chapter
Satcoms
5

David Oni,
research analyst, Nigeria, NSR, an Analysys Mason company

A growth period for satellite communications

Over the next ten years, NSR forecasts US$1.2 trillion in revenues, 34,000+ satellites to be launched, and 530 exabytes of information. Space and the satellite communications sector is on a growth path – generating more revenues and connecting more places than ever before.

Amongst the global landscape of satellite connectivity, Africa will be a key market fuelling that growth. As digitalization initiatives expand, partnerships will be key, and new satellite connectivity solutions such as the direct-to-device satellite connectivity markets will be greenfield opportunities for global operators and local providers alike. Overall, new business models and new technology is helping to drive satellite connectivity to a stronger position in connecting Africa.

Now, more than ever, Africa is looking to digital solutions to improve productivity and drive development among member nations. Post pandemic, authorities see an opportunity to leverage digital technology and services to build economies that are more resilient to future shocks, enhance productivity and efficiency in service delivery, and ensure more inclusive socioeconomic development. Many of the industry-relevant regulatory policy changes made by most African governments during the pandemic emphasized digital accessibility.

The AU's Digital Transformation Strategy 2020–2030 aspires to achieve universal digital access and a single pan-African digital market by 2030. According to the International Telecommunications Union (ITU), Africa achieved 13% year-on-year growth of internet penetration. Today, 40% of the African population are online. The Global Systems for Mobile Association (GSMA) projects that there will be nearly 100 million new subscribers by 2025, taking the total number of subscribers to 613 million (50% of the region's population).

Satellite communications in Africa have come a long way. Although a burgeoning segment in the continent's rapidly developing digital industry, several stakeholders and industry players have

Direct Satellite-to-Device Subscribers by Region
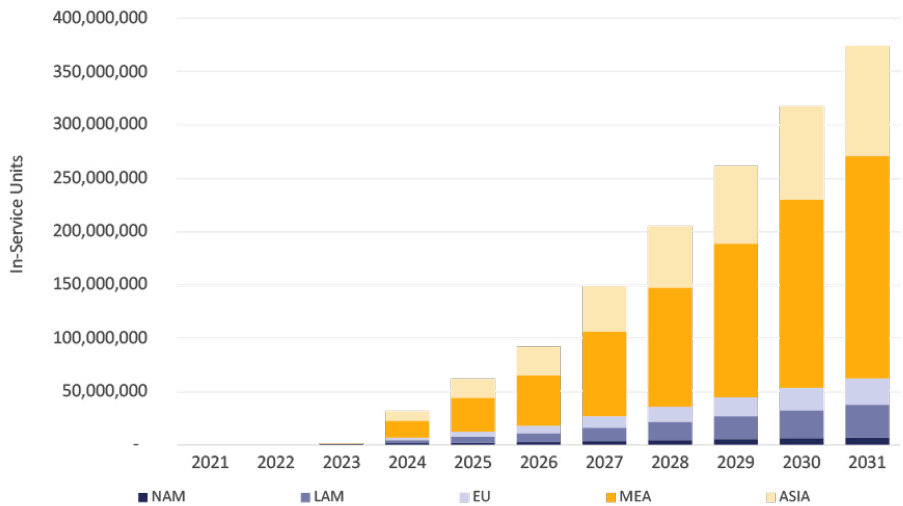
Source: NSR

come to realize the importance of providing connectivity to remote locations on the continent. Satellites are a particularly cost-effective way to reach large numbers of viewers, particularly in regions with widely dispersed populations and challenging environments. Satellite covers all households within the footprint, including those unable to access over the top (OTT) services due to insufficient internet bitrates. This enables the service provider to supply all customers with a similar instantaneous service across regions. Direct satellite-to-device has the potential to become the largest satcom market.

While satcom operators will initially focus on developed economies, NSR's 2022 5G via Satellite report forecasts a sizable portion of the demand to be generated from emerging markets in the Middle East and Africa (MEA), where coverage is underdeveloped, and satellite connectivity will have more room to capture market share. In the long-term, Africa presents a significant growth opportunity.

Satellite connectivity has long been touted as a possible solution to the challenge of providing connectivity in hard-to-reach locations. The dominance of mobile network operators (MNOs) such as Vodacom, MTN, Airtel, and Orange in Africa is undisputed, and has led to innovations and service delivery through MNOs becoming the de facto option for most non-fibre connectivity requirements.

Some countries have launched operational GEO satellites to provide internet services to underserved and remote locations. Indeed, most of Africa still relies on satellite operators to provide connectivity. As such, some countries have come to realize the importance of partnerships with these legacy companies; Vodacom DRC has selected Intelsat to provide its Ku-band satellite services, Free Senegal has signed a deal with Avanti Communications to build a satellite gateway for the latter's Hylas 4 Ka-band satellite, and Orange Mali has also partnered with Intelsat to extend mobile broadband services to rural

areas. All this though, is occurring amongst a sea-change of connectivity from space - the migration from GEO to non-GEO.

Non-GEO satellite operators have gained access to the African market. The low Earth orbit (LEO) constellation model promises a reduced cost structure and higher-performance capability relative to legacy geostationary satellites that operate at much higher altitudes. Pockets of great deal activities exist in some west African countries (Ghana, Nigeria, Senegal, Cote d'Ivoire), East Africa (Kenya, Ethiopia) while Angola and South Africa see decent growth. Demand in DRC continues to grow with recent deals (Intelsat, Eutelsat etc.). Multi-nation deals continue to grow with large telcos operating in multiple countries.

Starlink has been approved in Nigeria and Mozambique and is set to begin operations before the end of the year. Globalstar has obtained spectrum rights to operate in Kenya, Gabon, South Africa, Mozambique, and Rwanda. Telesat also has an existing partnership with the UK's Sat Space Africa to provide broadband connection in selected southern African countries. Liquid Telecom has similar arrangements with Telesat to improve the quality of service in broadband delivery to 10 African countries. In 2019, the Rwandan government together with Qualcomm Technologies and Softbank Group Corp raised a total of US$3.4 billion to finance OneWeb's LEO constellation. Also, SES is providing similar services in Senegal and the Democratic Republic of Congo (DRC) through its medium Earth orbit (MEO) O3b system.

Satellite combined with other technologies like fibre to form hybrid solutions is seen as critical to efforts by industry stakeholders to increase broadband connectivity in Africa. Combining linear TV via satellite and on-demand services via OTT offers content in optimum quality at the convenience of the viewers. Wireless backhaul is also witnessing the entrance of new actors traditionally not involved with satcom. This is the case for towercos or cellular integrators that now see the opportunity of offering new services to MNOs. This trend initiated in Africa, but it is

Total Backhaul Capacity Demand in Gbps
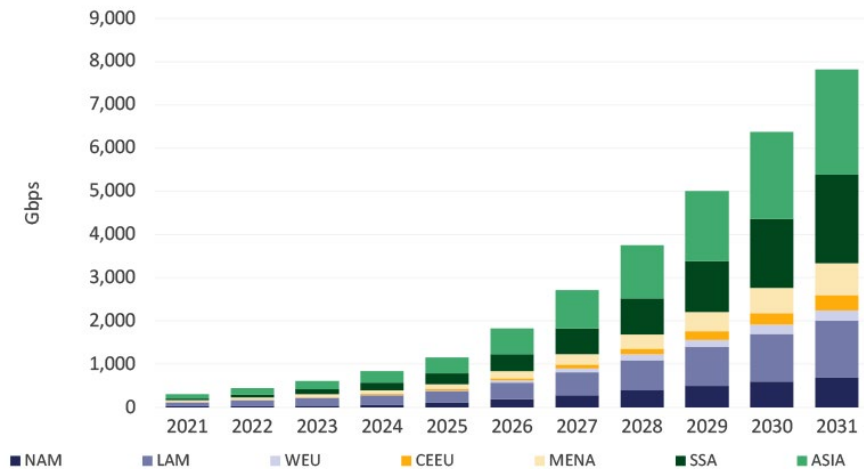
Source: NSR

starting to expand towards other regions.

NSR's 2022 Wireless Backhaul via Satellite report highlights while that most of Africa is performing strongly, there are several critical challenges to solve before unleashing its true potential. Accessing the funding to kick-off deployments has been a major challenge and some satellite operators have decided to take part of the risk themselves through investments, loans or equipment purchases to accelerate network rollouts. Similarly, execution of the deployments is certainly a massive challenge. Reaching rural Africa (unpaved roads, non-existent energy grid, etc.) while keeping cost under control is a hard balance. Extreme pressure on pricing continues, with some operators now owning aging satellites with low utilization rates, they moved to be extremely aggressive on pricing to try to activate elasticities and foster 4G deployments (2G networks can still monetize voice traffic with better margins).

Nigeria hosts the largest addressable market, but it is also a highly contested market. Multiple satellite operators have gateways and landing rights in the country, and various integrators (start-ups and traditional towercos) are going after the same business. DRC continues to be

an extraordinary market for satcom with new deployments taking shape. The Ethiopian market is finally opening. The mix of new entrants, poor coverage and difficult geographies set the perfect scene for satellite to capture opportunities. South Africa and Kenya might have been slower lately, but these markets are ready to embrace LTE, and newly competitively priced capacity will surely unlock growth in the future.

The bottom line

As satellite becomes a cost-effective solution for rural connectivity, a massive addressable market in Africa will offer huge growth opportunities, given the number of unconnected populations.

However, low purchasing power weakens any potential scale. Government and social inclusion programs by development institutions are critical to unlock the opportunity to scale. Operators continue to pursue strategic investments in local distribution and network as a service (NaaS) providers to capture market share: AMN and Intelsat, NuRAN Wireless and Spacecom. Partnerships for managed services continue to rise, helping both operators and service providers de-risk unstable demand (ABS and iSAT). ∎

Robert Bell,
executive director,
World Teleport Association

Growth opportunities in satellite-cellular integration

Satellite and cellular networking technologies have evolved in parallel over decades to create conditions for significant growth in satellite backhaul. Once confined primarily to fulfilling regulatory requirements to serve remote areas

and supporting government disaster relief efforts, satellite backhaul is now widely viewed as a commercially viable business that can help the data-centric cellular industry continue its worldwide expansion.

The World Teleport Association (WTA) surveyed 10 subject-matter experts representing

satellite service and technology providers to discover how satellite and cellular have converged to create conditions for significant growth in the satellite backhaul business, and to characterize the noteworthy trends, markets, and challenges ahead.

Serving MNOs

Prominent satellite backhaul markets today include rural and ultra-rural communities in developing countries, disaster response and peak-hour offload, as well as island territories and remote vacation spots. Technological advances are expected to spur growth in each of these markets.

The primary near-term satellite backhaul markets are in developing parts of the world where terrestrial infrastructure is limited, particularly in rural and ultra-rural areas in Africa, Central and South America, Asia, and the Middle East.

In sub-Saharan Africa, many rural villages are being connected with cellular for the first time. These 'greenfield' deployments are often for 2G services limited to voice and text. The ability to serve these markets rests in part on the availability of low-cost 2G handsets.

For areas with low population density, data services are not profitable, so only voice and texting are available. However, for towns of 2,000-3,000 people, 4G can be installed since there are enough potential subscribers to support a large deployment. For smaller communities, as time goes by and mobile and internet adoption increases, hopefully alongside prosperity, 3G and 4G technologies may become viable.

Technical requirements

4G/LTE standards lend themselves to satellite backhaul solutions, and 5G networks are expected to be even more closely intertwined with satellite. The technical requirements for satellite backhaul tend to be driven by MNOs, who want three things: easy compatibility with their own network architecture; high reliability; and low costs.

Individual MNOs might use multiple network configurations, and satellite service providers must accommodate that. For example, an MNO might use both Layer 2 and Layer 3 IP communications protocols and satellite networks need the flexibility to handle either.

While TDMA remains prevalent in satellite backhaul due to the 'bursty' nature of data services, MNOs are increasingly employing technologies and applications that are not well suited to a bandwidth sharing environment. Thus, satellite service providers need the ability to dynamically shift between TDMA and other solutions such as Single Channel per Carrier (SCPC), in which capacity is fixed and dedicated to a single site.

Satellite service providers must also be able to identify and prioritize network traffic. Voice and signalling traffic are the top priorities, whereas data services are effectively 'best effort.' MNOs tend to be more demanding than consumer broadband customers owing to the basic business model: if a website fails to download, the customer tries again, whereas dropped voice calls are a bigger problem. If an outage affects a small number of residential internet customers, it's not the end of the world - but if a base station with 500 users goes down, you're in deep trouble.

That said, there is variability between MNOs on reliability requirements. For low-cost cellular service providers, reliability rates of 99.5% might be sufficient, whereas the major carriers demand 99.9%+. MNOs typically require

availability rates of 99.999%, and service providers need to ensure they design antennas and networks to meet that. For satellite service providers, meeting MNO stringent reliability requirements means going the extra mile to protect against things like rain fade and jitter.

Competitive pricing

In recent years satellite has shifted from an option of last resort to a more integral part of MNO offerings, but service providers still have room for improvement on pricing. This will likely change as more non-geostationary satellite constellations enter service.

Currently, satellite backhaul prices are driven by the usual market factors, such as volume and minimum quality of service requirements. Variables include service reliability, network efficiency and volume.

Managed services may be the big opportunity for satellite and teleport operators to add value to basic bandwidth provision. MNOs often lack the knowledge to manage 4G and 5G networks over satellite, and many are looking to get out of the business of managing infrastructure altogether. Satellite service providers can work closely with local terrestrial infrastructure operators to create end-to-end solutions for MNOs.

Satellite and teleport operators could help MNOs monitor their networks and troubleshoot problems, bringing different advantages to the table. Most national telecom regulators require that satellite signals land at a domestic teleport, putting local teleport operators on the critical path to backhaul delivery. Teleport operators are often better connected with local infrastructure owners, giving them an advantage in the provision of managed services to MNOs.

Innovations driving growth

Rapid technical innovation and the growing push for interoperability will help teleport and satellite operators capitalize on the continued cellular build-out, from greenfield deployments to upgrades to 4G/LTE and 5G. HTS and VHTS satellites have already dramatically reduced bandwidth costs to expand opportunities in backhaul. Medium and low Earth orbit constellations are expected to further reduce bandwidth costs while significantly reducing, if not eliminating, the latency that has long been an issue with geostationary satellites.

On the ground side, several technical innovations are enhancing satellite network speed and efficiency, improving its attractiveness as a backhaul option. Adaptive coding and modulation (ACM) can help network operators lower the price they must pay, in terms of bandwidth, to protect against antenna pointing errors, interference and, in the case of Ka-band systems, rain fade.

Software-defined wide-area networks (SD-WANs) are another emerging capability that will increase transmission speeds and bandwidth efficiency while reducing expenditure. SD-WAN technology recognizes the type of traffic being carried by a network and dynamically routes it over the most logical pathway, be it terrestrial infrastructure or satellite. Many experts view SD-WAN as the key to true integration of satellite and cellular networks.

The satellite ground segment has fallen behind the space segment when it comes to flexibility. Between rapidly reconfigurable, software-defined satellites and the utilization of different orbits, there is a massive new space layer. The answer is digitization and virtualization of the ground segment.

5G is viewed as a major opportunity to integrate satellite and terrestrial networks. The 3GPP is

helping to create 5G non-terrestrial standards, which, if successful, will facilitate more seamless integration of traditionally distinct satellite and cellular networks.

The changing business case

Several innovations are making the business case for satellite backhaul more attractive. Key among these is virtualization of base stations, which has dramatically reduced the cost of core networks and base stations in remote areas. These virtualized base stations are a fraction of the size of traditional base stations, and in many cases, can operate exclusively on solar power.

Combined with LTE small cell technology, virtualized base stations are helping to close the business case for backhaul solutions in remote areas, independent of universal service obligations. They can be used for roaming services in cooperation with MNOs or to create private LTE networks that leverage over-the-top calling applications like WhatsApp or Skype.

Private cellular networks for enterprise are another major growth opportunity in cellular backhaul. Remote sites are increasingly leveraging edge computing, by which signals are processed locally rather than being transported via satellite to distant servers, freeing up additional bandwidth and easing latency issues. Edge computing applications in satellite backhaul environments include tele-health, IoT, precision farming, and content caching.

Cellular infrastructure sharing is another way to serve remote areas for less cost, providing additional opportunities for satellite backhaul.

Intelligent routing, which recognizes the types of signals being transmitted and directs them accordingly, can create new opportunities for satellite even in urban and suburban areas well served by terrestrial infrastructure. During

peak demand, satellites can be an important safety valve, offloading traffic from stressed terrestrial infrastructure.

The mobile future

For mobile connectivity and backhaul, the future is widely expected to bring continued growth. There will be more people getting connected with more devices in different parts of the world, with video and emerging applications like IoT and connected cars driving demand.

The GSMA's 'The State of Mobile Internet Connectivity 2021' report projects industry capital expenditures will reach $900 billion over the next five years, while governments will continue to invest large sums in narrowing the digital divide. Over half of the world's population, or more than 4 billion people, are using mobile internet today, an increase of 225 million compared to 2019. Growth has been steady in low- to middle-income countries, which still account for 93% of the unconnected population. The number of people with no mobile coverage currently stands at 450 million, with the largest portion residing in sub-Saharan Africa.

The backhaul market is expected to grow along with the broader cellular market. According to Kenneth Research, the global wireless backhaul market is expected to grow to $63.69 billion by 2025, a compound annual growth rate (CAGR) of more than 13.5% from 2016. The IMARC Group consultancy predicts a 12% CAGR for backhaul from 2021-2026, while Mordor Intelligence put the figure at 14% over the same period.

The extent to which satellite backhaul will grow along with the overall cellular market depends heavily on its ability to integrate with the terrestrial grid, especially 5G. While substantial progress has been made, compatibility gaps remain. Teleport infrastructure in many cases remains analogue

based, and thus less responsive to the dynamic reconfigurability requirements of modern mobile communications. Moreover, satellite networks are not well suited to transmitting oversized data packets, known as jumbo frames. Another looming gap is the ability to monitor traffic and network health across all three segments of the overall architecture: satellite; satellite ground; and cellular.

Challenges notwithstanding, most of the experts we spoke with view closer satellite-cellular integration as inevitable. With software-defined networks and intelligent routing, data will follow the path that makes the most sense based on factors including cost, bandwidth efficiency and latency tolerance. That means closer integration, not only between satellite and cellular networks, but also between satellites in different orbits. ∎

Martin Jarrold,
vice president international programme development, GVF

What does space mean to you?

This question has never been more important than it is now. Recognition of the importance of asking, and getting answers to, this question is growing significantly; prompted by various factors. One of those factors is that "Space is – demonstrably, objectively and without doubt – vital in our lives here on Earth."

To understand what space means to humanity we don't need to look back in time to the extremes of the Universe's beginning. We can look much closer to home; between the Karmen line (altitude 100km) and the geostationary orbital arc (altitude 36,000km). This is what I refer to as Earth's useful orbital space; but levels of general awareness of its significance in our everyday lives is very limited, and people have little understanding of the breadth of the work being done in space today.

What on Earth is the value of space?

This is the title of a recent report on global perceptions of space. Research commissioned by Inmarsat provides a snapshot of global attitudes to space and illustrates that people do not appear to understand the role space is already playing in their everyday lives, nor its potential to deliver a brighter future.

The research findings show that 21% of people associate space with aliens, 14% with science fiction and 10% with 'Star Wars' – compared with just 8% for communications & connectivity and 3% for broadcasting & television. The fact that perceptions are being shaped by such popular cultural influences is a wake-up call for the satellite communications industry – our technologies and services are invisible to the majority.

Across a global demographic there are wide variations in perceptions of space; differences arising out of different cultures, different countries, different age cohorts, and differences between business leaders and the public. People over 55 remember the Cold War Space Race, human footprints on the Moon, and NASA's Space Shuttle programme. Meanwhile, young people aged 18-24 are more likely to link billionaires like Bezos, Branson, and Musk, as well as millionaire space-tourists, with space; conflating the technological innovation of the internet age (perceived as good) with billionaires and customer millionaires in private rockets (perceived as bad, and exclusive to a

tiny minority), resulting in mixed attitudes to the Space 2.0. Without realising it, this digital generation is benefitting from technologies that are by-products of the first Space Age, but the innovations are so embedded in everyday life that they're taken for granted.

Space 2.0

We are now witnessing Space 2.0/NewSpace, with expectation of important returns from scientific and engineering advances and direct and indirect economic benefits. The public are not totally unaware of this, but what awareness there is does not come with a sense of wonder and curiosity.

Inmarsat's research highlights that a small core globally are aware of the potential for space to answer many of the world's challenges. 7% said that space can alleviate poverty; another 7% thought space can support the goal of producing enough food to feed our growing population; 11% imagined space will have a role in researching and finding cures for diseases like cancer.

Overall, space-and-satellite is almost invisible, or confusing. People fail to appreciate that without satellites they would not enjoy the levels of connectivity they have come to expect as a daily given.

The imperatives of space and satellite business for Africa

In this second space age, I see a three-fold imperative of space business for Africa: the centrality of satellite communications and Earth observation to the continent; African nations' direct engagement in space business; the contribution of space to wider sustainability issues impacting the continent, as well as

affecting the rest of the world.

Across Africa businesses such as telcos and MNOs, themselves serving enterprises with their own data management applications requirements, have in common exponential growth in their need for access to, analysis and management of, vast volumes of data. This growth is dependent on constant and ubiquitous high-performance connectivity. Moving massive volumes of data within Africa and to regions outside of Africa can be costly, difficult, and unsustainable. Given that fibre and microwave infrastructures have limitations in deployment feasibility, amounting to a significant barrier to advancing network growth and connectivity, the solution is flexible, high-bandwidth, low-latency, cloud-optimised seamless global networking based on satellite connectivity.

Coverage ubiquity is an established facet of GSO (geostationary) satellites. NGSO satellites – existing medium Earth orbit (MEO) and more advanced MEO systems coming on stream, and the growth of various low Earth Orbit (LEO) mega-constellations – add much reduced latency, more ubiquitous capacity, and slashed costs of bandwidth. This constitutes what it takes to accelerate the deployment of universal, reliable, and affordable broadband networks in Africa, and to build innovative solutions to provide always-on connectivity. In even the most remote and challenging locations for connectivity – mining, rail, oil and gas, civil defence, and first responder humanitarian aid – where other networks simply don't exist, satellite is allowing people to access the internet, private data networks and cloud services from anywhere, including while on-the-move.

Joining the club of space faring nations has always been a very expensive business. However, the advent of NewSpace has set in train a countervailing trend, diluting the

barriers to entry. Africa, 20% of the Earth's land mass, is endowed with a true wealth of natural resources that is not well reflected by its widespread problems of poverty, inequality, and unemployment, and associated political instabilities.

Of course, some African countries have been active in the space economy for years, and those with established space agencies have moved ahead of the countries where governments have not instituted funding for such activities. Such prioritising of funds has usually come from a recognition that space activity brings socioeconomic benefits through, for example, satellite telecommunications infrastructure or monitoring natural resources from space, and a political will to grow domestic capacities in satcoms, Earth observation (EO), and navigation.

The second sub-Saharan African country into space, after South Africa, was Nigeria. Its space agency, NASRDA, was the continent's leading light in satellite remote sensing with the launch of NigeriaSat-2 and NigeriaSat-X, each carrying payloads of imagers for EO applications such as resource management, mapping and agricultural and disaster management.

For Africa, satellites play a vital and increasingly important role in enabling broadband communications, expanding access to the internet, and monitoring and measuring innumerable facets of everyday life, gathering, managing, and analysing data generated by the bustling urban mega-conurbations, from industry, from agriculture, and from the remoteness of the rain forests and coastal waters.

Now, more African nations have engaged in space business, with around 20 having space programmes at various levels of development. With NewSpace manufacturing it has already become increasingly viable for lower-income nations to design and manufacture their own small satellites to serve broadband communications, navigation, and Earth observation.

One of the more recent sub-Saharan countries to reach orbit was Ethiopia, and more recently still came the beginning of the space ambitions of Mauritius in the form of a nanosatellite built to collect climate change data, and for weather forecasting, road traffic management, and maritime surveillance of Mauritius' Exclusive Economic Zone.

As elsewhere in the world, each African country enters space business to meet its own policy objectives and national requirements (in terms of enhanced communications capabilities, access to nationally relevant Earth observation/remote sensing data, etc.), and there can be a myriad of facets to this. Equally, becoming a member of the club of space faring nations can be a matter of national prestige, or a matter of competing with neighbouring states.

In terms of national policy objectives, countries have always desired to leverage their national rights to ITU coordinated orbital slots, historically, and most commonly, related to increasing resources to additionally contribute to bridging the national digital divide.

The satellite design, build, and launch environment is now very different to the commissioning, building and launch of bespoke design, multi-metric tonne, geostationary spacecraft the size of a double-decker bus. The major change has been to an affordable, entrepreneurially oriented, domain populated by many small-scale start-ups and spin-offs from academia. A plethora of 'smallsat' manufacturers employing short development cycles, small development teams, off-the-shelf components, miniaturisation technologies, mass-production, and standardised form-factors, approaches akin to factory production lines.

POWERING THE NETWORKS THAT CONNECT PEOPLE EVERYWHERE

LEARN MORE AT HUGHES.COM

Countries may desire their own satellites not only for their functional purpose, but to develop the advanced technology base of their higher education institutions (or even, these days, their technical schools) and promote improvement of the population skills-base in STEM (science, technology, engineering, and mathematics).

Climate change and sustainability

At the start of the United Nation's Cop27 climate summit in Egypt, a World Meteorological Organisation report set out how record high greenhouse gases in the atmosphere are supercharging extreme weather with the past eight years being the eight hottest ever recorded. Africa is more vulnerable than any other continent to the climate crisis. Seemingly all the negative effects of global warming are amplified. Africa loses up to 15% of GDP growth a year to the destructive forces of climate change; extreme weather threatens life, food, and water security.

African nations engaging in space business for communications and remote sensing have been alerted to the role of satellites in combatting climate change. Inmarsat, partnered with Globant, has quantified the per annum CO_2 tonnage that three major sectors could save by using satellite communications technologies. Satellites are helping agriculture, transport, and energy to identify efficiencies and decarbonise to the tune of 1.5 gigatonnes of carbon per annum – the equivalent carbon output of the UK, France and Germany combined. There is still more that could be achieved, and the expansion of the African continent's satellite resources devoted to agricultural monitoring,

fisheries and forestry, urban planning, etc., can only add to the capacity for effective environmental monitoring.

Space needs better PR

Industry concern about perceptions of space and satellite is increasing, so much so that there are now conference events exploring the issue. Included in the Secure World Foundation '4th Summit for Space Sustainability' programme was a panel with communication and public relations experts looking at how people and the media perceive space, and asking such questions as: "how does the world outside the space bubble perceive our domain?" and "what can we do to promote our own sector in a productive, modern and fruitful way?"

The space and satellite industry has this public relations problem at the time when we need to be encouraging more young talent into STEM, and to enter the space industries, bringing with them their aspirations for what space could enable us to achieve.

Space needs more talent

GVF – and its partners, SatProf and the SSPI – has developed a series of Space Business Qualified (SBQ) Fundamentals courses as the first part of a comprehensive solution to the staff recruitment, onboarding, and retention needs of the space and satellite industry.

SBQ is a set of online courses and certification ideal for people new to the space and satellite industry or those looking to deepen their knowledge, providing a comprehensive understanding of the business of space today and tomorrow. SBQ offers a series of online courses, taught through a mix of self-paced, interactive tutorials, videos, illustrations, and

testing to validate understanding and reinforce learning on topics including launch, orbits, LEO, MEO, and GEO, antennas, signals, and links – all with a business perspective.

Recently made available for immediate enrolment is course SBQ405: Space Business – Finance, Legal & Regulatory, the fifth and final course in the Fundamentals series following SBQ401: Fundamentals of Orbits and Getting into Space; SBQ402: Spacecraft Fundamentals; SBQ403: Space Communications Fundamentals; and SBQ404: Space Business – Markets. Following on from the Fundamentals courses will be more specialised courses in satellite communications, Earth observation and spacecraft and launch. A free of charge introductory course, SBQ400: Welcome to the Business of Space is available. ■

Martin Coleman,
partner, COLEM Engineering

Can we connect a continent?

I am reminded by the numerous articles and debate on the digitalisation inroads made in Africa. Yet, Africa remains the most disconnected continent · a communications 'black-hole' in many areas. Why? The solutions are available, yet division and proprietary systems within the communications industry still rule. No wonder progress is slow…

The real innovation for today's communication systems was the internet, the creation of networks and IP, the routing and addressing of packets of data. The problem is that communication is seen to have two sides: terrestrial and satellite.

The arguments about spectrum remain between terrestrial and satellite, each at loggerheads with each other over how to share or reorganise spectrum. Additionally, disagreements over standards and proprietary versus open, remain. The satellite industry still talks in terms of proprietary or bespoke products and services.

Most conversation between the mobile and satellite industries is still entrenched in backhaul. That is good business and should be continued, as satellite is a terrific way to service this need. It should, however, be noted that the mobile industry only uses backhaul via satellite when it must · it is not the preferred method of operation due to cost and complexity. About 1.5% of total mobile network connectivity utilises satellite backhaul. There is, of course, a significant difference in revenue generation between the two industries which is why, when looking at the satellite industry's business, backhaul accounts for around 20% of revenue.

But the conversation needs to move on. We know about backhaul and the continued role for satellite. This just brings home that each industry needs each other to operate. Satellite needs to push the conversation forwards and be the technology and role innovator. Through the auspices of 3GPP and the technology innovations of some satellite operators, that

> "The problem is that communication is seen to have two sides: terrestrial and satellite."

conversation is starting to move forward. We know that 5G broadcast is available, but we rarely talk about it. Yet, that is really something the satellite network can deliver, and now.

It should be remembered that users are application based, not service based - and the devices we use are not the problem either. Around 2015/2016 the term 'hybrid' was "the new way forward" for communication. Odd: for the past 50+ years of my career, communication has always been a single entity. There are no boundaries between methods and technology, terrestrial or satellite, just routes to connect people and systems.

To be part of the world's increasingly digital economy, individuals and businesses need reliable, high-speed internet and cloud access. World organisations and national governments across the globe know this, and work with the private sector to improve access to gigabit broadband. Indeed, UNESCO and the ITU Broadband Commission for Sustainable Development have set a target of connecting 75% of the world's population to high-speed internet by 2025. To reach this ambitious, but possible, target, developing countries will need to be the area of focus and no other is more important right now than the continent of Africa!

Sub-Saharan Africa has the lowest access to high-speed internet - less than 30% of the population use the internet at all and, in most cases, it's not high speed. This is compared to some 55% of the world's population and 85% of those in Europe and Central Asia who have minimum download speeds of 60+Mbps and upload speeds of 15+Mbps.

The difference in these figures is striking and has a negative economic impact for just this one area of Africa - a region which contains many of the least developed countries in the world. Widespread, reliable, high-speed connectivity is vital to support economic growth and development. Without it, a region such as this simply will not have access to the same opportunities that others take for granted.

Where are we today?

The arguments around spectrum remain critical to the way we build out both terrestrial and satellite infrastructure. Each region of the world has different priorities and so spectrum decisions must be made by balancing the practical use against the services needed. Sharing needs to be avoided until smarter technology is truly available.

Specific areas of spectrum must be available to satellite. That equally applies to terrestrial. But there is plenty to go around. It is crazy that we manually allocate spectrum through laborious procedures and the four-year rolling process of WRC! We must be more dynamic than this, four years is way too long. Our industries must do better than this.

Some good news is that the communications industry has successfully managed the transition of C-band use to 5G. Commercial objectives have been met for both terrestrial and satellite, and management of 5G interference incidents are being resolved by satellite operators and affected clients. This has worked so well that we can apply this to all bands and manage the spectrum way forward in a practical and proper manner.

We now have terrestrial versus LEO versus MEO versus GEO. Again, these are often seen as competitive, yet this is a real opportunity. Adding more useable layers to the communication structure is a key ingredient. Cloud infrastructure is also available; that must be another vital ingredient to solving connectivity and quickly using software defined

systems can be implemented to meet the demands of user growth.

5G - the catalyst?

The onus is squarely on the satellite industry to deliver their role in 5G.

Satellite can easily deliver to the cell tower. Simpler ground infrastructure can be utilised until we have truly functional and cost-effective flat panel antennas. Satellite can enhance cell tower connections both nationally and globally. Remember my reference to 5G broadcast earlier - this is where satellite can deliver.

Satellite should embrace the cell structure of mobile. Consider an aircraft. Scrap the idea of using a particular airline's service; all that logging on, paying by card and with different rates for each airline operator. Simply consider it a 5G mobile cell or several integrated cells, depending on size. Note, this simple concept can apply to anything from a building to a cruise ship.

As soon as you make everything a continuation of the mobile cell structure, you have immediately met the new requirement of true service provision. That is it. The user simply turns on their mobile phone or device in the usual way, including integrated billing.

The real step change here is simple. The service should start and stay with the mobile operator, who can set the packages up for the user. Packages can range from pay-as-you-go through to fully inclusive and can be integrated as part of a fully inclusive deal or be taken up as extras, as and when the user wishes. The point is, the mobile operator sets the ball in motion; it has the processes already, it does the billing and thus makes it simpler for the user. All services that use satellite become part of the common way we use our mobile devices. The mobile operator pays the fees to satellite

operators, airlines or entities used, which feeds back into the equipment supply chain for the aircraft or other vertical...

The result? Terrestrial and satellite truly working together to supply an integrated connection for users. Seamless, simple, and managed!

How do we connect Africa?

A decent plan and some basic rules are needed if we are to connect the planet, all 8 billion of us. Africa must be the priority.

We have fibre, wireless, cell (4G & 5G), satellite (LEO, MEO & GEO) and new possibilities with HAPS (High Altitude Pseudo Satellites). All these methods will be needed to achieve the goal of connecting Africa. Satellite cannot supply individual terminals everywhere, what with the need to connect with all three orbits – this is just too expensive to consider.

The concept to achieving this goal of global connectivity is to mix the technology. Fibre, wireless, cell and satellite will all be required in all capital and major cities throughout the continent. Gateway satellite ground stations equipped with common agile terminals that can be used for all satellite orbits – LEO, MEO, GEO, etc. - is key.

To enable this connectivity to spread to suburban areas, a combination of fibre, wireless and cell would be optimum, with all cell towers fitted with satellite agile terminals. Smaller outlying towns and villages could be best served by cellular with satellite, and local distribution via wireless.

For main transport routes and remote areas, rail and road can be connected by cell, with satellite and wireless for local distribution where necessary. All remote areas can be served by individual satellite terminal or vehicles fitted with comms-on-the-move (COTM) equipment.

"Everything is still in terms of mobile and satellite being separate industries. An industry is something that has standards, processes and is automated in its operation. Something the communications industry is, or certainly, should, be. Thus, both mobile and satellite are really branches of the communications industry."

We can provide reliable mobile and broadband networks, and if we standardise the infrastructure, the system can easily grow. With so many layers of communication available, all can be put into immediate use. Together.

Cell towers can be connected from space, high altitude, and the ground. Wireless networks can cover wide areas or just a single building. We can manage spectrum. Not share, but truly manage and set sensible working boundaries so that all the technology can be used simultaneously. We can utilise cloud-based software defined infrastructure and transmitted and received signals from space over IP.

Smart networks exist and they are getting smarter with better automation, machine learning and artificial intelligence. Therefore, what is stopping us from achieving the goal when we have a plethora of technologies to plan with? We need some basic rules or structure on how we bring these methods together.

Firstly, we manage spectrum. 5G and C-band management has worked well and paves the way for all spectrum use. Both mobile and satellite industries must rationalise their thinking and make spectrum management work. We must be clever with the resources we have and allow our spectrum to be better used, dynamically managed and enable the re-use of portions for numerous purposes, not simply dedicate it to either satellite or terrestrial. That must stop.

Final thoughts

Satellite provides a vital layer of communications providing us all with safety, disaster recovery, medical/healthcare, tracking (aero, maritime, agriculture, freight/fleet, trucks/cars) and, of course, navigation through the various GPS services available. Satellite delivers this totally and is a high reliability network for such cases. That must stay in place, at all costs!

However, none of the above applications grow the satellite business; from a harsh business point of view, there is a real need to strengthen that business model. The satellite industry needs to up their game to allow this vital piece of the humanities puzzle to exist.

5G is the opportunity. Satellite missed out once at the 3G inception and backhaul is still the headline. Innovation is not yet fast enough to make 4G/5G better, or to help connect and make mobile and broadband stronger, more affordable and for everyone.

Everything is still in terms of mobile and satellite being separate industries. An industry is something that has standards, processes and is automated in its operation. Something the communications industry is, or certainly, should, be. Thus, both mobile and satellite are really branches of the communications industry.

We have the technology now.

We need to connect Africa, now! ■

Alastair Williamson,
CEO, Wyld Networks

The shortage of water is becoming a critical issue around the world, but across Africa in particular. And with the population growing, the Economic Commission for Africa predicts that by 2025 close to 230 million Africans will be facing water scarcity, and up to 460 million will be living in water-stressed areas.

Agriculture is a main source of income for almost half of the continent's citizens and it is also the largest user of freshwater. African countries are also reliant on agriculture to maintain and increase gross domestic product and to preserve food security for citizens. With droughts increasingly becoming the norm in recent years, the focus is on helping to solve water scarcity with responsible water use for farming. One approach is to introduce technologies that support sustainable irrigation, to help prevent water sources from being depleted in a way that will negatively affect water availability for both current and future generations. This means reducing water wastage, consumption and pollution, while irrigating only to the demands of the planted crop.

Water is often wasted due to unnecessary irrigation (over irrigation) and poor drainage causing runoff. Accurate irrigation scheduling requires continuous soil moisture monitoring to make the informed real time decisions.

Until recently, remote regions with no access to reliable wireless connectivity relied on physical site visits to collect soil moisture data. But now, with terrestrial and satellite connectivity, it is possible to bring continuous data monitoring to remote locations. This allows soil sensors to send their latest data so that users can make

informed irrigation decisions based on near real-time, reliable moisture readings. When combined with environmental data including temperature, humidity and rainfall, the information can also be used to predict crop water demand and even monitor metrics such as chill units to help predict flowering in many crops.

Over the past few years, Wyld Networks has been working with South African company DFM Technologies to connect soil moisture and weather station sensors to low Earth orbit (LEO) satellites. The soil probes measure moisture content and temperature readings at six depths in a soil profile as well as measuring surface temperature.

Data collected from DFM sensors are transmitted to terrestrial networks if available or to the LEO satellite network via the Wyld Connect range of low-power, sensor-to-satellite LoRaWAN® terminals and modules. With 100% global coverage, it means that this data can be collected from even the remotest of locations. Through continuous soil moisture and environmental logging, farmers can prevent over and under watering, reduce unnecessary crop stress, promote root development and improve fertilizer uptake.

DFM is currently working on a number of exciting projects to improve irrigation and reduce water scarcity. For example, it has helped farmers to reduce pasture water requirements and cut carbon emissions associated with irrigation, to meet carbon neutrality goals.

In another project, DFM has implemented precision irrigation to avoid water and fertilizer wastage as well as reduce plant stress on a strawberry farm by only watering when needed. By using continuous data and taking the guesswork out of irrigation scheduling, the farm has achieved a 50% saving on water for irrigation. Another big benefit is that soil health is so much better and fewer plants are lost to soil pests.

Date palms have expansive and complex root systems with four zones, which require accurate irrigation management. The first zone is a respiratory root system, while the second zone is used predominantly for nutrient uptake by the palm. The third root zone is focused on water uptake and reaches from 1.5-1.9m in depth. Deeper than 2m is a fourth zone, which is highly adapted to the depth of the water table. DFM has produced solar powered soil moisture probes made up of 18 individual sensors to detect soil moisture at every 10cm. By collecting this data via terrestrial and satellite links, irrigation can be monitored and controlled with pinpoint accuracy and tailored to the requirements of each specific root zone.

Satellites are the only way to provide 100% global coverage, but there is a range of connectivity options across licensed and unlicensed spectrum.

Wyld, uses LoRaWAN, the Low Power, Wide Area Network (LPWAN) protocol in the unlicensed spectrum. LPWAN communicates at significantly longer ranges and with a much lower power consumption than cellular or WiFi options, and LoRaWAN enables affordable, seamless connectivity to private terrestrial networks as well as satellite networks.

The LoRa Alliance® - an open, non-profit association with the mission to support and promote the global adoption of the LoRaWAN® standard – recently upgraded its guidelines to include Long Range Frequency Hopping Spread Spectrum (LR-FHSS) data rates for the LoRaWAN® standard. LR-FHSS enables reliable low power data links directly from sensors to satellites. ∎

Looking ahead: The sensor-to-satellite 'revolution' is still in its infancy, and we have only just scratched the surface of its potential. Importantly, it overcomes the two key barriers – global coverage and affordability – to help address some of the more demanding environmental and agricultural challenges lying ahead. Away from farming and irrigation, Wyld is also working with Swiss-based Miromico that is involved in other satellite IoT projects in Africa. These include:

· Tracking of raw material supply chains from the mine to the electric car factory using multiple wireless technologies
· Engineering and component supply for high-tech safety equipment used in mining
· Wildlife tracking across different countries, regions and national parks, to track animal species from tiny birds up to rhinos and elephants.
· Tracking and Trace for cars and goods
· Custom large-scale smart-farming and predictive maintenance system.

Sensor-to-satellite is also starting to have a major impact on energy and utilities. For example, oil and gas pipelines cover millions of kilometres across the world and are vulnerable to leaks and corrosion caused by weather erosion, natural disasters and usual wear and tear.

Collecting data from these remote locations and over huge distances often requires energy companies to take in-person measurements if there is no wireless connectivity. But with LEO satellites that can collect data from IoT sensors, issues can be identified in near real-time to avoid operational problems and unplanned downtime. By enhancing network visibility, through collecting data, monitoring and conducting predictive data analytics it is possible to detect faults and manage utility assets and networks more effectively.

With global reach, satellite connectivity is transforming the future of the IoT and opening up exciting opportunities across Africa and the rest of the world.

Dawie de Wet,
CEO of Q-KON Africa,
chief Engineer of Twoobii

We need to note that 2022 was the year that marked the beginning of a new paradigm. During 2022, the opportunity was created for satellite technology to transition from being a connectivity option of 'last-resort' off-grid rural applications to taking a front row seat as a primary connectivity option for multiple applications.

With the NewSpace developments in LEO, MEO and GEO, satellite services have exorcised the myths that satellite connectivity is slow, expensive and has a latency problem. Services being introduced by OneWeb, LightSpeed, mPower and others have firmly established an updated expectation of what satellite connectivity can provide.

Research done by Statista and published in February 2021, shows that nearly 56% of the population in sub-Saharan Africa has been reached by fibre networks. In absolute numbers, 620 million people now live within 25km of an operational fibre optic network node. That still leaves some 44% of the population of sub-
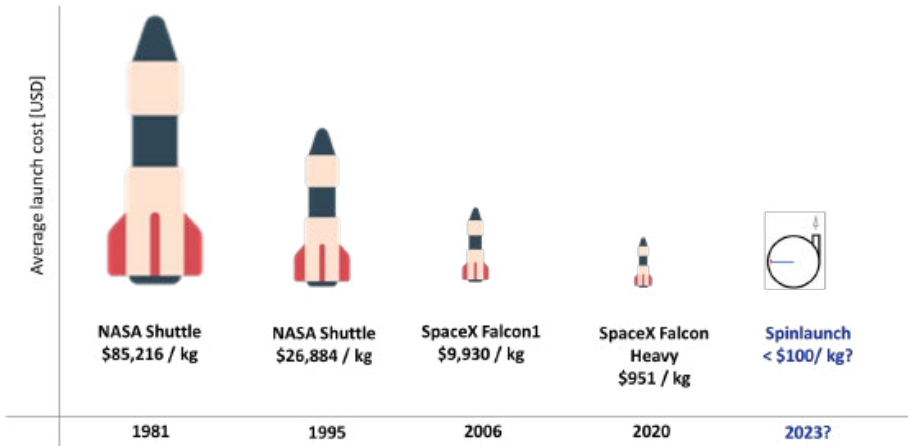
Saharan Africa having to rely on mobile networks or local wireless ISP services instead.
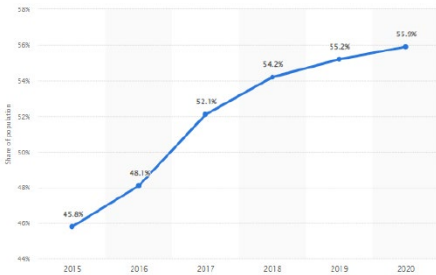
Africa's connectivity needs are still largely un-serviced, especially if we exclude niche and specialised services for the aero and mobility sectors. It is this un-serviced market that has the potential for industry innovation and for implementing the new space services that have taken root during 2022.

Spinlaunch have continued with their innovative centrifugal launch technology to further reduce the $/kg launch costs. They have now successfully broken through the symbolic $100/kg barrier. This represents a massive drop from the NASA Space Shuttle cost of $85,216/kg back in 1981 and is just 10% of the current $981/kg cost of SpaceX Falcon Heavy launches.

During 2022 the discussion moved on from "if" to "when." It is no longer a question of "if" LEO and MEO services will be feasible and enter the market; rather, it is now simply a question of "when" these services will enter the market.

The traditional GEO satellite space industry has moved from a 'spectator' role to being an active participant. Eutelsat, SES and Intelsat have all announced partnerships, collaborations or development projects with various LEO

NASA Shuttle $85,216 / kg	**NASA Shuttle** $26,884 / kg	**SpaceX Falcon1** $9,930 / kg	**SpaceX Falcon Heavy** $951 / kg	**Spinlaunch** < $100/ kg?
1981	1995	2006	2020	2023?

technology providers.

Notably, Starlink maintains its established position as an autonomous NewSpace satellite operator with a direct-to-market channel approach. During 2022, licenses were granted to Starlink for operations in Nigeria and Mozambique with services expected to be active from quarter four in 2022 or early 2023.

Developments have also continued in the GEO constellation field, with Viasat and Intelsat both developing next generation, software-defined satellite constellations. Viasat initially planned to launch their first Viasat-3 satellite in quarter four of 2022 over the Americas. This would have been the first phase in the implementation of a global signal coverage network provided by three satellites, each with an estimated capacity of 1Tbps. The launch of the first Viasat-3 satellite is now scheduled for early 2023.

These are just some of the key NewSpace waypoints that have already been reached in 2022, all of which mark turning points in the New Space industry discussion. 2022 has proven to be the pivot point.

For Q-KON Africa, 2022 was the year we successfully reached capacity on phase 1 of the Twoobii Smart Satellite Service. Our Smart Satellite Services product strategy has proven to be very successful with an excellent response from both the financial sector and enterprise users with SD-WAN applications. As a Smart Satellite Service, the Twoobii platform can support real-time applications such as video surveillance, and also offers customer-friendly, content-aware smart billing models – and that's a great cost-win for end users.

Twoobii is now the preferred service provider for four of the largest commercial banks in South Africa for point-of-sale (POS), ATM and bank branch connectivity. The Twoobii team has demonstrated our understanding in this market sector, and we look forward to start introducing NewSpace services into the Twoobii Smart Satellite Services portfolio.

2022 has also contributed to our experience and updated understanding of the business case metrics that will be required to successfully deliver NewSpace, Smart Satellite Services to the African market. ∎

Looking ahead: While being aware that we can't simply predict or forecast the future, we can share.

Firstly, the continued development and introduction of NewSpace services leading to inaugural commercial activations and a possible first customer network deployment. In particular, OneWeb, SES mPower and Starlink will commence service deployments during 2023 - initially at market demonstration levels, then rapidly progressing to full commercial rollouts.

Secondly, the industry will start adapting to the new technology landscape through universal changes to business at all levels. The drive to successfully deliver NewSpace services in Africa will oblige mainstream satellite operators such as SES, Intelsat and Eutelsat to review and reconsider their positioning as wholesale providers, to licensed regional service providers. The availability of space capacity at Tbps-levels will enable different industry structures and start addressing the current dilemma; namely, that satellite services are too small for the large telcos and too big for the regional service providers.

Doreet Oren,
senior director product and solution marketing, Gilat Satellite Networks

Gilat Satellite Networks globally executes its vision of calling for the right of all people to be connected. Sub-Saharan Africa is an important continent where Gilat is proud to enable broadband connectivity to the most remote regions.

The COVID-19 pandemic taught us and emphasized the dramatic difference between those who are connected and those who are not. The inequality and digital divide became more pronounced as areas lacking connectivity suffered more in all walks of life.

Online health services were not available to those who are not connected, and the lockdowns which attempted to control the spread of the virus affected business, education, and social interactions. The ability to maintain such basic activities was severely hampered or lost completely due to the lack of broadband connectivity. We now understand even more clearly and hear additional voices declaring internet connectivity as a basic human right.

During 2022 Gilat saw a surge of post-COVID-19 activity in establishing reliable, affordable communication in rural areas. Gilat is the global leader in cellular backhaul over satellite with about 75% market share in 4G networks.

Gilat works closely with telcos and mobile network operators (MNOs) to extend terrestrial networks beyond the reach of fibre to areas where it is not feasible or prohibitively expensive to lay out terrestrial infrastructure. Satellite backhaul provides a cost-effective solution to rapidly grow the network to reach the unserved or underserved.

In serving sub-Saharan Africa, Gilat is a longtime partner of Africa Mobile Networks (AMN). AMN operates the largest satellite cellular backhaul network with Gilat's SkyEdge II-c platform enabling coverage extension to a dozen countries in sub-Saharan Africa. The network serves Tier-1 global MNOs allowing reach to new subscribers and better service in the most rural regions.

This year, with the growing demand in Africa, Gilat collaborated with a cellular/wireless network provider, who already operates in several countries in Africa. Powered by Gilat's cellular backhaul over satellite solution, additional coverage will be provided to the rural regions in Africa.

Furthermore, we have been working closely with our partner, Intelsat, and closed a multimillion-dollar deal to answer the connectivity needs in the DRC. Congo is the second-largest nation

"Online health services were not available to those who are not connected, and the lockdowns which attempted to control the spread of the virus affected business, education, and social interactions. The ability to maintain such basic activities was severely hampered or lost completely due to the lack of broadband connectivity. We now understand even more clearly and hear additional voices declaring internet connectivity as a basic human right."

in Africa with over 90 million residents, with a tremendous need for connectivity, and where a terrestrial solution is not an option. Here, Gilat's SkyEdge II-c platform will provide cellular backhaul over satellite starting with about 1,000 remote sites of a Tier-1 MNO.

Gilat's cellular backhaul technology is widely chosen due to the following factors:

- Fast and reliable for cellular coverage extension, emergency response and business continuity
- End-to-end encryption with patented layer 2/3 embedded acceleration achieving 1Gbps to the handset
- Enabling advanced edge computing for IoT aggregation and caching in remote 5G networks
- Satellite network integration with cloud infrastructure and SDN/NFV core for simplified operations
- SkyEdge IV Aquarius VSATs with > 2Gbps throughput for demanding 5G applications
- Extending 5G private networks to any location

Gilat has been leading the satellite communication market for over 35 years, with innovative technology operating in all regions of the world. The cross section of global expertise, local presence, vast experience working with MNOs and outstanding support and delivery capabilities makes Gilat an ideal match for its partners in Africa. ◼

Looking ahead: The satellite industry is undergoing tremendous innovation and change. The launch of non-geostationary (NGSO) constellations, very high throughput satellites (VHTS) and highly configurable software defined satellites are offering the industry unprecedented increases in bandwidth and flexibility. But while these new satellites and digital payloads offer a profound step up in capability, they are also introducing far more complexity, and growing the need for ground-breaking deep technology and tight integration between ground and space.

Disruptive innovation is required to provide the needed higher throughput and flexibility. A major enabler of this revolution is the ability to provide orchestration and harmonization between the ground equipment and the whole new software defined space. This was the driving force in the development of SkyEdge IV, Gilat's latest ground segment technology. SkyEdge IV is a multi-orbit, multi-service platform that enables, together with software-defined satellites (SDS), the creation of programmable software-defined networks (SDN) that support on-the-fly changes to optimally address dynamic network changes.

SkyEdge IV is a multi-service platform providing solutions for multiple applications required in sub-Saharan Africa and the MENA (Middle East North Africa) region. Gilat sees an increase in the need for cellular backhaul over satellite to reach the rural and ultra-rural regions and expects to continue to provide this required need for connectivity. Gilat also sees a renewed interest in education projects, sponsored by governments and others, to increase school connectivity and promote e-learning opportunities for a growing need of the population.

Gilat has already teamed up with the satellite operators such as SES and Intelsat to deliver on the promise of the next generation of satcom. Gilat's SkyEdge IV platform was selected by SES as the ground segment for the O3b mPOWER constellation and is working together with SES to bring upon the successful launch next year. Gilat is excited to be working next year with its partners to fulfill its vision of the right of all people to be connected.

Libby Barr,
COO, Avanti Communications

A quarter of the world's population is predicted to live in Africa by 2050, and Avanti is perfectly placed to unlock this growth. However, connecting those in ultra-rural areas presents its challenges. These locations tend to be off the grid and miles away from infrastructure.

When it comes to rural connectivity, one of the biggest barriers MNOs face is a lack of infrastructure and terrestrial networks. Traditionally, large telecommunications towers are used to connect dispersed populations, but this takes time, it's expensive, and requires a level of infrastructure ultra-rural areas cannot support. Avanti has introduced connectivity to hard-to-reach areas by partnering with companies to install small, more efficient towers on the outskirts of remote villages which are designed to cover a couple of kilometers, in contrast to the large towers that can cover 50km.

Our partnership with Clear Blue Technologies has significantly accelerated the rollout of low-cost connectivity solutions in some of the hardest-to-reach areas across sub-Saharan Africa. In the past year we have connected 550 sites and we plan to connect a further 2,000 in 2023 covering Nigeria, West Africa, South Sudan, Ghana and South Africa. We are also the only Ka-band satellite provider with gateways in Nigeria, Johannesburg and Senegal.

In 2023 we will see the continuance of many of the trends that have existed over the last few years. It is likely we will see consolidation, particularly between the larger GEO operators with significant mature broadcast and C-band services. We also anticipate further consolidation as operators start to move down into channel to get closer to customers and develop solution and distribution capabilities. There is a large amount of existing and planned satellite capacity which may be hard to monetize. This is an area where we believe Avanti holds a critical capability lead for our key market sectors in carrier, education, and government services and, in particular, in Africa.

In addition to our growth in African infrastructure, capacity, and coverage, 2023 will see significant increase in deployments of our EXTEND offering, a managed service for rural connectivity. Avanti has huge internal focus on continuing the development of this service throughout 2022, ensuring we have the right systems, processes, people and partnerships in place in country to support our customers. Managed services for rural Africa are a challenging solution to crack, but we have a proven service which is scaling and poised for huge growth. ∎

Looking ahead: The first part of 2023 sees the expansion of our network with our own HYLAS fleet, through the commissioning of our Senegal gateway, as well as serving new capacity across West Africa to Senegal.

This will be Avanti's third HTS gateway in Africa. Our approach as a Ka-band HTS operator with African gateways for African capacity on our fleet is unique, bringing huge benefits to our partners and end users in terms of technical integration, security, and geopolitical aspects.

Our new partnership with Turksat will expand our coverage even further into Northern Africa and the Horn of Africa, as well as adding depth of capacity to our existing African footprint.

What sets us apart, in addition to our technology, is the presence we have on the ground. We have offices and expanding teams in Kenya, Nigeria and South Africa which means we can react quickly to local opportunities.

Paolo Pusterla,
managing director EMEA, ABS

At ABS, we are seeing some growth opportunities in Africa. We have actively set up managed platforms in close association with our partners in the region to provide quality and effective services to MNOs and service providers across the continent.

We have also managed wherever possible to offer solutions both over Ku and C band

"We see more collaborations and synergies as a way forward. We work closely with partners and vendors across the value chain, notably hub vendors and system integrators. We are ready to invest to deploy hub platforms in various African countries to create domestic networks that could be used for government and mobile operator applications."

payloads, thus maintaining legacy installed base and at once keeping high quality and availability of service.

The COVID-19 pandemic has brought almost a paralysis to many countries; the lead time to deliver equipment and access to remote facilities has reached untenable levels. More recently business has restarted but there is still some inertia in the supply chain and in the logistics.

Some key markets seem to be emerging with important opportunities particularly, Ethiopia and Mali. We also see school/education programs gaining momentum across Africa. Backhauling continues to be a growing market.

We see more collaborations and synergies as a way forward. We work closely with partners and vendors across the value chain, notably hub vendors and system integrators. We are ready to invest to deploy hub platforms in various African countries to create domestic networks that could be used for government and mobile operator applications.

At ABS, we are keen to deploy our resources in emerging markets like Africa, India, Indonesia and the Philippines.

For Africa, we have enough capacities on Ku and C frequencies to meet increased demand for wide beam coverage. We shall continue with our strategic partnerships to build local and international gateways to connect schools, hospitals, government entities, NGOs and MNOs. ∎

Looking ahead: Over the last few years, we have seen an oversupply of capacities in Africa thereby putting pressure on prices. The big operators have been running short on wide beam capacities recently which is forcing a rise of prices in the industry for such services.

Carrier-grade type of services will remain key for MNOs and high-end service providers, whereas some lower segments of the market will be captured by the NGSOs' services.

ABS still believes in the quality that GEO satellites can provide to service providers to serve the needs of corporate and governmental networks in the continent.

Alexandre de Luca,
president enterprise, energy and
government, Marlink

Our experiences and observations of the satellite market in Africa over the last 12 months can be summed up as a continued development of the trend observed since the pandemic.

Enterprise users, whether they are NGOs, IGOs or energy and mining companies are combining increased demand for higher throughput with a move from physical, local assets to cloud-based network solutions.

Companies and their employees operating in remote areas are seeking to maintain a high degree of connectivity but reduce their exposure to large, complex installations. Access to the internet is key to the efficiency of their operations and the ability to use heavyweight applications via the network brings them a 'lean advantage.'

Installing IT environments in remote locations comes with layers of risk; for oil and gas or mining customers, downtime is dollars and for NGOs and governments, uptime is everything. For remote users who rely on contact for safety and operational reasons, a watershed has been passed in terms of what satellite users expect from connectivity providers and how the providers respond to the challenge.

Cloud computing and higher levels of mobility have redefined how users see mobile networks. By understanding what these changes mean and responding with new solutions, connectivity and network providers can deliver higher throughput with lower latency over a stabilised and optimised link. Replacing local physical networks with a virtual network, designed from the ground up around user needs has come to be seen as the natural choice. We are increasingly being asked to manage the network, infrastructure, software, and hardware on the customer's behalf.

For solution providers demand is increasing for optimized hybrid network solutions combining satellite (primarily VSAT), fibre and cellular connectivity to remote and local offices or to interconnect specific sites. This extends the range of available digitally managed services such as VoIP and video conferencing, enterprise resource planning and other office applications to ensure secure access to corporate data centres, cloud services platforms and headquarters to further streamline mission-critical operations for help organisations.

Marlink supports this digital enablement by providing value added services, including extended demarcation points to enable software-defined network operations (SD-WAN) and cloud services. By enabling more data handling and processing at remote locations, traffic can be prioritised, and bandwidth can be more optimally utilised for faster application performance. ∎

Looking ahead: Our expectations for next year are for continued interest in what 'new LEO' or 'non-Geo' satellite constellations will bring in terms of throughput enhancements and further reductions in latency. Earlier this year we introduced agreements with SES on MEO capacity, and recently we signed up to deliver both OneWeb and Starlink new LEO capacity, so there will soon be more data on what users can expect once these services are available.

In the meantime, we expect to see an increasing application of hybrid connectivity services comprising GEO, MEO and existing LEO signals together with 4G to deliver the increasingly complex demands of NGOs, governments and energy/mining customers. This demand requires skills of orchestration and curation; our customers require partners that can deliver regardless of location or application requirement, and we expect that demand to continue.

Ralf Schmitz,
chief commercial officer,
AXESS Networks

When many companies were pulling back their sales operations due to COVID-19, we increased our presence in Africa, particularly, in Central, West and Southern Africa. Our activities are now picking up momentum. We have seen solid business growth within the government and enterprise market spaces.

Unpredictable payments due to government restrictions and international money control issues have been some of the biggest challenges this year. We have also seen delays in payments due to volatile rate of exchange between local currencies and the US dollar. COVID-19 has added strain on shipping and delivery schedules resulting in delays of equipment which ultimately led to delays of customer project implementations.

In terms of emerging opportunities, we see mobile network operators (MNOs), oil & gas, and mining companies that require network reliability. MNOs require coverage expansion at minimal network hops to rural communities. For both the oil & gas and mining industries, we see increased digital transformation, specifically the merging of information technology with operations technology, being able to view and manage critical applications remotely. Connectivity remains the backbone of digital strategies, and it must be robust and hardened.

We are seeing more schools coming online. International NGOs are actively bridging any gap (digital, physical even health). On the business strategy front, we have noticed increased strategic partner alliances, thus leveraging on each partner's strengths.

Our customers remain at the centre of everything we do. We have created a platform to hear more from our customers and will shortly be launching our next annual customer satisfaction survey. The results allow us to make step changes in our operations with the aim of continuously delighting our customers - the way we build and managed our products and services, the way we serve them and the way we contract with them.

We will build on our revenue growth in mining, oil & gas, and NGO/government space, and we will continue to increase our presence and position regionally and in our various vertical markets. We will also leverage more strategic partnerships to increase the value proposition to our customers. ∎

Looking ahead: During the past 12 months, we have seen a gradual increase in businesses returning to normal. Customer and prospect budgets are currently being finalised and we anticipate increased business opportunities.

Some of our objectives are to: increase customer value and growth; increase shareholder value; and protect current business. We will continue to increase the quality and quantities of project contracts.

We are moving closer to international NGOs and governments, as they are moving forward on deploying the broadband strategies and plans in Africa. With our current success rates, rolling out connected schools in rural communities, we are confident more international agencies and government organizations will entrust AXESS with their projects.

Through our innovation centre, we are building expertise in MNO, mining operations, education, and telemedicine beyond just connectivity.

Pieter Paul Mooijman,
regional vice president, Africa, ST Engineering iDirect

Africa is a key region for ST Engineering iDirect and we continue to work, as we always have, to connect the unconnected. People and businesses increasingly use the internet for a multitude of different reasons – from providing mission-critical links in the event of a disaster to enabling news broadcasts and public service information to remote communities.

Our technology is helping service providers across the continent to provide all of this. For example, this year one of our longstanding customers, InterSAT Africa underwent a significant technology upgrade to its existing Evolution platform, enabling it to leverage new technologies and efficiencies to remain competitive in an increasingly challenging market.

"Cost-effectiveness is of paramount importance in the market and there is no one-size-fits-all technology to meet this diverse continent's connectivity requirements. A blend of technologies (satellite, terrestrial, cellular, and wireless) will enable the most cost-effective and scalable communications solutions."

Cellular has been one of the main drivers of Africa's tech growth. We have seen a significant increase in that area as well as a steady migration from 2G to 3G and 4G. Obviously, 4G provides more flexibility and efficiency. And with respect to IP, there's an increase in data utilization.

More and more people in rural areas are embracing and utilizing connectivity. That's why we've been developing tools such as Mx-DMA MRC (multi-resolution coding) which brings the full scalability of TDMA return technologies to SCPC-like efficiency levels and enables service providers to cover a myriad of use cases without making tradeoffs between speed, efficiency, scale, and cost.

The region continues to face challenges, from legislation to the high cost of adoption of new technologies. Governments and commercial companies in the ecosystem are trying to improve this. We need to strengthen all these aspects as one ecosystem so we can focus on reducing the end customer cost which would allow for wider and faster adoption of connectivity for the unconnected. There is still a lot of work to do in the region.

As we are moving into a new era of satellite connectivity, the networks are becoming much more complex which means that more investment is needed and more technical skills are required in the workforce; these are difficult to find in Africa as there is a major shortage of qualified engineers.

Africa represents a huge opportunity for satellite technology. Over half of the population still remains unconnected and there is massive pent-up demand. The majority of people access the internet on a mobile device so the ability to enable MNOs to deliver cellular services to both urban and remote regions is only going to increase.

Cost-effectiveness is, of course, of paramount

importance in the market and there is no one-size-fits-all technology to meet this diverse continent's connectivity requirements. A blend of technologies (satellite, terrestrial, cellular, and wireless) will enable the most cost-effective and scalable communications solutions.

Another important trend we have noted is OTT which is growing in demand. It can be challenging to deliver a high QoS, even in urban areas due to an increase in demand at peak times. This is because even with developed infrastructure in place, there is inadequate bandwidth capacity to meet this population's broadband needs.

The inexorable rise of the smartphone has also been key this year – acting as not just a phone but a TV, a bank, and a source of important information to people. Because of this, demand for data continues to rise exponentially.

HTS satellites are also driving down the cost-per-bit of satellite connectivity. And although more affordable connectivity via satellite does already exist in Africa, it is constantly evolving, and the industry is innovating to improve affordability to reach more customers.

The price point of satellite antennas has been falling as has the size of antennas, reducing shipping costs and import duties. That said, further technological innovation will

> "The price point of satellite antennas has been falling as has the size of antennas, reducing shipping costs and import duties. Further technological innovation is required to bring the cost of terminals down to acceptable levels."

be required to bring the cost of terminals down to acceptable levels.

Cellular backhaul will continue to be a primary focus for us in the region. We are currently working to meet the requirements of regional MNOs that are moving away from managing and maintaining their own infrastructure. This is to reduce cost as managing your own infrastructure is complex and expensive and it is not the core experience of an MNO.

We will also continue to enable more African businesses, organizations, and core services such as healthcare and education to operate more effectively and reach communities that they need to through our technology. ∎

Looking ahead: Satellite cellular backhaul is going to continue to be a critical part of Africa's connectivity portfolio.

There is a focus on enabling the continent to move from 2G to 3G and even 4G services. 5G is still in the future for Africa, but there are signs of its adoption in countries such as South Africa where the government has issued a temporary 5G frequency license.

New 5G applications are emerging that fit very well with the African market, such as IoT for agriculture, telemedicine, and industrial augmented reality. As

demand grows for these applications MNOs will need to rely on satellite to increase the reach and reliability of their services, and they'll need to leverage newer LEO, MEO, and HEO constellations for increased coverage and performance.

It is thought that 5G will become the new standard. It will revolutionize how things are processed and how people stay connected. One thing we should seek to do on the adoption of 5G is to work on coverage and affordability. People should be able to gain affordable access to technology.

Rhys Morgan,
VP - general manager, EMEA media
and networks sales, Intelsat

At Intelsat, our mission is to help extend coverage to more people across the continent. Our team of highly qualified sales and technical professionals in Johannesburg, Nairobi, and Dakar as well as people on the ground in the Democratic Republic of Congo (DRC), respond to the continent's connectivity needs by working closely with our customers and partners to develop innovative solutions, new business models, and creative partnerships. This has been the basis of our success since we were first founded in 1965.

After opening three new customer operations centres, launching new satellites, and growing our commercial aviation business, the past year proved a transformational for us. Intelsat leveraged these next-generation capabilities to widen our network and service strategy, serving customers every day with the excellence for which we are known.

As the foundational architects of satellite technology, we never stop pushing the boundaries of innovation. Our ultimate goal is a world with ubiquitous connectivity and no communications boundaries. To make that a reality, we're investing over US$2 billion to build the world's first truly global and unified 5G network. Intelsat's unified network will set the standard in 5G connectivity and uninterrupted global broadband service with unrivalled coverage, economics, and performance.

Our commitment to empowering Africa never stops. We are encouraged by the initial results of our partnership with MaxIQ Space in Africa in delivering space-focused STEM learning tools to teenagers across the African continent. Sparking that tech interest at such a young age inspires future leaders who will soon lead the way with advancements we never dreamed possible.

Mobile networks remain the only form of internet access for many people, underlining the urgency to identify solutions to accelerate mobile internet adoption and use. Though the coverage has significantly improved in the region in recent years, sub-Saharan Africa still has the largest mobile broadband coverage gap, according to a recent report from GSMA. In 2021, one in five people in sub-Saharan Africa lived in an area without mobile broadband coverage, representing an estimated 210 million people.

As the world emerges from the pandemic and social and economic activities begin to recover, connectivity will continue to play a vital role in how people live, and businesses operate. This is particularly true for Africa, where the impact of internet connectivity on economic development is significant, and the pandemic emphasised the inequalities in access to digital coverage prevailing across the continent. The World Bank estimated that a 10% increase in mobile internet penetration in Africa could translate to a 2.5% increase in the gross domestic product (GDP); thus, Intelsat's connectivity solutions play a significant role in ensuring inclusive and sustainable development.

Closing the digital divide requires multi-stakeholder partnerships. Our hybrid solutions that combine satellite solutions, subsea, and terrestrial infrastructure prove to connect more businesses, people, and communities across the continent. Although subsea internet cable access plays a role in that development, they are not a viable option for land-locked interior countries. Satellites have always supported service providers in Africa, expanding their network coverage and improving the profitability of their networks considerably.

Intelsat is a leader in innovative solutions. We always believed that a fresh approach, fully integrated hybrid networks, new business models, and creative partnerships would be essential to accelerate the build-up of a robust network

infrastructure that would provide an excellent foundation for endless opportunities in Africa.

Intelsat CellBackhaul, our end-to-end managed service, enables MNOs to quickly and cost-effectively deploy their 2G/3G/4G network infrastructure into unreachable areas. They can overcome the cost, complexity, and ROI barriers historically hindering reliable, quality coverage everywhere, even in hard-to-reach rural and remote areas. For example, Intelsat and Ragasat's partnership has made it possible for service providers and mobile operators in DRC to expand their network coverage countrywide, swiftly connecting more subscribers, land areas, roadways, and IoT devices with minimal investment.

Intelsat specializes in building mobile network base stations serving rural communities in sub-Saharan Africa, where there is no existing service, providing existing licensed mobile network operators with a CAPEX-free route to roll out. Today, AMN operates 2,000 mobile network base stations in rural towns and villages spanning ten countries, serving about 7 million previously unconnected people and processing an average of 1.2 billion phone calls yearly. We are a trusted source among Africa's leading mobile network providers, working to extend their networks, connecting remote, urban, semi-urban, and ultra-rural populations. We serve over 100 MNOs globally with satellite-based backhaul services, including Africa's top 10 mobile groups.

Banking, mining, oil, and gas industries, government organizations, and private and aid-oriented agencies depend critically on their ability to distribute information to and gather information from remote places. They rely on Intelsat's simple and accessible solutions.

Intelsat is the first choice for video distribution in Africa through seven prime video neighbourhoods and is well-versed in viewer preferences and habits in this market.

African and international broadcasters can grow their audience and reach nearly 45 million TV households with IS-20, the most watched media location in Africa, and connect with viewers in emerging markets such as Nigeria, Ghana, Tanzania, Ethiopia, and Kenya. ∎

Looking ahead: At Intelsat, we're continuously working on developing and implementing new ways to address the need for broadband and mobile connectivity.

We continue to lead the industry in innovation with the world's first fully global and unified 5G network. Combining our extensive terrestrial infrastructure with the power and agility of Intelsat's multi-layer, multi-orbit, space-based network enables seamless connectivity to keep innovation moving forward for our customers.

Our unified network will set the standard in 5G connectivity and uninterrupted global broadband service with unrivalled coverage, economics, and performance, with 12 satellites already in production, including four software defined satellites.

For customers, that will mean getting the exact bandwidth they need, when and where they need it - with the ability to quickly scale their existing services to meet traffic spikes. Mobile operators will also quickly and efficiently extend to even more subscribers and provide an optimal roaming experience.

Robust connectivity available across the entire continent is essential to address the significant development challenges of the continent and will help enhance productivity, competitiveness, and economic diversification.

Together with our partners, we are committed to driving digital inclusion in Africa.

We believe in a connected Africa where rural communities will get access to healthcare, education, and financial services, for an improved quality of life, and that's why we are working on the infrastructure of the future.

ABS
Unit 2107-8, Al Thuraya Tower 1
Dubai Media City
PO Box 50219
Dubai, UAE

T: +971 4454 2677
Email: info@absatellite.com

Delivering reliable satellite connectivity

Your mobility/ maritime solutions

Broadcast solutions - Grow your audience

ABS satellite-related service offerings

ABS creates and delivers innovative services that meet current and future customer demands. It delivers satellite communications connectivity for video, data, and telecommunication services globally through a fleet of five satellites: ABS-2, ABS-2A, ABS-3A, ABS-4/Mobisat-1 and ABS-6 serving over 180 countries. From broadcast, data, government, mobility and ABSPlus value-added services, ABS ensures essential delivery for a broad spectrum of satellite communications requirements.

For more information, please visit www.absatellite.com

Avanti Communications

Cobham House, 20 Black Friars Lane,
London, EC4V 6EB
+44 (0)20 7749 1600
www.avantiplc.com

Managed service for rural connectivity

Carriers expertise

Satellite backhaul

Avanti Communications

We are a highly customer focused satellite organisation. We have the ability to connect more than one billion people across Africa, Europe and the Middle East, whether you are on land, at sea or in the air. We have managed services which deliver seamless integration with your networks and our hybrid network gives you and your customers the world's most reliable satellite connectivity.

EMEA headquarter of AXESS Networks
AXESS Networks Solutions
Germany GmbH
Falkenweg 1, 53809
Ruppichteroth
Germany
sales-emea@axessnet.com
Phone: +49 -2295 908780

Energy

Telcos

NGO/Government

Business

AXESS Networks is a global leader in satellite telecommunications solutions. The company manages the entire satellite communications value chain with engineering solutions tailored to its customers' requirements from a broad range of industries: Oil & Gas, Mining, Telcommunications, Maritime, Corporate, Media, Government and Humanitarian Services.

Founded in 2019 via the merger of Axesat and CETel, two well-established companies in Europe and Latin America, it operates and owns teleports in Germany, Colombia, Mexico, Peru, Saudi Arabia and the United Arab Emirates (UAE).

AXESS Networks offers an exceptional quality of service to its customers wherever and whenever they need it: on 8,000 sites, in more than 50 countries, on four continents. A dedicated team of over 200 employees serves more than 800 customers with deep market understanding.

To learn more, visit www.axessnet.com and follow AXESS on LinkedIn: www.linkedin.com/company/axessnetworks/

Es'hailSat
Property No. 414, Al Markhiya
Street No. 380,
Area No. 31, Umm Lakhba,
P.O. Box 10653, Doha, Qatar
Telephone No.: +974 4499 3535
Fax No.: +974 44993504
Email: info@eshailsat.qa
Website: www.eshailsat.qa

About Us

Services

Channels

Contact Us

Es'hailSat, the Qatar Satellite Company, was established in 2010 to deliver satellite services to broadcasters, telcos, enterprises and governments in the MENA region and beyond.

With a goal to be a truly global satellite operator and service provider, Es'hailSat commenced operations with Es'hail-1 in 2013, supporting key broadcasters, beIN Sports and Al Jazeera Media Network. Es'hail-2, the company's second satellite was launched in 2018 and is co-located with Es'hail-1 at the MENA hotspot of 25.5^{0}E/26^{0}E orbital location. Es'hailSat's high-powered satellites with Ku-band and Ka-band capabilities, provides the region with advanced and sophisticated services.

Es'hailSat's Teleport in Doha provides satellite Telemetry, Tracking and Command (TT&C) operations and capacity management, along with teleport services such as uplink, downlink, contribution, multiplexing, encoding, playout, VSAT services, hosting services, data centre and other services.

Es'hailSat plans to expand with newer satellites in other prime orbital locations around the globe, offering customers the most flexible and reliable services.

Contacts: sales@eshailsat.qa or info@eshailsat.qa

Gilat Satellite Networks Ltd.
21 Yegia Kapayim St., Kiriat Arie, Petah Tikva 4913020, Israel
info@gilat.com
+972 3 925 2000

Leading the Elastix Space Era

SkyEdge IV

Cellular Backhaul

Enterprise

Gilat Satellite Networks Ltd. (NASDAQ: GILT, TASE: GILT) is a leading global provider of satellite-based broadband communications.

With over 30 years of experience, we create and deliver deep technology solutions for satellite, ground and new space connectivity and provide comprehensive end-to-end solutions and services, powered by our innovative technology. We believe in the right of all people to be connected and are united in our resolution to provide communication solutions to all reaches of the world.

Delivering high value solutions, our portfolio is comprised of a cloud-based platform and high performance satellite terminals designed to work in harmony with satellite constellations, including Very High Throughput Satellites (VHTS) and Software-Defined Satellites (SDS) in multiple orbits; high performance Satellite On-the-Move (SOTM) antennas; and highly efficient, high-power Solid State Power Amplifiers (SSPA) and Block Upconverters (BUC).

Gilat's comprehensive solutions support multiple applications with a full portfolio of products to address key applications including broadband access, mobility, cellular backhaul, military, government, and enterprise, all while meeting the most stringent service level requirements. For more information, please visit: www.gilat.com or follow Gilat on LinkedIn, Facebook and Twitter. Contact us here

Hughes Network Systems, LLC
11717 Exploration Lane
Germantown, MD 20876
USA
globalsales@hughes.com
P: 301-428-5500

Broadband

Cellular Backhaul

Community Wi-Fi

Multinational Networks

Hughes Network Systems, LLC (HUGHES), an innovator in satellite and multi-transport technologies and networks for more than 50 years, provides broadband equipment and services; managed services featuring smart, software-defined networking; and end-to-end network operation for millions of consumers, businesses, governments and communities worldwide.

The Hughes flagship internet service, HughesNet®, connects millions of people across the Americas, and the Hughes JUPITER™ System powers internet access for tens of millions more worldwide. Hughes supplies more than half the global satellite terminal market to leading satellite operators, in-flight service providers, mobile network operators and military customers.

A managed network services provider, Hughes supports more than half a million enterprise sites worldwide for customers ranging from petroleum retailers to financial institutions to mobile network operators. Headquartered in Germantown, Maryland, USA, Hughes is owned by EchoStar. To learn more, visit www.hughes.com or follow HughesConnects on Twitter and LinkedIn.

Stratosat Datacom
26 Spartan Road, Kempton Park, 1619 | Tel: +2711 974-0006 | email: sales2@Stratosat.co.za

Stratosat Datacom forms part of the German based SCHAUENBURG International Group, which is a fast-growing family business with more than 30 affiliated companies worldwide. Investments are focused on niche technologies in electronics, plastic processing, engineering and industrial solutions on a global scale.

Stratosat Datacom, established in 2002, provides cost effective tailor-made turnkey satellite and microwave communication solutions in Sub-Sahara Africa. We have rendered products and services to the majority of Telco and Satellite Operators in Africa.

Our customer focussed team provide expertise in equipment supply, installation, systems integration, commissioning, handover, training, maintenance, support and network monitoring.

Stratosat's main solution offerings are:

- High-Speed Satellite Managed Broadband Connectivity, Mobility (CoTM & CoTP),
- Managed Services,
- Tailor-made Communication Network Solution Design, Project Management,
- Satellite Equipment Supply & Distribution and Implementation & Management of Large Astronomy Projects (SKA / MeerKAT).

High-Speed Satellite Managed Broadband Connectivity

Managed Services

Tailor-made Communication Network Solution Design

Satellite Equipment Supply & Distribution

Stratosat DATACOM

Cerillion
www.cerillion.com
info@cerillion.com
+44 20 7927 6000

Cerillion is a leading provider of billing, charging and customer management systems with more than 20 years' experience delivering its solutions to mobile, fixed, cable and multi-service communications providers worldwide.

BSS/OSS Suite

DEV Systemtechnik GmbH
Grüner Weg 4A
D-61169 Friedberg
Germany
info@dev-systemtechnik.com
Tel.: +49 6031 6975 100

RF signal transmission and management Systems for satellite earth stations and broadcasters:
- RF Matrices, RF over Fiber, RF Switches, RF Distribution
- Satellite ground station redundancy / diversity systems

More from DEV Systemtechnik GmbH

NORTHERN AFRICAN WIRELESS COMMUNICATIONS

Take a look at recent issues of Southern African Wireless Communications

Recent Issues

Register for your FREE annual subscription:

Register Now