chapter Satcoms



Martin Jarrold, chief of international programme development, GVF

"Space, the Final Frontier..." These opening words from the science fiction of Star Trek have permeated popular culture since the late-1960s. Since then, we have greatly expanded the frontiers of the science reality of our space activities. Now, space agencies – including many new national agencies of developing nations – and commercial organisations are extending further the uses of space. As more nations focus on space, including several across Africa, and as global commercial space activity expands, it is absolutely essential that we do not lose sight of the irreplaceable value of the orbital real estate which enables us to maintain and protect life on Earth at its current, complex, level of civilisation. Space might be the Final Frontier; it is certainly the Essential Frontier.

Whether at geostationary (GEO) altitude, medium Earth (MEO) altitudes, or low Earth (LEO) orbit, we must protect this unique asset. GEO has only two-degree spacing between orbital slots, but we have long-practiced good husbandry of this orbit, ensuring that satellites approaching end-of-life still have sufficient on-board fuel to navigate to a graveyard orbit from which it will take thousands of years for Earth's gravitational attraction to decay their orbit to a plasma-engulfed atmospheric end. In fact, recently, we have gone further to enhance the good management of GEO with the Mission Extension Vehicle programme to re-fuel still functional satellites. This is one of many facets of a rapidly emerging "new space race" wherein established industry players and many new entrants are pushing the boundaries of space logistics.

Many have written about the "new space race". or NewSpace. NewSpace is a big topic, but not in the same way as the now decades-long history of the business of designing, building, and launching satellites to orbit. Before NewSpace, the "big" in satellite related to the size/mass of spacecraft - for communications, Earth observation (EO), weather forecasting, determining military strategy, intelligence gathering, etc. - and to the scale of the commercial sector and government sector budgets which provided funding. NewSpace is multi-facetted and includes the recent successful realisation of fully software defined satellites, featuring programmable payloads. NewSpace is not only about space segment. It is having a multi-faceted impact on ground segment infrastructure too, with innovation

in satellite antenna design, qualification and testing (about which more below); in modem design; in teleport engineering, operation, and deployment.

The business of NewSpace has already engaged around 20 of Africa's nations (with space programmes at various levels of development) and applications using satellites are becoming a more affordable domain populated by many small-scale start-ups and spin-offs from academia leveraging the reducing costs of technology. It is increasingly viable for lower-income nations in Africa to design and manufacture their own small satellites and at least 11 have done so to serve broadband communications, navigation, and EO.

The number of smaller space-active nations is many more than just 10 years ago when, among African nations, Nigeria's space agency (NASRDA) was the continent's leading light in satellite remote sensing with the launch of NigeriaSat-2 and NigeriaSat-X. With payloads of imagers for EO applications such as resource management, mapping and agricultural and disaster management, these two satellites were somewhat precient of today's even greater need for such orbital assets.

The protection needed for MEO, and increasingly populated LEO, is from ourselves, from our actions or inaction. Just as we have realised that we must change our behaviour to preserve Earth's current climate equilibrium (with satellites having a vital role to play in this task) we are realising that we must not abuse orbital space either.

For Africa, satellites – vehicles the size of a double-decker bus in GEO orbit, through to shoebox-sized spacecraft in LEO – play a vital and increasingly important role in enabling broadband communications, expanding access to the internet, and monotoring and measuring innumerable facets of everyday life, gathering, managing, and analysing data generated by the bustling urban mega-connurbations, from industry, from agriculture, and from the remoteness of the rain forests and coastal waters.

Whilst, as noted above, GEO is a comparatively well-managed resource, we are only now learning that we must parallel the growth of our expanding broadband communications and remote sensing business assets in the lower Earth orbits with internationally agreed and implemented policies, protocols and good practice. An estimated 170 million man-made objects are orbiting Earth, threatening humanity's access to useful space. With the density of objects in LEO enough to cause collisions, this could cause a self-sustaining cascade, as each collision generates more debris, leading to



more collisions. This – the Kessler Syndrome – describes rendering impractical the use of satellites in LEO for generations to come.

The world's growing space community – the commercial and national government agency space powers of pre-NewSpace, plus the increasing number of smaller space-active nations in Africa and elsewhere, plus the enterprises of NewSpace from the likes of SpaceX 'Starlink' to small IoT-focused or EO/remote sensing start-ups – must act now to create a regime of protocols to ensure the long-term sustainability of space, to protect the technology we place there and the applications. Many of these bring together the sustainability of our planet's current with the sustainability of our planet's current climate equilibrium.

The distinction between communications and EO is eroding. Satellite broadband communications work entirely within the IP environment, and EO - visible spectrum, infrared, ultraviolet, or x-ray frequencies - is also a stream of digital data. Both share the same lower orbits, and there are many more of both being launched. Finally, both contribute to what I, and others, have elsewhere described as Actionable Intelligence and the emergence of a Digital Planet. The idea of a Digital Planet extends to the emerging concept of a "global digital ecosystem"; a concept of the United Nations Environment and Development programmes. The 'product' of this "global digital ecosystem" will enable the formulation of Actionable Intelligence, and foster a culture of Sustainable Decision-Making that, in the context of trying to meet the UN Sustainable Development Goals (SDGs) and of trying to stem climate change, will be the indispensable currency of the future Digital Planet.

The merging of satcoms with EO (plus Artifical Intelligence/Machine Learning), the gathering of data and its dissemination as Actionable Intelligence, affects our understanding of our use of Earth's natural resources, of water and food security, and of understanding population demographics, and providing public services, etc. Data helps inform strategic decision-making by governments, international agencies, and the World Economic Forum with its Stakeholder Capitalism Metrics which are designed to show how companies are doing on climate change action and contributing towards the SDGs.

Glasgow, in Scotland, will soon host the COP26 Climate Change Summit which will aim to accelerate action towards the goals of the 2015 Climate Accords agreed at COP21, and the United Nations Framework Convention on Climate Change. The broadcast satellites which bring us news video of such gatherings, as well as of extreme weather events which the scientific community recognise as symptomatic of a changing world climate, are just one element of a greater orbiting infrastructure on which we depend to monitor and evaluate the impact on the Earth of the Anthropocene Epoch.

Space agencies and private EO companies are actively monitoring the Earth as climate change evidences itself, using a wide range of technologies to monitor sea levels and coastline change, track atmospheric carbon dioxide and methane levels, monitor rain forest logging, and measure other (negative) changes impacting the planet's flora and fauna. Utilising space to help tackle the complexities of climate change requires action now to create a binding approach to space sustainability; otherwise, we will lose not only access to the precious resource that is near-space, but an important tool to protect and preserve the Earth we know. But, it isn't only physical collisions between increasing numbers of spacecraft that threatens the security of our satellite real estate. A continuing threat is radio frequency interference arising from various causes.

Some 98% of all radio frequency interference (RFI) is unintentional, caused by one or more of human error, antenna cross polarisation leakage, faulty equipment, or adjacent satellite interference. Unintentional RFI can also be the result of overlap or interference between signals used to communicate

with satellites and those used for terrestrial networks such as mobile phone systems. A complex regulatory framework exists to manage RF spectrum. The ITU recognises the RF spectrum and specific orbital regions as limited resources, providing for efficient and economic use, and equitable access. Allocation of a frequency band designates it for specific space or terrestrial applications. An allocated band can be further divided into allotments or channels, designating its use in particular geographic areas.

ITU Member States and other space stakeholders all have a role in reporting harmful interference using the Satellite Interference Reporting and Resolution System (SIRRS) which enables space stakeholders to report harmful interference affecting space services as well as to receive support from ITU. Through SIRRS, ITU is accumulating an international repository of interference events, making them easier to track, analyse and resolve. The satellite industry has developed RFI mitigation techniques, including Carrier Identification (CID), advanced monitoring and geolocation technologies, and more robust operational training.

first line of defence against interference and there is agreement within the industry that training reduces uplink errors and improves equipment maintenance and installation practices. The GVF training programme is building a global force of qualified VSAT installation technicians available in local areas to support expansion of VSAT networks. The training content is focused on interference prevention skills, serving the industry's drive to combat unintentional interference. Over 17.000 students globally. including thousands across Africa, have taken advantage of over thirty courses and over a dozen certifications covering VSAT installation and other equipment training. Students equipped only with Internet terminals can access realistic simulations of the behaviour of real-world equipment through advanced web-based e-learning materials featuring interactive 3-D animations based on numerical algorithms. facilitating grasp simulation of technical concepts and practice of hands-on skills such as dish pointing, polarisation alignment, and uplink signal line-up.

A necessary concommitant to training is satellite Proper training is increasingly recognised as a equipment quality assurance. Satellite operators



attach a high priority to antenna performance in limiting RFI. In this conection the GVF Mutual Recognition Arrangement Working Group (MRA-WG) was formed to develop a consensus-based framework to improve the efficiency of satellite operators' terminals type-approval procedures.

Using this framework, once a type-approval is provided to a manufacturer by any participating satellite operator, other operators may mutually recognise the results of the tests conducted during the first operator's type-approval process. The MRA-WG procedure defines a set of standard tests that an antenna or earth station manufacturer should perform in order to apply for type approval from any satellite operator, improving the quality and completeness of test data helps reduce the time and cost required to bring new ground-segment technology to market.

In furtherance of the desirability for operators to work with antenna manufacturers to improve the antenna terminal qualification process, GVF and a group of satellite operators (AsiaSat, Eutelsat, Inmarsat, Intelsat and SES, most of which serve the connectivity needs of the African continent) have collaborated to produce guidance for antenna manufacturers regarding expectations for new antenna products, and how to demonstrate compliance with the Satellite Operators' Minimum Antenna Performance specifications (SOMAP). (See https://gvf.org/working-groups/ for more detail.)

GVF member company, QuadSAT, joined GVF to participate in the MRA-WG, and work with the SOMAP group. QuadSAT is developing a novel approach for conducting on-site antenna verification using Unmanned Aerial Systems (UAS), or drones, which avoids the need to transport antennas under test to an outdoor far-field antenna range.

The GVF terminal type-approvals procedures and the SOMAP requirements were identified as directly linked with QuadSAT's UAS-Antenna Performance Evaluation (UAS-APE) system technology development. This inter-relationship of the GVF's already existing framework and QuadSAT's technology/product development objectives signalled the opportunity for a European Space Agency collaboration. The space agency recognised the value of this technology and awarded QuadSAT a contract to develop and validate the technology with support from GVF in the form of technical advice.

GVF's recognition of the importance and innovative significance of QuadSAT's technology and product development potential was, and remains, rooted in its contribution to the satellite communications industry's objective of reducing rising levels of RFI and in improving the effectiveness of type-approvals processes. Antenna testing using traditional methods can be expensive and logistically difficult.

QuadSAT's drone-based measurement method differs significantly from traditional test-range methods by bringing the test range out to the antenna no-matter its location. That satellite antennas can be tested anywhere, easily and effectively, with the quality/reliability of measurements fully comparable with high-end traditional test ranges is a change recognised by satellite operators as better enabling industry growth and innovation.

As alluded to above, Earth's growing "global digital ecosystem" will include an ever more heavily populated LEO, with tens of thousands of satellites, comprising various constellations launching over the next decade. OneWeb is one of those constellations, and the companies have partnered to test ground-based satellite antennas at OneWeb gateway stations using drones. Following antenna installation, operators primarily use on-orbit testing for link calculation diagnostics and calibration to increase operational performance. By using such drone technology instead, on-site testing can be conducted while minimising transmission downtime.

More generally, MEO and LEO megaconstellations bring new challenges to the industry, requiring adaptation of testing methods. New performance requirements inevitably come for a ground segment which must track satellites across Africa's skies.



Pieter-Paul Mooijman, regional VP for Africa, ST Engineering iDirect

Ver the past two years, in Africa and worldwide, we've never been more aware of the importance staying connected is for society, healthcare, education and business.

In Africa, particularly sub-Saharan, Mobile connectivity remains vital for keeping people connected and assisting the Covid-19 recovery. MNOs providing access to platforms, applications, digital content and online services are helping people and businesses get online and obtain information. Over-the-top (OTT) content is in increasing demand in Africa and provides a needed entertainment outlet.

Satellite technology is vital in enabling MNO's delivery of services to Africa. ST Engineering iDirect, throughout the past year, continued assisting operators with deploying mobile services regionally.

Satellite cellular backhaul plays an invaluable part in Africa's connectivity profile. The rise of the smart phone – in 2020, with 495 million subscribers to mobile services in sub-Saharan Africa, representing 46% of the region's population an increase of almost 20 million from 2019, resulted in an exponential increase of data demand.

Today High throughput satellites (HTS) are reducing cost-per-bit of satellite connectivity. This is important for lower-income countries, where smartphones operate as phones, TVs, banks, information sources and consequently require increased data access.

Clearly there's a wide range of use cases in Africa dependent on mobile connectivity, for business and entertainment purposes. Assisting Democratic Republic of Congo (DRC)'s MNO, Vodacom, address customer demands, by deploying our Dialog® platform to improve mobile services country wide. Dialog solution enabled Vodacom to migrate its VSAT-based 2G network to 3G across 150 Base Transceiver Stations, (BTS) the Base Station Controller, being in Kinshasa. This replaced traditional SCPC links to deliver increased efficiency to facilitate 3G data traffic. It also accommodates Vodacom's future growth, enabling increased satellite coverage and deliver increased capacity for expansion.

For semi-urban regions, satellite backhaul is used to deliver voice and data, and other services. Consumer broadband, cloud services and Over the Top (OTT) are all served by satellite backhaul.

Content is increasingly important as OTT services pervade networks, worldwide, these networks often become congested. Offloading traffic onto satellite is an important solution in alleviating the issue. Here, hybrid satellite and terrestrial methods are good. Satellite is cost effective for multicasting content to towers or CDNs, and its role will increase.

For rural and ultra-rural regions, the services MNOs facilitate are crucial. Mobile communications enable important applications such as Mobile Money in rural sub-Saharan Africa for the unbanked. Mobile Money can represent 30% or more of MNOs' revenue.

Addressing remote sites not connected via terrestrial networks, Dialog® platform was deployed by ABS, in partnership with iSAT Africa, a satellite solution provider, using the platform to launch new managed data services on ABS-3A satellite.

Platform offers cost-effective, robust, highspeed broadband for general enterprises, oil & gas and NGO users. It addresses locations requiring network infrastructure diversification and back-up services for fiber links.

The platform offers versatility and supports MF-TDMA and SCPC technologies with advanced bandwidth management features.

We need to work together with the connectivity ecosystem and the communications industry, to better connect Africa, delivering a high quality, seamless, plug-and-play experience enjoyable by all.

In Africa, we see satellite connectivity being a key technology to extend coverage to hard-to-reach populations. Increasingly, this involves satellite being used to provide ultra-rural communities with essential voice and data services.

For much of the African market, cost effectiveness is paramount and there is no one-size-fits-all technology to meet this diverse continent's connectivity requirements. A blend of technologies will enable the most costeffective communications solutions. Satellite, terrestrial, cellular and wireless will need to work in tandem to create affordable yet reliable

Looking ahead: We expect the rise of the smartphone to continue next year, and there's already huge demand for services on these devices. At close 2020, 20 million more people subscribed to mobile services in sub-Saharan Africa than in 2019. This trend is expected to continue into the future.

Entertainment is a massive application for smartphone use in Africa, but the smartphone is truly no longer just a phone – now it's also a TV, bank, marketplace and source of information. Thus, demand for data continues to rise, as people access apps and services they rely on as a part of daily life.

As affordable connectivity to facilitate modern smartphone use cases in Africa continues to evolve, we will see more collaboration toward a hybrid solution. Over-the-Top (OTT) services are, crucially, being supported by satellite backhaul and scalable services that can reach the most remote communities.

When it comes to advancing their networks by leveraging satellite connectivity, mobile network operators are looking for efficiency, performance, flexibility, and scalability. They want a reliable service they can use to easily extend connectivity to rural sites and integrate seamlessly within their terrestrial network. Networks need to meet the scale requirements of large point-to-multipoint networks and throughput demands.

ST Engineering iDirect is a leader in satellite ground infrastructure and solutions for the cellular backhaul and trunking market. We've deployed 80+ mobile backhaul networks, we hold the largest network with 1,500 cellular sites, and 12 of the top 25 telcos are ST Engineering iDirect customers. Our leading multiservice platforms, branded under iDirect and Newtec supporting the broadest range of connectivity applications and network requirements across 2G, 3G, 4G/LTE and emerging 5G networks. ■

and there is no one size fits all solution for these user demands. A mix of technologies is best suited to meet connectivity needs of the continent. Satellite, terrestrial, cellular and wireless need to collaborate in the service landscape to make sure dependable, scalable services are available to support connectivity needs without leaving remote regions behind.

This kind of hybrid approach has the added benefit of working towards a cost-effective solution. For example, HTS satellite is already lowering the cost per bit of satellite connectivity – and antennas are becoming less expensive too. The industry is hard at work innovating to make terminals more affordable and it's safe to say the future is bright for affordable, scalable connectivity and a plug and play experience enjoyable by all.



Alastair Williamson, CEO, Wyld Networks

B 2050 United Nations predicts world's population at 9.7 billion, necessitating 69% increase in world food production on 2010 level. Population and climate change pressures could pose difficulties for agriculture in Africa. This increases pressure for ways to generate higher yields while facing water shortages, rising temperatures and extreme weather. Increasing yields will require commitment and investment from private and public sector and a quantum leap in harnessing the power of technology.

At Wyld over the past year, we've been helping sow the seeds of this technology transformation by harnessing the power of the satellite-connected Internet of Things (IoT), creating communications and sharing actionable data between people, processes and things. Agriculture is one of the fastestgrowing IoT markets and according to the Statista report, 'Worldwide IoT in Agriculture Market Size 2023' it's expected that the global agricultural IoT market will reach almost \$30 billion by 2023.

Fundamental to agricultural innovation revolution is the need for more data points to give agronomists and farmers a highly granular picture of food production cycle.

"LPWAN makes communication possible at significantly longer ranges and much lower power consumption than cellular or Wi-Fi options" Key data sources include soil moisture sensing, weather stations, crop and storage monitoring, livestock and asset tracking, following the complete field to fork journey. For example, knowing soil moisture level at different locations and depths across a farm helps to calculate the best times for sowing and harvesting, while detecting temperature changes in a greenhouse makes it possible to adjust ventilation and irrigation.

This year, Wyld Networks partnered with South African company DFM Technologies to connect soil moisture sensors to low earth orbit satellites. DFM's soil probes are multilevel soil moisture content and temperature-logging devices. Probes measures moisture content and temperature readings at six depths in a soil profile and measure surface temperature.

Probes guarantee accuracy and reliability, as they are temperature compensated and are not adversely influenced by salinity levels. They are affordable, easy to use and have proven reliability in the field. Through continuous soil moisture content logging, farmers are able to prevent over and under watering, reduce unnecessary crop stress, promote root development and improve fertilizer uptake.

Data collected by DFM probes is sent via Wyld Connect to the Eutelsat Low Earth Orbit satellite network and then back to the DFM Probe Utilities Software, a userfriendly package that provides users with an abundance of information.

Deploying sensors and devices needs to be linked with connectivity improvements as the full benefits of the IoT will never be achieved while mobile cellular networks only cover 15% of the earth's surface.

Agricultural IoT devices have specific communications requirements such as low cost, low power, long-range and low data rates,

which have driven the development of new connectivity technologies such as Low Power Wide Area Network (LPWAN), non-cellular standards like LoRa and Sigfox along with cellular standards like NB-IoT and LTE-M.

LPWAN makes communication possible at significantly longer ranges and much lower power consumption than cellular or Wi-Fi options. Also LPWAN networks can be created anywhere, they offer farmers the opportunity for connectivity of sensors even when there is no cellular coverage.

LPWAN and especially LoRaWAN radio technology is low power (think 2 x AA batteries lasting years sending small data packets on an hourly or daily basis) and in contrast to Wi-Fi, LoRaWAN can operate at distances between 10.15Km, as the lower power signals operate at much longer wavelengths.

LoRaWAN is a game changing solution

Looking ahead: Emergence of sensor-to-satellite connectivity means that areas in Africa will come into range, while access to remote data opens up new applications. For example, a crop requiring a certain soil type, water input and fertiliser may become possible in each environment if true information of the ecosystem is understood, both on a macro level and highly localised way. Specific, granular conditions can alter inputs to improve yield and reduce environmental impacts. The opportunity to blend this data with highly local satellite imagery is a potential game changer.

And with sensor-to-satellite, cost for access to the internet for IoT devices using this technology is expected to be a few dollars per node per year. With sensors able to run off low voltage batteries or small solar cells, this will enable IoT technology to reach everyone.

So, this revolution in satellite IoT technology will overcome two key barriers to universal access in Africa – global coverage and affordability - and as such but even with all these benefits, it's limited by scale. On African farms, 10-15Km is no great distance. But with sensor-to-satellite connectivity, it's possible to send data from a sensor on a farm directly to a Low Earth Orbit satellite without maintaining a terrestrial LoRa network. Effectively, the terrestrial gateway is replaced by a gateway in space, freeing up sensors to be placed anywhere on the globe, however remote.

Wyld Networks works with Eutelsat S.A., a world leading satellite operator to develop satellite IoT terminals as part of the Eutelsat ELO programme. Eutelsat's fleet of Low Earth Orbiting (LEO) satellites, called ELO (Eutelsat LEO for Objects), offers global IoT coverage enabling sensors to transmit data, irrespective of location, demonstrating how satellite technology can complement terrestrial networks.

can truly be termed as technology to democratise the IoT and help to deliver against more demanding future environmental and agricultural targets.

Additionally helping to meet growing demand for food, sensor-to-satellite revolution will also support struggling economies. At circa 23% of Africa's GDP, agriculture is a very important economic sector. In sub-Saharan Africa, it provides work for nearly 60% of the economically active population, while Africa's exports of food and agricultural products are worth between US\$35 billion and US\$40 billion a year.

In addition to the ongoing work with DFM in South Africa, some of the other satelliteconnected applications Wyld is working on include beehive monitoring with Bayer and water level management in wells and reservoirs in Guinea. But these are just the start. With truly global reach, satellite connectivity transforms the future of the IoT and opens exciting opportunities across Africa and the rest of the world.



Brian Jakins, general manager networks business, Intelsat

hatsApp Chatbots in South Africa, selfdiagnostic tools in Angola, contact tracing apps in Ghana and mobile health information tools in Nigeria: Covid-19 has spurred innovation across the continent with the development of health technology innovations that have been piloted or adopted in Africa. The continent, with its rising youth populations, has proved that, in spite of the pandemic, it was pursuing its transformation with cross-generation entrepreneurs driving it into its next phase of development.

Yet, as countries entered lockdowns and people became even more dependent on connectivity for work but also to access news, health, finance services and education, as well as communicate with friends and family, the Covid-19 pandemic highlighted the digital divide across the continent. Despite submarine cables running up and down Africa's coasts, combined with fibreoptic cables and cellular towers, dramatically improving access to connectivity over the past ten years, 670 million people were not covered by mobile broadband (3G or higher) as of the end of 2019, according to GSMA.

Infrastructure in Africa remains the biggest challenge for telecom operators. Reaching the remote communities, in dire needs of connectivity, is often uneconomical or not feasible due to geographic complexities and the number of remote communities. This is, however, a serious obstacle to the continent's growth and development.

Satellites and space-based communications have been at the heart of the many information and innovation revolutions over the past six decades, and we have witnessed first-hand —especially this year — the power of satellites to connect and the tremendous impact that broadband connectivity can have on a community.

Satellite is typically the only practical way to provide connectivity to areas underserved or un-served by terrestrial networks, where economics do not make sense. Satellites' ubiquitous coverage means that there are no 'last mile' issues, while the scalable and costeffective space-based solutions can help countries meet connectivity challenges quickly.

At Intelsat, our mission is to help extend coverage to more people across the whole continent and we work on developing solutions, even in the most challenging times such as the past year, to ensure that everyone, regardless of their location, benefits from connectivity.

Intelsat has pioneered innovations in space-based technology for more than five decades and the last year was no exception. We experienced the future of in-space servicing with MEV-1 and MEV-2 that provide the Intelsat 901 and Intelsat 10-02 satellites respectively with five additional years of high-performance life. Space servicing is a valuable tool for Intelsat in extending the high-quality service experience that customers depend upon. Mission-extension services represent a smart and efficient way to maintain our existing fleet and free up even more resources to invest in advanced, next-generation technologies. For customers in Africa that rely on Intelsat 10-02 for media distribution and broadband services, this is the assurance of an uninterrupted experience.

It takes more than just new technology to make broadband services available and affordable – new business models are just as important. Our fully managed service, Intelsat CellBackhaul, is a new service model that helps mobile network operators quickly and cost-effectively expand their coverage into unserved and underserved areas. These include many areas that were previously considered geographically impossible to reach or simply too expensive to connect. The deployment of Intelsat CellBackhaul from Kinshasa in the DRC has made it possible to connect any cell tower, anywhere in the country.

Working with local partners also plays a crucial role in helping close the connectivity gap. Their understanding of local requirements, combined with the power Intelsat's global satellite network, help reaching an increasing number of people – enabling, ultimately,

critical educational opportunities, local business growth and game-changing consumer finance solutions. For example, the partnership between Intelsat and Liquid Telecom has led to the connection of more than 2,000 VSAT terminals in 20 countries in Africa, while AMN, relying on Intelsat's network, operates 2,000 mobile network base stations in rural towns and villages spanning 10 countries, serving around seven million people who were previously unconnected, and processing an average of 1.2 billion phone calls a year. These local partnerships help ensure the continuity of high-speed, reliable satellite connectivity to mobile operators, carriers and enterprises across Africa, while also better serving the growing demand for improved connectivity in rural service areas.

Intelsat has remained as committed as ever to keeping customers, partners and colleagues supported and connected since the crisis started. Our business continuity plans enabled our teams to rapidly execute remote working arrangements and Intelsat's global

Looking ahead: We believe in a connected Africa where rural Africans will get access to healthcare, education, financial services, for an improved quality of life, and that's why we are working on the infrastructure of the future. This communications infrastructure will be fuelled by Intelsat's investments in standards-based design and integrated, highthroughput and software-defined architecture, which will help us respond to the booming connectivity needs, always more easily and at a lower cost.

Already, Intelsat is leveraging its unparalleled global orbital and spectrum rights, scale, and partnerships to build the world's first global 5G satellite-based, softwaredefined "network of networks." This will play a crucial role when African telecom operators develop their network to support 5G, helping to realise the technology's full potential, by complementing the capabilities of terrestrial 5G networks, and to bring network connectivity to places where terrestrial networks cannot go. They will also further harden network infrastructure by providing an added layer of resiliency to mobile networks. operations have continued to support the missioncritical services that our customers rely on to provide communications and connectivity services, much of this by leveraging remote-operations applications. Our recently launched Customer Operations Centre, located in Johannesburg in South Africa, has enabled us to work always more closely with our customers and better serve them throughout the continent.

While the Covid-19 crisis has highlighted the crucial role that broadband plays in connecting the world and keeping societies strong and healthy, it has also accentuated the digital divide, as many people in Africa, and around the world, are still without access to reliable connectivity. While we kept businesses, governments and communities connected in these unprecedented times, we also worked on expanding access to broadband services to everyone. An objective that is central to Intelsat's mission and that drives us to develop new innovative solutions, business models and new partnerships.

Not that we are the only ones to believe in the importance of connectivity for the continent. The recent investment in AMN by independent African private equity fund manager Metier will help AMN expand its reach to more than 5,000 towers across more than 15 countries by the end of 2023. This significant move also shows that there are investment-grade opportunities in connecting the underserved.

A connected Africa will also depend on the next generation of satellite engineers in Africa who know better than anyone else the specificities of the continent. This is why we have paired with XinaBox to deliver space-focused STEM (science, technology, engineering and math) learning tools to teenagers across Africa. The objective of this initiative is to spark a tech interest and inspire them to become the future leaders that will lead the way with new advancements.

Providing connectivity to communities across the most rural parts of Africa can be challenging. Innovative technology, proven business models and experienced people are there, though, to make it simple.



Daniel Losada, VP international sales, Hughes

More and terrestrial network operators in the Middle East and North Africa (MENA) region are seeing rapid growth in demand for services, driven by both the global pandemic's shift to on-line communications and steady economic development in many countries. A number of cloud storage providers, including Amazon and Microsoft, have opened new facilities in the region to meet the growing demand from both government and enterprise networks. The coming rollout of 5G networks, while expected to be slow in most MENA countries, will yield even greater demand for cellular backhaul links to areas currently unserved and for hybrid networks that blend satellite, fiber and mobile broadband connections.

Network operators are challenged to deploy 4G throughout the entirety of their coverage areas. A recent study by GSMA Intelligence noted that smartphone penetration had reached nearly 60% across the 22 countries that make up the MENA region, well above the global average of around 47%. However, the same report noted that MENA lags other parts of the world in building out 4G networks, with only 29% of MENA customers having access to 4G compared to a global average of 51%. As

"Satellite connections will play an important role in supporting these networks as demand for cellular backhaul increases and cloud-based hybrid networks are developed to support a range of enterprise customers" regulators grant additional spectrum for 5G in urban areas it is increasingly likely that the operators will be required to introduce 4G in currently unserved areas – places where satellite can be cost effective to enable backhaul links.

According to a recent report by Analysys Mason, total telecom revenues in MENA are expected to grow by less than a half-percent per year through 2025. Subsequently, 180 mobile and fixed telecom operators in the region can be expected to turn increasingly to enterprise data customers for growth. The report notes that 5G rollout has just begun but that 5G penetration should reach 23% of all mobile connections by 2025. The forecast estimates that the average mobile data traffic per connection by 2025 will have increased five-fold since 2019.

Satellite connections will play an important role in supporting these networks as demand for cellular backhaul increases and cloud-based hybrid networks are developed to support a range of enterprise customers. Oracle opened a cloud data center in Abu Dhabi in early 2019, its first in the region. Since then, units of Microsoft, Amazon, Orange, Alibaba and IBM have all launched data centers in Middle Eastern countries. In addition, a number of countries are developing data-center infrastructure to support smart city and digital transformation projects.

The global pandemic has sped up the adoption of distributed enterprise networks around the world, as banks, retailers, schools, restaurants, and even government agencies shifted more and more to online services for both employees and customers. For locations far from terrestrial cable and fiber, the only links available have been often unreliable cellular connections, making satellite connectivity even more critical for business and government users.

On the horizon

With network use continuing to climb, better network management tools are critical. In a study

of Hughes' customers across the nearly halfmillion enterprise sites we manage globally and found that bandwidth demand per site is up by 150% over the past three years. In a separate assessment of data from 1,900 sites over a single three-month period, 25% of the branch locations experienced network congestion during daily peak hours (and that was pre-Covid-19).

We are seeing customers in markets around the world adopt software-defined, wide area networking (SD-WAN) as the best solution for managing vastly different broadband access types and infrastructure while supporting the proliferation of cloud-based applications. Widearea networks typically allow enterprises to connect their remote locations to central data centers or into the cloud. The networks are often a blend of hardware and software from a wide variety of providers, and connections can sometimes involve dozens of Internet service providers across a wide geographic area. Getting everything to work smoothly and reliably can be daunting for network engineers. Network congestion, unacceptable latency and periodic service outages are common problems.

With managed SD-WAN, enterprise users can complement LTE and fiber connections with highthroughput satellite connections to ensure very high availability. A managed SD-WAN solution takes over the task of data routing and overlaving the network with control policies that allow the disparate network connections to run more like dedicated circuits. SD-WAN manages traffic flow by using dynamic load sharing across multiple connections. The approach is carrier agnostic and weaves together wired, cellular and highthroughput satellite connections into a seamless network. Cellular 4G LTE (and soon 5G) can be used for low-latency applications while satellites can carry the bulk capacity data, giving enterprises a dual path for high-availability networking.

Once installed, a managed SD-WAN solution can use integrated machine-learning algorithms to look at capacity trends, network states and other factors to improve overall network performance. The SD-WAN software also looks for network vulnerabilities to ensure the highest level of cyber security, whether the enterprise is protecting customer credit card numbers or the integrity of an electrical grid.

Looking ahead: Countries across the MENA region are developing broadband infrastructure at varying rates. Nations like the members of the Gulf Cooperation Council and Israel have 4G penetration at just under 50%, while those in the rest of the region have more customers still on 2G networks than on 4G. This digital divide presents an opportunity for development of community-based Wi-Fi hotspots powered by satellite connections. Throughout the region, YahClick, the Hughes and Yahsat joint venture, offers YahClick Express Wi-Fi, a community Wi-Fi solution that uses the Facebook Connectivity platform and enables local merchants to sell internet access at a low price per megabit, thus sharing the cost of the VSAT. These broadband hotspots bring Internet

access to consumers wherever they are – no matter how rural – at markets, truck stops, taxi stands, and food shops.

It's true that a rising tide lifts all boats, and as the broadband revolution gains traction in urban areas and developed markets with 5G and multi-transport SD-WAN networks on the cutting edge, the impact will resonate across rural and hard-to-reach places with 3G, 4G and shared Wi-Fi solutions. As that happens, networks that bring together terrestrial infrastructure and satellites will become more common throughout MENA and other regions, making it more important than ever that network managers have the tools they need to assure the best level of connectivity no matter the transport.



Alexander Mueller-Gastell, ND Satcom CEO

Preverberate worldwide and industries continue to reverberate worldwide and industries continue to adapt to external factors ranging from unprecedented supply chain interruptions to the multitude of changing regulations impacting borders and commerce. Additionally, ongoing safety and health measures for employees and customers were universal issues.

The degree of flexibility, agility, and commitment required – under the circumstances – defined companies that will conclude 2021 with an improved bottom line. ND SATCOM was amongst them. With stable leadership, it progressed investment in new technologies and market opportunities. As well as advancing its digitalisation plan by securely connecting its worldwide office network, partners, and customers with its headquarters.

We launched a variety of innovative products aligning with customer expectations and extended our SKYWAN 5G solution with a new and military application. Additionally, we countered the pandemic's impact on traditional B2B interactions (trade fairs and direct customer visits) by introducing new partner and customer communication channels via social media and our own interactive platform, which securely hosts live meetings, demos, and training. ND SATCOM's virtual activities successfully closed the pandemic-driven distance and learning gaps by providing the forum for group meetings and one-on-one sessions customers requested.

Through resilience, dedication, and creativity, the entire ND SATCOM family came together to support our global network and achieve our goals.

In 2021, ND SATCOM's sales volume showed

a very positive development, with the defence market as a strong driver. Growth was sustained by the successful installation of SKYWAN 5G solution across multiple governmental customers worldwide as the core component within most projects. Our staff faced the pandemic with our entire team's outstanding experience and customer engagement reflecting brand quality and reliability.

We have been successful in positioning SKYWAN 5G as the standard modem and core element among defence customers.

We extended support for tactical applications for military customers by developing customised and rugged versions of the modem in relation to size and weight but also encryption. With the fast-growing SatCom-On-The-Move market for defence, we are ready and experienced, after completing, with a German research institute, extensive tests with different antennas to serve customer needs.

We continue global growth: in Asia, cooperation with governments was convincing for customers to order complex networks with stringent requirements for resilience and geodiversity. The combination of mesh network capabilities with additional geo-redundant DVB-S2 out-bounds to interconnect sites was already adopted for several networks with more following. To support growth, we increased our regional expert team in several Asian countries. A "multi-station network in a 4U rack" was used to demonstrate SKYWAN technology in both theoretical courses and real operations.

ND SATCOM not only builds components "Made in Germany", it designs and delivers turnkey solutions that comprise complete networks. 2021 saw ND SATCOM awarded a project in the Americas for SKYWAN 5G modems with release 2.0 that comes with TrueMesh ACM. Key factors for success included the modem and other components developed inhouse and strong local support plus customer's trust in ND SATCOM's service organisation for the solution's lifetime.

At the AFCEA conference in Bonn, ND SATCOM presented the new Multi-band FlyAway Terminal (MFT) family and exhibited the X-band version of the MFT 1500. One advantage that sets the terminal apart is its wind resiliency: it can withstand and function in very high wind speeds and severe storms. Customers value high reliability and security that SKYWAN represents. The bar was raised by integrating pioneering innovation of Adaptive Coding and Modulation (ACM) for Mesh TDMA, permitting transmission during heavy rains with adaptive bandwidth control.

ND SATCOM's SKYWAN 5G modem evolution, was one of the main core tasks of the R&D team. After the SKYWAN release 2.0 launched in 2020, an updated, extended version of the software was released. New features include customisable dashboard for the network management software (NMS) and support of the MFT. Updated software is now available for all platforms featuring backward compatibility with SKYWAN release 2.0.

Other launches occurred in 2021: the HPA 4-Series, the latest version of high power amplifiers, marks the next generation of TWTA with its power and performance. It has improved usability through intuitive WebUI, simplified Automatic Level Control (ALC), enhanced performance through reduced intermodulation and halved warm-up time, easy maintenance through firmware upgrades via LAN, and consistent M&C and dimensions to its legacy series. We launched, the redundancy controller RCU 6000, covering the range from single HPA control up to the management of six active transmission chains. It offers a highly intuitive user interface to manage all functionalities: various base band encoders, modulator to upconverters, and multiple HPAs with all switch elements. The RCU 6000's quality and higher temperature range support failsafe operations.

Usability, performance, and monitoring highlights include 6 waveguide switch interfaces, ultra-fast multi-core CPU and 8 fast Ethernet ports, and dual 1-Gbit/s LAN for remote access.

Looking ahead: 2021 brought commencement of activity to enhance the core product SKYWAN 5G by enabling proprietary waveforms for special platforms to integrate with Ku and Ka-band antenna subsystems for high-speed communication links. After many hours of simulations, this new market will be addressed in 2022. Also, we will complete its Multi-band FlyAway Terminal (MFT) to cover the mid-size range from 1.5m to 2.4m with many RF and power combinations. MFTs will be verified to comply the MIL standards. The tight integration of SKYWAN modem will provide an extension of existing VSAT networks any new scenarios or customer problems will be addressed.

Recently launched HPA 4-series and new RCU 6000 controllers, next generation of uplink components have been successfully brought to market continuing the success of ND SATCOM in the field of uplink devices. The next generation of the antenna control units - the ACU 6000 – will be launched in 2022 to complete the portfolio.

October saw ND SATCOM CEO Alexander Mueller-Gastell taking part in a panel at the Satellite Innovation conference, discussing with industry leaders "Terrestrial Infrastructure Enablers for Advanced Space Systems". With more trade shows occurring, we will strengthen existing relations with customers and partners and establish new ones.



Caroline de Vos, co-founder & chief operations officer, SatADSL

ounded in 2011, SatADSL has grown year on year to become an award winning, worldwide technology and operator agnostic satellite provider. The company is disrupting the existing satellite industry in order to realise the increasing potential of satellite connectivity in the new digital economy.

Specialising in bespoke solutions that best fit client's stated requirements and that provide flexible service plans meeting client's needs, while providing services to satellite operators, teleport and hub operators, governments, enterprises, and internet service providers.

SatADSL's flagship platform, neXat is the first satellite aggregation system that acts as a capacity broker and connects teleports with new markets and customers, while providing cost effective and reliable IP access.

Concentrating on the professional market of enterprises, prosumers, or small office home office to provide quality services. Additionally, customers are from Non-Governmental Organizations, public administration, educational institutions, and churches as well as other clients.

The advantage of SatADSL solution is

"For many Africans direct and immediate communication within a community is important as a cultural aspect" "This is one of the reasons why satellite solutions can really shine in the African market, connecting rural or hard to reach areas and providing the reliability that is so badly needed. In fact, this is something we consider to be a real opportunity for SatADSL"

the dynamics and flexibility that can be achieved, which is why it is flexible enough to be used by all the previously mentioned customers to meet their requirements.

Satellite connectivity is of huge importance to Africa for many reasons. Most African countries are still not connected bv terrestrial connectivity because fiber arrives in the country starting at the coast. This means that there are large parts of the territory that are not covered simply due to the lack of necessary infrastructure to support it.

In remote areas, it is difficult to implement terrestrial connectivity such as fibre and 4G efficiently and the alternative technologies that do exist, are frequently unreliable. This is one of the reasons why satellite solutions can really shine in the African market, connecting rural or hard to reach areas and providing the reliability that is so badly needed. In fact, this is something we consider to be a real opportunity for SatADSL.

For many Africans direct and immediate communication within a community is important as a cultural aspect. This is where the contribution SatADSL's solution

"In remote areas, it is difficult to implement terrestrial connectivity such as fibre and 4G efficiently and the alternative technologies that do exist, are frequently unreliable"

in Africa comes into play for the demand within African communities.

As a result, digital communications tools such as social networking apps become necessary for them. Indeed, we know from our data that apps like WhatsApp account for significant portions of data on our networks. This speaks to the cultural value of connectivity for the purposes of direct communications in Africa. Keeping people connected is not only about servicing business goals but also the more human element of connecting families, friends, colleagues, and students who want to be able to engage each other directly.

SatADSL's carrier grade platform

has been built with the support of the European Space Agency. As a result, we deliver not just the resilience and redundancy to mitigate network outages, but also security and superior service all come as standard.

Looking ahead: SatADSL is currently enhancing neXat security, redundancy, and resiliency features in the frame of a contract with the European Space Agency (ESA). The added security makes it more attractive to large teleports, governments, and large-scale enterprises with stringent safeguarding requirements.

SatADSL has developed an e-commerce feature which will allow customers, ISPs, and teleport and satellite operators to request quotations and place bandwidth orders.

SatADSL is also currently embarking on a new and exciting project in Cameroon that will involve connecting 500 schools with about 60 Mbps VNO capacity for internet access and eLearning. We believe that the arrival of VSAT connectivity is a vector for development in Africa, one that makes it possible to serve remote regions.

Given that more and more professions are becoming digital (education, medicine, banks, administration), without reliable connectivity accessible to everyone, these professions will not evolve technologically at the correct pace. As such, Africa risks falling behind, relative to other parts of the world.

It is clear that the African market understands this to be true, hence the growing demand for satellite connectivity that we have observed for several years in African Telecoms.



Farhad Khan, CEO of YahClick

AhClick is a joint venture between Yahsat Group and Hughes, serving consumers, enterprises, mobile network operators (MNOs) and governments, using Ka-band capacity on Al Yah 2 and the Africa payload of Al Yah 3 covering 45 countries, YahClick operating in 34 of them. Providing wholesale capacity to other satellite operators. In 2021, it expanded its reach by joining hands with new partners and entering new market segments.

YahClick's markets typically have gaps in terrestrial broadband coverage, where access for government, enterprise and consumer users to high-speed internet is a critical component of national socio-economic advancement. Bridging this digital divide using terrestrial means is costly or operationally challenging, hence YahClick's affordable satellite-based internet services.

In 2021, we widened the scope of our differentiated go-to-market model in Middle East, Africa and Central Asia. Although these markets provide attractive characteristics for satellite operators, they require capabilities and market presence that many satellite operators haven't developed due to a historical focus on selling raw capacity, with such market facing components being performed by specialised satellite service providers focused on higher-end market needs.

We are proactive in offerings further downstream across the value chain, delivering value added solutions, with deeper partnership or go-to-market models. This creates a differentiation and overall value proposition often difficult for competitors to match, giving limited competition.

YahClick partnered with 3 key service partners, second half of 2021, broadening our distribution network, across Africa and Middle East:

YahClick signed a strategic partnership with Global Communications Extension Services Limited (GCES) to provide satellite connectivity for 9mobile, a leading Nigerian mobile network operator. Partnering with GCES brings satellite connectivity to hundreds of cellular backhauling sites, delivering 9mobile a reliable and robust means of rural connectivity across its Nigerian operations. YahClick's satellite services reach more than 60% of Africa's population, and GCES's agreement extends its reach to more regions within Nigeria.

The tie-up with Universal Satcom Group provisions reliable, high-speed Broadband through Al Yah 2 satellite coverage. Yahsat and Universal introduced a comprehensive value proposition to enterprise customers, offering satellite capacity and hosting services to Universal giving the support and capacity to provide their differentiated services. This collaboration is built from the combination of unique product offerings, with both sides coming together to develop the concept of Cooperative Competition supporting unserved territories throughout the Middle East and Africa.

Working with iSat Africa Ltd. FZC, expands YahClick's enterprise solutions business in Nigeria. Zambia, DRC and East Africa, A Pan-African network operator present in 12 markets, iSAT will deliver connectivity solutions for Mobile Cellular Backhaul (CBH) services, business applications, supervisory control and data acquisition (SCADA) systems, and provide remote site connectivity. Connectivity solutions are provided over YahClick's high-throughput satellite (HTS) Ka-band capacity enabling high-speed broadband solutions, with service plans up to 100 megabits per second (Mbps), reaching and serving remote locations. This should impact sub-Saharan Africa market, especially unlocking high demand flexibility in applications like Backhaul or Community WiFi.

YahClick, signed a partnership with HotSpot

Network Limited to support rural telephony for mobile network operators (MNOs) in Nigeria. The technology enables MNOs to expand their coverage, offering uninterrupted data services and high-speed broadband solutions, up to 100 Mbps to remote communities across Nigeria.

Connecting over 20,000 villages will lead to the enhancement of different sectors and will contribute to Nigeria's economic development. Aligning and enabling our mission to lead Africa's digital transformation through innovative services, YahClick is empowering people and companies by confidently supporting them to increase their efficiency and productivity.

YahClick in partnership with the Ministry of General Education in Zambia announced the beginning of a joint project enhancing the delivery of education through E-Learning Platforms, as YahClick's V-Sat Technology and WiFi solutions are introduced nationally to schools.

launched in May 2021 our V-Sat services at Kabulonga Boys Secondary School, in collaboration with the Zambian Government will implement highspeed broadcast connectivity solutions in 2750 locations, with further expansion opportunities outlined soon. Directly supporting children in their studies through e-learning platforms and their learning programme without limit of boundaries.

Due to the pandemic, students in low and middle-income countries lost nearly four months of learning while their counterparts in high-income countries lost only six weeks, catching up via remote learning. For African students these limitations bite harder because, in sub-Saharan Africa, about a third of the population is beyond 3G coverage. Africans in remote communities neither have access to quality education nor quality internet connectivity for virtual learning. YahClick teamed with Service partners to provide e-learning via its broadband service, activating more than 60 sites.

Partnering with South Africa's Department of Telecommunication & Digital Technologies (DCDT) will equip 480 remote Mission Critical Health Centers, at no cost for six months, with satellite broadband to combat Covid-19. Evidencing our social commitment.

With sparse terrestrial network connection in parts of uMzinyathi district YahClick connected 15 schools to e-learning facilities. So far, this initiative has connected 6 000 learners and 200 teachers.

Looking ahead: In recent years there's been broader acceptance of Ka-band reliability for higher-end users and applications, including cellular backhaul provision solutions to mobile network operators, supporting expansion of their 3G, 4G and 5G reach beyond areas connected via fibre. To capture this opportunity, YahClick is implementing several new channel models, to allow it to expand its reach and increase sales across all segments, optimising margins.

YahClick continues to focus on expanding its distribution network in underserved and or growing markets with strong economic and demographic fundamentals, such as Nigeria and South Africa, whilst further penetrating existing markets by developing solutions and services such as: VNO managed capacity service, cost effective internet trunking and backhaul solutions on Ka-band for MNOs and ISPs.

Time limited or data limited, Wi-Fi hotspot service enabling multiple user internet connection, via the same Wi-Fi access point using prepaid vouchers. For example, in Ghana approximately 250 schools have a similar service available. These hotspot solutions are operated in conjunction with the Facebook Express Wi-Fi eco-system and platform, allowing service providers to partner with local communities and local entrepreneurs.

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Carriers expertise

Satellite backhaul

Avanti Communications Avanti Communications is the leading KA-band high throughput satellite capacity partner to the communications industry across EMEA focused on driving connectivity across Africa.

Our mission is to work in partnership with the people of Africa to empower growth, protect communities and unlock opportunities for individuals, businesses and governments, by creating better connections across the continent.

Avanti recently launched Avanti EXTEND, a new managed service for rural connectivity. Avanti EXTEND provides high-performance and cost-effective 2G, 3G and 4G solutions to remote and hard-to-reach areas across sub-Saharan Africa. This enables MNOs and Tower Companies to provide reliable cellular service to the 100 million people living in these challenging locations that would otherwise be impossible to reach using traditional terrestrial infrastructure.



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Es'hailSat

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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 $25.5^{\circ}E/26^{\circ}E$ 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.

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Hughes Network Systems

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Community Wi-Fi

Multinational Networks Hughes Network Systems, LLC (HUGHES), an innovator in satellite and multitransport technologies and networks since 1971, 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 subscribers 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 hundreds of thousands of enterprise sites with its HughesON™ portfolio of wired and wireless solutions. Headquartered in Germantown, Maryland, USA, Hughes is owned by EchoStar. To learn more, visit www.hughes.com or follow HughesConnects on Twitter and LinkedIn.



Russian Satellite Communications Company

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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.

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- 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).



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SatADSL offers satellite services worldwide to operators, teleport & hub operators, government and enterprise bodies, and ISPs. SatADSL, with its neXat platform, is the world's first satellite bandwidth aggregation emarketplace. Speedcast Communications -Global HQ 4400 S Sam Houston Pkwy E

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