the second-biggest mobile network in Ghana, and according to figures from the country's National Communications Authority, as at the end of 2015 the cellco had more than 7.6 million subscribers and a 21.74 per cent market share.

Like most countries throughout Africa, Ghana has seen ever increasing mobile traffic on its networks. Over the years, Vodafone has given more people in the country access to the mobile internet through the development of a 3G network, and by connecting rural areas to the rest of the world. As a result, a growing number of user groups have placed great strain on the Vodafone Ghana's back office storage systems.

In its live network, the operator used NetApp's FAS series as its primary storage system and EMC products for the backups. The primary system stored internet traffic data, call records and billing records for two months. After that, the data and records were transferred to the backup system in the disaster recovery (DR) centre for storage over three years.

But skyrocketing user growth in Ghana has created massive data, and since 2014 Vodafone has faced two main challenges: firstly, the capacity, scalability and performance of its existing storage systems was unable to meet its current operational needs; and secondly, outdated storage systems, expensive expansion costs, and uneven resource allocation meant that the storage system for the live network had to be re-built.

In March 2014, following an in-depth analysis of Vodacom Ghana's requirements, Huawei proposed a solution to comprehensively upgrade and construct the operator's existing storage systems using bespoke solutions.

First, an overall backup and archive system was added to the existing systems in the data centre. The vendor's *OceanStor 9000* storage system, three *RH2288 V2* servers, and Commvault's backup software (formerly branded Simpana) were deployed.

Huawei says the *9000* features distributed storage architecture and offers reliable data protection. It was used with Commvault's software to build a new backup and archive system in the production centre, and to migrate data backup that could be stored from two months to three years from the existing production system to the new platform.

Huawei's solution uses all-IP interworking technology to keep the existing networking architecture unchanged, and will also facilitate what the vendor describes as "smooth expansion" for future service development.

It adds that Vodafone Ghana can configure NAS nodes on demand without worrying about the deterioration of system performance due to expansion. Huawei says the *OceanStor 9000* allows linear expansion from three to 288 nodes, enables system capacity and performance to grow linearly as nodes increase, and has expanded a single file system with up to 40PB of capacity.

According to the company, Vodafone Ghana has suffered zero data loss thanks to its system's advanced data protection technologies and highly reliable designs. It says the operator is also benefitting from fully utilised storage resources, reduced device quantity, and simplified O&M management due to the central and unified data backup and archive system. Furthermore, Huawei reckons Vodafone Ghana has made TCO savings of more than 20 per cent compared to its original storage systems. ■

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While satellites and radios have been used to track animals for several years now, using cellular networks for IoT applications can offer greater advantages. For example in 2012, conservation organisation Biosphere Expeditions fitted three leopards with collars embedded with SIMs from Namibian operator MTC. This was then used to track the animals' movements by sending data to a laptop whenever the leopard moved within range of a mobile tower.

Can the leopard change its spots?

While the IoT offers great potential, including helping to protect endangered species, PROFESSOR DAVID ROGERS says it will be for nothing if standards bodies like the ITU don't face up to reality.

A couple of months ago, I was present at an ITU meeting in Geneva where the "Internet of Tigers" was discussed. The topic was raised by an African country – tigers are of course resident in Asia, although some do live on reserves in Africa, such as at Tiger Canyons in the Karoo, South Africa.

Real-time tracking of endangered species is a use case that is great to describe the benefits of the future in terms of the Internet of Things (IoT). Tiger Canyons currently track its tigers using satellite, but with more advanced network technology, the sensors could be richer, send much more data, have hugely better battery life, and be less burdensome for the animal.

So wouldn't it be great if instead of only being able to use a few people to keep tabs on endangered wildlife, we could crowd-source round the clock monitoring from people across the world? Not just from tags on animals, but perhaps even from live streaming video services right across national

parks, even from above? Advances in technology in the past twenty years have been such that this is a realistically achievable objective by 2026. So how do we get there?

Part of the ITU's work is to develop technical standards in order to protect and support everyone's fundamental right to communicate. The problem is they're not very good at it. This is represented by the lack of implementation of many of the standards in the majority of the connected products on the market. The main reason for this that I hear from manufacturers is that the standards are often simply so bad that they cannot be implemented. The same can be said for testing against those standards.

Take the problem of counterfeit devices, for example. You wouldn't think this would link to Tigers, but bear with me.

Counterfeit mobile devices are a big problem for African countries where the market penetration is very high relative to elsewhere around the world. A number of countries, including Kenya, Tanzania and Uganda, have switched off these devices because they can cause havoc with network management; the radios are not calibrated properly and they simply can't be identified – the counterfeiters don't care as long as someone buys them. Furthermore, the components being used often contain harmful substances because they're being manufactured and sold illicitly.

There is, however, a real dilemma here. On the one hand, it could be argued that the challenge for regulators is that counterfeit products still help to connect people and that improves their lives. If the devices are turned off, where does that leave the user? But on the other hand, the phones have avoided (high) import taxation and have security and quality risks.

Solutions that won't work for Africa

One particular work item in ITU-T looks at tackling the problem of counterfeit by attaching an IoT-enabled chip on every product, thereby actually increasing the price of an authentic product. The proposed work item was thrown out of Study Group 11 of ITU-T only to reappear in Study Group 20. The exact same proposal was then accepted.

The implications are massive: an increase in e-waste of 100 per cent on all products (not just electronic) shipped worldwide. The increased cost to manufacturers will of course be passed down the supply chain, ultimately inflated at the point of sale to the consumer. The eventual cost to the environment and to our world in consumption is absolutely not worth the limited gain.

The worst part of all is that the proposed solution would not impact the supply of counterfeit products. The criminals who run such operations do not stand still; they utilise and challenge new technologies in a constant arms race.

What is needed is pressure to deal with the source of these problems and prevent the export of counterfeits to Africa. Some of these issues suffer from the country-driven approach at the ITU – it is not acceptable to say that China is the source of more than 60 per cent of counterfeits (according to an OECD report). It is deemed more appropriate to say that "there are a lot of counterfeits in the world". This kind of diplomatic get-out does not actually help to fix the problem.

So going back to our tigers, the authentic IoT tracking device would itself be required to have another IoT module to track the tracker, probably doubling its price. The proposed solution also attempts to use a proprietary platform called the 'Handle System' instead of the internet, thus potentially increasing the implementation cost by many times.

So how does any of this exactly help developing countries tackle the problem of counterfeit devices? The answer is it doesn't. Ultimately, it seems that African countries are being failed when it comes to ITU standards that should help them.

At the time of writing, the World Telecommunications Standardisation Assembly (WTSA-16) was due to take place in Tunisia at the end of October. It is important because, strategically, the resolutions agreed at the meeting is what ITU working groups will be focusing on for the next four years, nominally to produce standards that achieve some useful objectives.

The problem is in the production of those standards. In some of the working group meetings, there are less than five people – sometimes from the same country. There are lots of mailing lists with no discussions, just communiques from the secretariat. There are few technical experts, but lots of people from government institutions with policy backgrounds. There are gross inefficiencies in the way that the meetings are structured in comparison to other standards bodies.

The lack of openness at ITU means a severe shortage of peer-review from experts who could usefully contribute their knowledge. In the age of the internet, experts from all over the world should, and could, be able to read and contribute to developing standards. Why should a UN agency close its doors to the people of the world in this way?

So if not ITU-T, then where? Well here's a thing – other bodies were working on IoT standards long before the ITU's Study Group on the topic was started in 2015. For instance, the Internet Engineering Task Force (IETF) has a list of some of the work its done on IoT going back ten years, while the W3C Web of Things working group is doing some extremely interesting work *(see https://www.w3.org/WoT)*.

There are few gaps to fill that haven't already been addressed or where work is already scoped and under way. But because the Internet of Things is not one 'thing', it is impossible for any one standards body to declare ownership. To do so is arrogant and misses the point about the IoT – it encompasses so many types of things and network types that it is not monolithic. Thus, the ZigBee Alliance, ZWave, the Industrial IoT Consortium, the IoT Security Foundation, etc., are all individually doing their bit.

A long-term vision

In addition, there are emerging radio technologies that will offer longer range but low data transmission capability. This is also tied to the long-term vision of 5G; IoT is linked in the sense that network segmentation can allow for different types of equipment, connected heterogeneously via multiple types of radio bearer. 5G means that, for example, a personal health monitor could communicate along with a high-speed streaming video. The two have very different resilience and data usage requirements, and they almost certainly have very different physical and radio properties. New technologies such as Mobile Edge Computing (MEC) and NFV will all help to facilitate this new world.

Not surprisingly, many standardisation bodies have been working towards 5G for a long time now, so the ITU-T's IMT2020 project is not contributing much in this regard, either. Don't get me wrong – I do think the ITU could have a role to play, but not without wholesale reform. Representation of African countries in standards bodies is very low because the cost of participation is high. African requirements therefore end up being under-represented. That needs to change.

One model I like is the World Wide Web Consortium (W3C). It has offices in Senegal and South Africa, is open, and its standards can be downloaded and implemented for free. Participation is via mailing list and conference call. Anyone in the world can get involved. This is something that standards bodies should aspire to if they want to get a wider variety of opinions and expertise from around the globe.

So will we have our "Internet of Tigers"? I really do think so. If you are looking at use cases for 5G and IoT then it is sensible not to anchor to one standards body but to look to engage broadly across the spectrum. Try to use open, free, widely implemented standards, pick your radio network carefully, and you are unlikely to go wrong. ■

Professor David Rogers runs UK-based software and security company Copper Horse Solutions. He chairs the GSMA's Device Security Group and also sits on the executive board of the Internet of Things Security Foundation. Rogers is a visiting professor in cyber security and digital forensics at York St John University and also teaches mobile systems security at the University of Oxford.


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IoT helps create air pollution map

UK cycle courier company Gophr is equipping 50 of its riders with *CleanSpace Tags*. The couriers will map pollution levels on their journeys across London, collecting data that will help to build a real-time map of the city's air pollution.

CleanSpace Tags are portable air pollution sensors powered by Freevolt, the innovative technology that uses wasted wireless signals to power low-energy devices so their batteries never need changing *(see Wireless Solutions, Oct-Nov 2015)*.

In what's said to be the first example of a public LoRa network in London, Gophr's couriers will be equipped with devices that use the long range IoT technology. These will track the couriers' locations via satellite connectivity provided by Inmarsat, negating the need to use mobile location based services which drain battery life. It also means fewer access points are needed to cover the whole city.

The carbon monoxide data collected from the tags will feed into the interactive *Air Map* that will show the actual pollution levels at each courier's location. With the cyclists predicted to travel more than 17,000 miles each month, it's claimed the amount of indoor and outdoor air pollution data collected will be on a scale that has never been achieved previously.

Gophr's cycle couriers will be equipped with LoRa powered tracking devices that monitor air pollution levels in real-time.

LatAm police force upgrades satellite-based mission critical network

Advantech Wireless has supplied an end-to-end advanced VSAT network solution to a state police force in Latin America. Neither the customer nor its location can be named due to confidentiality agreements.

The network, which covers the country's entire land area, includes internet for police use and beyond line-of-site communications for security.

In 2007, the customer selected and installed a VSAT network solution from Advantech in order to offer internet services to more than 200 remote police bases located in rural sites.

Eight years later, the vendor was selected to provide an FTDMA VSAT network solution, adding options for its *A-SAT-II* system and SCPC upgrades. Advantech adds that it also provides in-country operation and maintenance services using its own personnel.

The upgrade started in January 2016. It includes one new *Discovery 100 Hub* with Advantech's *A-SAT-II* optimisation system and *S4120* terminals in order to connect more than 250 remote sites. It's claimed the ruggedised remote terminals are able to cover the diverse topography of the nation and accommodate "flexible and expandable" satellite resources.

Advantech Wireless' CMO of VSAT business unit Oscar Glottman says: "Our customer had faced the challenge of protecting the country's civil order in a large land area, with diverse geography including rugged mountains separating coastal areas on the Caribbean Sea and on the Pacific Ocean."

The solution is also said to include versatile and highly portable VSAT systems including flyaway and driveaway antennas installed in police trucks and tracking systems.

"Using the enhanced Advantech Wireless system, a network node in an emergency site can be assembled and deployed in under 15 minutes, and is used for fast deployment of help assistance centres in case of fires, floods or earthquakes," says Glottman.

Alaskan fishing firm first to use *GX* powered broadband in Bering Sea

Alaskan Leader Fisheries (ALF) will use Inmarsat's new high-speed broadband maritime communications service in the remote and hostile waters of the Bering Sea.

ALF is a commercial fishing company specialising in the harvesting, processing and marketing of Alaskan seafood. It will use Inmarsat's *Global Xpress* powered *Fleet Xpress* system to support its daily business operations.

As well as providing crew members with a vital communication link and internet access during long sea voyages, the service will help ALF's shore-based sales teams to maximise their sales potential with up to date information on catch qualities and weights. It will also enable the sharing and recording of geographical catch areas for more targeted sustainable fishing methods.

After successfully converting the first VSAT system on board the *Alaskan Leader*, Fusion Marine Technology will now equip the three remaining vessels in ALF's fleet.

ALF's currently operates four vessels in its fleet including the *Alaskan Leader* which was the first to have its mini-VSAT system converted for *Fleet Xpress*. The installation was led by Network Innovations and its partner Fusion Marine Technology. It features a Cobham *100GX* one metre VSAT antenna which, together with a *FleetBroadband* antenna and below deck unit, form the hardware needed to operate the service.

David Pratt, VP Fusion Marine Technology, says: "*The Fleet Xpress* service has allowed the Alaskan Leader Fisheries to maintain connection and speed even in the harshest of conditions of the Bering Sea, with antenna elevation around eight to thirteen degrees."

Sri Lankan operators trial 4.5G networks

Two Sri Lankan mobile operators are claiming a regional first by trialling 4.5G LTE-A Pro technology which is capable of achieving speeds in excess of 1Gbps.

Earlier this year, Sri Lanka Telecom's mobile subsidiary Mobitel and Dialog Axiata each announced that they had demonstrated 4.5G LTE-A Pro.

Dialog says its trial was carried out on its LTE infrastructure that was provided by Huawei. Mobitel also partnered with Huawei well as ZTE for its lab test.

According to the latter, the prime factor behind the super-fast speeds demonstrated in 4.5G LTE-A Pro is the use of multiple carriers of spectrum to generate an aggregated spectrum block to deliver significant throughputs for end-users.

It says the use of OFDM with 256 QAM in LTE-A Pro allows easy upward scalability for higher bandwidth requirements. This higher modulation rate is coupled with up to five-component carrier and 4x4 MIMO technology to provide Gigabit speeds for end users.

Both Dialog and Mobitel plan to commercially deploy 4.5G services but have yet to announce any further details.

In the meantime, the two firms say these latest tests continue to prove that Sri Lanka is spearheading mobile technologies in South Asia.

Refugee camps given free emergency internet connectivity

Cloud network specialist Cradlepoint has partnered with Irish voluntary organisation Disaster Tech Lab (DTL) to deploy free emergency Wi-Fi in refugee camps across Greece.

DTL is using Cradlepoint's *COR IBR1100* series router to provide essential connectivity in 18 camps across the Greek mainland and islands.

According to Cradlepoint, its compact and ruggedised 3G/4G/LTE devices are designed to provide highly available, mission critical networking for extreme environments.

The company's *Enterprise Cloud Management Portal* enables DTL to monitor and troubleshoot the network locally on the ground. The system is also providing internet access in mobile vehicles used by NGOs across the country, including the UNHCR.

As new refugee camps are set up, Cradlepoint's technology provides first response emergency connectivity. There are two levels of access provided.

First, an open Wi-Fi network is used by refugees who rely on smartphones to keep in touch with relatives and communicate with the authorities.

Asylum seekers in Greece make their initial applications to the authorities via *Skype* using connectivity provided by Cradlepoint and Disaster Tech Lab.

For example, on arrival in Greece, asylum seekers are required to make their initial application to the country's authorities via a *Skype* call. This presents a real challenge as many camps do not have electricity infrastructure for months after being set up. The power needed to enable free connectivity often comes from solar panels, batteries or wind turbines rigged up by DTL.

Secondly, there's a password-encrypted network to help the authorities communicate and process asylum applications securely. This is essential given that biometric data is taken and processed for every refugee.

Orange Poland and Nokia set capacity-distance record

Orange and Nokia say they have achieved the world's first optical transmission of 250Gbps per wavelength over 870km.

The milestone was reached when a six-carrier 1.5Tbps superchannel occupying a bandwidth of 300GHz was transmitted through Orange Poland's existing network between Warsaw and Wroclaw over standard single mode fibre.

Nokia says optical systems typically achieve maximum transmission capacity over short distances, and lower capacity across long distances. The company claims the trial demonstrated how capacity and distance can be improved in tandem using its commercially available technology, resulting in a 250 per cent increase in bandwidth over commonly deployed 100Gbps networks using the same amount of spectrum.

The field trial used a 870km fibre link with flexible grid infrastructure and standard erbium-doped fibre amplification applied to 20dB spans of standard single mode fibre. The 1.5Tbps superchannel was based on six carriers of 250Gbps capacity each. Nokia says the size of the superchannel, and its 50GHz spacing between channels which is the same as existing 100Gbps channels, will ease network planning and operation.

Christian Gacon, VP in charge of Orange's transport networks, says the milestone will form the basis for faster networks and a better user experience. He adds: "Reaching these new heights in optical transmission proves we can meet bandwidth demand while maintaining the lowest cost per bit so our business can continue to flourish."

Telkom Indonesia looks to HAUD for network security

Telkom Indonesia, which is said to be the world's seventh largest cellco, will use mobile network security technology from HAUD to protect its 157 million subscribers from spam and fraudulent SMS traffic.

The deal follows a successful trial in which HAUD deployed a bespoke firewall solution with 24/7 monitoring, and carried out an in-depth traffic audit of millions of text messages.

According to the Malta headquartered vendor, its mobile network firewall provides modular, 360° protection against SS7 security vulnerabilities, and effectively ring-fences networks from malicious messages. At the same time, it's claimed to prevent grey route traffic that bypasses network termination fees.

HAUD will also provide Telkom with A2P SMS monetisation services to create new sources of revenue and improve its subscriber experiences.

Through what's claimed to be a "pioneering" Revenue-as-a-Service approach, HAUD says it will manage the entire A2P monetisation process, from traffic identification and blocking, to redirection of traffic to monetisable channels, without requiring any initial investment from the operator.

"Revenue-as-a-Service is a new approach to helping operators to make the most of all possible income streams available to them," says Mårten Björkman, SVP Asia Pacific at HAUD. "The global A2P SMS market is worth billions but many operators are not equipped to claim their fair share and routinely lose out on large amounts of revenue due to the ongoing use of grey routes."

Peru gets its "most reliable" first responder network

DAMM has rolled out a citywide TETRA network covering Lima in Peru. As well as the capital city, the deployment covers its surrounding regions including Tumbes, Piura, Lambayeque, La Libertad, Ica, Arequipa and Cuzco.

According to the Danish PMR specialist, it helped overcome Peru's challenging topography with a network that supports more than 40 sites and over 3,000 professional radio users. DAMM worked with its local system partner, Dolphin Telecom, which has successfully built the network over the last years and plans further expansions in both capacity and coverage to enhance the service offering.

DAMM says the challenges in Lima were "easily overcome" thanks to its decentralised IP-based architecture, *BS421* base station, and directional antennas.

Over a six month period that began earlier this year, the network was expanded with 20 sites. DAMM claims challenges such as need for enhanced coverage in tunnel areas and indoor locations were "easily overcome" by utilising its decentralised IP-based architecture and "easy" mountable outdoor *BS421* base station in connection with directional antennas.

Dolphin Telecom CEO Javier Sanchez adds: "With the open API in DAMM *TetraFlex*, it was easy for us to enhance the application services including AVL tracking, fleet management, and advanced alarm solutions."

Upgrade for Bravo

Saudi Telecom subsidiary Bravo is upgrading its mission-critical network that serves more than 3,000 customers across the country. Its current network is based on a proprietary technology, and the replacement programme underpins Saudi Arabia's *Vision 2030* which is about optimisation, digitisation of different verticals, and enhancing public/private partnerships. The new mission-critical TETRA network is planned for completion by 2019. Complementary mission-critical LTE, based on 3GPP Release 13, will be rolled out on a zone-by-zone basis according to customer needs, beginning in 2017.

First NFV telco cloud

Etisalat has activated its first live NFV (network function virtualisation) telco cloud in Abu Dhabi. It has been built using Quanta servers, Arista switches and Canonical Ubuntu OpenStack, a multi-vendor combination that has been integrated for production for the very first time. Etisalat says activations are currently in progress at more sites across the UAE. It also aims to virtualise its infrastructure and services across its portfolios of data, communications and video, beginning with mobile services.

WorldSIM connected

WorldSIM says it is now the most connected mobile network in the world. With the launch of *WorldSIM Infinity*, the global roaming specialist claims its network now encompasses 50 million Wi-Fi hotspots and 600 mobile networks in 200 countries. It says the new service gives subscribers "seamless" connectivity when they roam internationally, regardless of whether it's via Wi-Fi or mobile. The company claims that travellers will be able to always connect to the fastest network at the lowest cost.

Huawei and Vodafone test 20Gbps using E-band

Huawei and Vodafone claim they have conducted the world's first 5G outdoor field test at E-band, reaching 20Gbps peak rate for a single user device with high spectrum efficiency.

The demonstration took place at Vodafone's headquarters in Newbury, England earlier this year, and was part of a strategic partnership agreement on 5G technologies that it signed with Huawei in 2015.

According to the two companies, the 5G mmWave field test covered Single User-MIMO with a strong reflection path to reach 20Gbps UE peak rate, and Multi User-MIMO for long-range UE to reach 10Gbps peak rate. A peak user rate of 20Gbps is targeted by ITU-R as a 5G requirement.

Huawei believes the test will contribute to the study of spectrum above 6GHz for 5G enhanced mobile broadband, and to promote global spectrum harmonisation at World Radio Congress in 2019.

Vodafone Group CTO Johan Wibergh adds: "This field test in an outdoor environment is a significant step in validating the performance of 5G in high frequency bands, improving our understanding of the capabilities of the technology."

E-band millimetre wave spectrum can be used as complementary frequencies to the lower-band to deliver what's said to be an ultra-high mobile broadband user experience.

In particular, Huawei says it can enable new applications such as virtual/augmented reality, and act as self-backhaul for the 5G traffic.

Airbus and CSL upgrade comms network for Hong Kong electricity provider

CLP manages around 2.5 million customers in Hong Kong. It owns and operates more than 14,900km of transmission and high-voltage distribution overhead lines and cables, as well as more than 14,200 substations. PHOTO © CLP HOLDING LTD.

Airbus Defence and Space (ADS) is working with mobile operator CSL to upgrade the communications network of Hong Kong's largest power company.

CLP Power supplies electricity to around 80 per cent of Hong Kong's population. Since the early 2000s, it has been using a TETRA network from ADS, which it claims was the world's first 800MHz system. CLP set up the network for the remote control and monitoring of overhead lines in an effort to improve the reliability of its power supply.

CSL is said to be Hong Kong's largest mobile operator and provided CLP's existing network, including base stations, switches and services. Over the next four years, ADS will work with CSL on numerous sites across the state.

The upgraded system, based on the latest IP-based TETRA technology, will also offer the possibility to support LTE communications services in the future. There is also an option for CLP to add secure LTE services based on ADS' *Tactilon* product range *(see feature, 4G or not 4G?, Jun-Jul 2016).*

DSA welcomes India's Wi-Fi consultation

The Dynamic Spectrum Alliance (DSA) has supported the Telecom Regulatory Authority of India (TRAI) on issuing a consultation paper on the proliferation of broadband through public Wi-Fi networks. It has now submitted recommendations for increasing the amount of license-exempt spectrum.

India currently uses Wi-Fi to connect over half of its users to the internet. With mobile devices set to dominate the bulk of future online traffic, which is set to rise four fold by 2020, ensuring Wi-Fi connections are secure and robust is therefore considered essential.

The DSA believes it is vital that TRAI advance policies that will make additional license-exempt spectrum available. It says the regulator should do this both by designating bands for license-exempt use where available, and through intensive spectrum sharing between licensed and license-exempt users, where possible.

"The DSA is all about promoting and enabling spectrum sharing of all guises," says Professor H Nwana, executive director of the Dynamic Spectrum Alliance. "This means we prefer balancing more shared spectrum utilisation over exclusive utilisation, balancing static allocation with more dynamic allocation, and balancing licensed regulations with more unlicensed regulations. So naturally, we support plans worldwide to open up more spectrum to unlicensed access from devices and unlicensed sharing."

Nwana called for TRAI to increase the amount of license-exempt spectrum available through dynamic spectrum sharing in segments of the 5GHz band, TV white space frequencies, high-band spectrum (71-76GHz and 81-86GHz), as well as assigning the lower part of 6GHz and the entire 57-71GHz range for license-exempt use.

"With these steps there will be enough spectrum to fully support TRAI's objective of expanding broadband through the proliferation of public Wi-Fi in India," he concludes.

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