chapter 5 Satcoms

Throughout the last dozen or so years that we have been rounding-up developments in Africa's satellite markets for this annual publication, the same three questions have kept coming up: Isn't satellite capacity too expensive? Is there a risk of over-supply? Who needs connectivity from the sky when we have fibre in the ground?

Perhaps a fourth question can now be added to that list: are these issues still relevant for African satellite in 2018?

Certainly, concerns about capacity pricing still dominate discussions both within the satellite industry as well as without it. But now, that conversation is actually about low, rather than high, costs. For instance, in an interview first published in an issue of *Northern African Wireless Communications* magazine last year,[1] the Global VSAT Forum's secretary general, David Hartshorn, said there was a period in Africa where prices rose from USD2,000-3,000 per megahertz to USD8,000 in the space of just one or two years. He said this was created by unsatisfied demand and an undersupply of capacity. But today, with the launch of new types of satellites that offer high throughput coverage over the continent, prices have been driven down into the hundreds of dollars.

According to Hartshorn, capacity costs have historically been regarded in the industry in terms of price per megahertz. He believes this stems from the traditional business model of satellite operators running a wholesale business selling bandwidth.

"The traditional way that the entire value chain, right down to the end customer, has viewed bandwidth is central to the change that is currently under way in the satellite industry globally," said Hartshorn. "But now there is high throughput satellite, new technologies on the ground as well as in other variables in play, where everyone is thinking not in terms of price per megahertz but rather price per megabit."

Innovations in satellite technology – both on the ground with new terrestrial infrastructure, as well in space with satellites that use more efficient propulsion systems that enable more cost-effective launches – are contributing to ongoing price declines for satellite capacity pricing.

In fact, according to the latest *Satellite Capacity Pricing Index, 4th Edition* (*Q1 2018*) report released by Northern Sky Research (NSR) in March 2018, prices have actually fallen for a third straight year. NSR revealed that on average, capacity price declines for 2016-2018 ranged from 32 to 57 per cent across various applications and regions. According to the research firm, the road ahead "appears unclear as greater supply enters the scene, demand lags in some markets and competition intensifies".

NSR stated that while operators are now deploying strategies such as vertical specific market entry partnerships and framework agreements on discounts, these haven't stopped the impact of the widening gap in supply-demand economics. It added that this trend is exacerbated by competitive sales positioning by operators in each region. Despite expecting to see smaller price decreases in 2019, NSR reckons the industry must wait longer for them to bottom out. Report author Gagan Agrawal said: "With video hotspots facing pressure from both global pricing declines and OTT opportunities for non-streaming content, along with consumer broadband over Ka-band HTS consistently in the USD150 per Mbps per month range, the chances of recovery remain uncertain."

But he also pointed to a possible silver lining for the industry: "However, with capex per Gbps for new satellites marking new lows, declining lease prices come as a blessing to service providers in data and mobility, so they can fund expansion of their businesses and create mini telco businesses backed by satellite in the scaling process."

On the issue of over-supply, while some satellite operators acknowledge that there may be a risk here (ABS and Spacecom, for example – see interviews section starting on p70), most believe that Africa currently needs all the capacity and bandwidth it can get. With optimistic forecasts for GDP growth, booming demand for connectivity and digital services, plus a relatively young population for whom the use of mobile devices and services is now not only second nature but also a must, increased connectivity is an imperative for the continent.

Of course, that connectivity could come from satellites high above the Earth or from the cables that are buried within it. But on the subject of fibre, many commentators agree that it will be a long time before such cable networks penetrate deep within Africa's mainland – if at all.

While fibre continues to connect people in urban areas, satellite is still playing a unique role in providing a solution in remote, rural and hard to reach locations. Indeed in many instances, the technology continues to present the only viable solution where fibre cannot reach and mobile operators are unable to cost effectively build and run cellular networks.

"Today, with the launch of new types of satellites that offer high throughput coverage over the continent, prices have been driven down into the hundreds of dollars."

[1] See *Up in the air*, pp27-28, Apr-May issue.

Satellite also represents key infrastructure needed for accelerating digital transition. Last November, Eutelsat pointed out that it had been two years since the expiration of the digital migration deadline set by the ITU for Africa, and yet only six nations on the continent had so far completed their digital transitions. The firm blamed this slow progress largely on the steep challenges faced by countries with a large landmass, mountain ranges or islands that typically remain beyond the range of terrestrial networks, or with interferences issues in border regions, as well as by the question of funding. Eutelsat added: "In most cases, a terrestrial/satellite solution beats standalone terrestrial in terms of cost effectiveness and speed. Homes within a satellite coverage can receive DTT channels immediately without having to wait for new investment in terrestrial infrastructure and its gradual deployment across a territory."

The company believes that without digital migration, African countries are missing out on a number of opportunities that include:

- Transforming the diversity, signal quality and reach of channels into viewer homes
- Generating infrastructure upgrades and stimulating the local content creation industry
- Releasing analogue frequencies for other applications such as mobile services

Thus in answer to the first three questions above, it is apparent that satellite capacity prices are continuing to fall, the risk of over-supply is small compared to satisfying Africa's booming demand for mobile services, and terrestrial solutions such as fibre do not provide the ultimate answer in connecting the continent.

So what about the answer to the fourth question? If satellite was no longer viable in Africa, you would not see all the big name operators continuing to invest in new spacecraft for the region. So until such time when demand for satellite service in Africa begins to take a nosedive, and there is truly ubiquitous coverage from terrestrial network operators, continuing to ask the same old questions about the technology no longer seems relevant. ■

Upcoming missions

Boeing will help expand broadband services in Africa with two new satellites planned for the continent. In a deal worth USD161m, **Spacecom** announced in late December 2016 that it had contracted the company to build *AMOS-17*. The new satellite is expected to be launched in 2019 and will cover Africa, the Middle East and Europe. It will operate from 17°E – the same location that was previously used by *AMOS-6* before all contact with it was suddenly lost at the end of 2015 resulting in its write-off.[2]

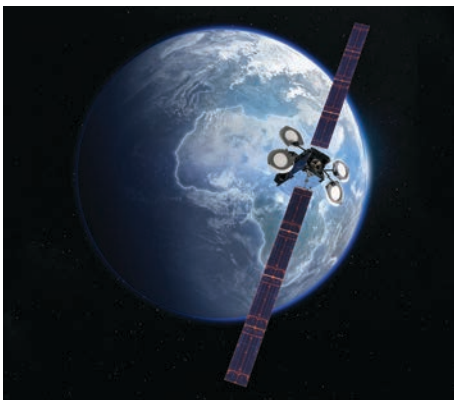
Spacecom said *AMOS-17* will be designed for an in-orbit life of more than 15 years and offer a payload power of around 8.5kW. It will offer Ka-, Ku-and C-band services, and feature a combination of broad regional beams and high throughput spot beams to maximise throughput and spectral efficiency.

In a separate deal announced in September 2016, Boeing will also build *GiSAT* for Cayman Islands-based **Global IP**. The spacecraft will be based on Boeing's *702* platform but with a new digital payload offering twice the capacity of previous designs. Global IP's mission will be to deliver streaming media, digital broadcast and other communications services to sub-Saharan Africa. With a coverage area encompassing 35 countries and 750 million people, it claims GiSAT will deliver higher data rates at lower costs than previous satellites serving the region.

"Our vision for GiSAT is to provide end users with connectivity and services that are affordable, rich in local content and truly broadband in nature," said Bahram Pourmand, CEO, Global IP. "With the ability to reconfigure the GiSAT on-board processor, the Boeing digital payload will allow us to broadcast different channels to different beams from different locations, providing better service to broadcasters, mobile operators and ISPs."

Scheduled to enter service in 2019, *GiSAT* is designed to operate with more than 10 gateways in Europe and multiple gateways within Africa.

Towards the end of 2017, **Avanti Communications** announced that the launch of *HYLAS 4* would be delayed but added that it will be able to save time thanks to the technology behind the satellite.



GiSAT will feature Boeing's new digital payload technology and provide coverage over sub-Saharan Africa. PHOTO: BOEING

Built by Orbital Science, the new Ka-band hybrid propulsion spacecraft features part traditional chemical orbit raising, part electric orbit raising, and electric station keeping. The previously announced launch slot of 4Q17 for *HYLAS 4* would have required around 100 days of electric orbit raising for it to reach geostationary orbit, meaning that it would be on station by the end of 1Q18. *HYLAS 4* was finally launched by Arianespace in early April 2018. Avanti said the launch configuration of this new slot meant that extra chemical fuel was loaded on the satellite as it was paired with a partner spacecraft that was lighter than originally planned. This enabled chemical-only propulsion to be employed and meant that *HYLAS 4* was able to reach geostationary orbit in just 10 days, saving approximately 90 days of electric orbit raising.

As a result, Avanti said revenues from *HYLAS 4* were expected to flow from July as previously planned. It added that the launch configuration also provided sufficient fuel on board to support the new satellite for up to 19 years in orbit, an increase of 27 per cent over previous expectations.

[2] African Wireless Communications Yearbook 2017, pp74-76.

JANUARY 2017

ABS-2A began commercial service on 21 January 2017 following its launch on board a SpaceX *Falcon 9* rocket in June 2016 and subsequent testing. Equipped with 48 Ku-band transponders, the satellite orbits at 74.725ºE and will serve customers in Africa, the Middle East, Russia, South Asia and South East Asia. *ABS-2A* is the second of two all-electric satellites Boeing has delivered to ABS. The operator adds that it has now completed its investment to build and launch three satellites in three consecutive years.

FEBRUARY

Hong Kong's Asia Satellite Telecommunications has agreed to relocate *AsiaSat 8* from 105.5ºE to Spacecom's 4°W orbital position. It will be co-located with Spacecom's *AMOS-3* for a four-year period and is expected to begin service in 1Q17. Spacecom has an option to extend the agreement for an additional year of service. *AsiaSat 8*'s beams will cover Africa, the Middle East and central Eastern Europe, enabling Spacecom to continue serving its customers at 4°W following the end of life of *AMOS-2*.

MARCH

UAE-based Intersat is delivering internet services across Africa following the signing of a multi-year capacity agreement with SES. It will use *NSS-12* located at 57ºE to deliver broadband connectivity to businesses and consumers. The agreement includes a new C-band capacity lease, infrastructure services out of SES' Betzdorf teleport, and a renewal of upgraded Ku-band capacity out of the Djibouti Teleport. The latter is managed by BringCom and has been used by SES since

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New birds

In what it described as "one of the biggest tech refreshes" in history, Iridium finally launched the first orbiters that will eventually replace and enhance its existing network of LEO satellites that span the entire globe.

The first 10 that comprise the operator's *NEXT* constellation were originally due to be launched by SpaceX in September 2016. But the loss of Spacecom's *AMOS-6* on the launchpad[2] resulted in a backlog in SpaceX's schedule. Iridium's satellites were eventually sent to space on 14 January 2017. They were delivered to a 625km temporary parking orbit where they were tested before being moved into their 780km operational orbit a few months later.

These first 10 satellites are the start of what the company claimed will be the largest commercial fleet in space, providing 100 per cent truly global communications coverage.

SpaceX planned to carry out seven more launches for Iridium over an 18-month period, deploying ten *NEXT* satellites at a time. One-by-one, these new birds will be positioned near a current generation Iridium satellite, each moving at around 17,000 miles per hour as testing begins. Iridium said "unique" inter-satcom links from nearby satellites will be repositioned to point to the new *NEXT* spacecraft as it prepares to take over service. Existing satellites will eventually be de-boosted and de-orbited, and the entire Iridium *NEXT* network is scheduled to be completed by mid-2018.

A SpaceX Falcon 9 rocket lifts-off with the first 10 LEO satellites for Iridium's NEXT constellation.

At the end of January, **Intelsat** announced that it had finally gone live with what was claimed to be the first multi spot beam, Ku-band, high throughput satellite (HTS) service for the EMEA, APAC, Mediterranean and Indian Ocean regions. *Intelsat 33e* was successfully launched in August 2016 and is the second satellite to use the company's *EpicNG* HTS platform. It was due to enter service at the end of 2016,[3] but this was delayed due to a malfunction in the primary thruster which meant orbit raising took longer than originally planned. The satellite eventually entered service on 29 January 2017.

Manufactured by Boeing, *Intelsat 33e* is said to be equipped with the "most advanced" HTS payload design that is also "exceptionally flexible". From its orbital location of 60°E, Intelsat said the new spacecraft will enable the delivery of enterprise-grade, broadband services to fixed and mobile network operators, aeronautical and maritime mobility service providers, and government customers. Some of the African customers committed to *Intelsat 33e*'s vast geographic coverage include Orange Cameroon, Djibouti Telecom, Africell, MultiChoice, Vodacom, Telkom South Africa, amongst others.

Intelsat said its global footprint of satellites that use the *EpicNG* HTS platform will be completed following additional launches over 2017-18. This included *35e* which left Earth on board a *Falcon 9* on 5 July and now orbits at 325.5°E where it replaces *Intelsat 903* which was redeployed. *35e* is delivering C- and Ku-band services for wireless infrastructure, mobility, broadband, government and media customers in the Americas, Caribbean, Europe and Africa. Orange, INWI, Sonatel and Speedcast were named as among some of the first customers using the satellite's capacity.

Intelsat 33e was launched on an Ariane 5 rocket last August, but its in-orbit testing was delayed.

The launch of the company's fifth HTS satellite did not go to plan and had to be re-scheduled following an earlier failed attempt. *Intelsat 37e* was due to go up from French Guiana on board Arianespace flight *VA239* together with its co-passenger, Japan's *BSAT-4a*, on 5 September. But lift-off was stopped due to an "out of specification condition" on the launch vehicle. The following day, Arianespace said: "Just after the ignition of *Ariane 5*'s main stage *Vulcain* engine, the on-board computer detected an anomaly affecting electrical equipment on one of the two solid-propellant boosters (EAP). This anomaly led to an interruption of the automated lift-off sequence."

The electrical equipment was replaced and after carrying out all related checks, Arianespace said that it was planning for a launch as "early as possible". Following a delay of more than three weeks, *37e* finally blasted off on 29 September. Intelsat was expecting to begin commercial services in 1Q18 after all in-orbit tests are successfully completed. The new satellite orbits at 342°E and will be

[2] African Wireless Communications Yearbook 2017, pp74-76.
[3] African Wireless Communications Yearbook 2017, p76.

2014 after it installed a nine-metre Ku-band antenna and hub equipment at the site.

APRIL

Gilat Satcom is providing satellite connectivity to Orange in the DRC. Following its acquisition of Tigo's operation in the DRC in 2016, Orange says it has seen greater demand for broadband and cellular services across all sectors in the country. Gilat Satcom and its local partner Raga Sat were previously providing 400Mb to the operator and this has now increased to 1Gb. Orange will use the additional capacity to support its international data, domestic and backhaul networks.

MAY

Ethiopia's Information Network Security Agency (INSA), which is responsible for the transformation of the country's high-tech and security industry, will use capacity on *EUTELSAT 8 West B* to deliver services from its new Ethiosat broadcast platform. *EUTELSAT 8 West B* orbits at 7/8°W which, according to its owner, is the "prime" video neighbourhood for North Africa and the Middle East. Ethiosat plans an initial launch of nine national channels.

JUNE

Asian satellite operator Thaicom has teamed up with Intersat to launch a managed satellite network service for African enterprises and governments. The platform will use capacity from *THAICOM 6/AFRICOM 1* which orbits at 78.5°E. Intersat will manage the end-to-end service from its teleport and NOC in Nairobi which features iDirect's

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used by broadband, mobility and government customers, not only in Africa but also in Europe and the Americas. It replaces *Intelsat 901* which will be repositioned to another location. Built by Boeing, the all-digital *Intelsat-37e* has full beam interconnectivity in C-, Ku- and Ka-bands, and also includes enhanced power sharing technology and steerable Ku- and Ka-band beams.

On 26 December 2017, a *Zenit-2SB* launch vehicle successfully lifted off from the Baikonur Cosmodrome in Kazakhstan carrying **Angosat-1** – Angola's first satellite. Developed by Russian company RSC Energia, *Angosat-1* will orbit at 12.8°E with a payload that includes 22 C- and Ku-band transponders. The satellite is said to have a conventional capacity equivalent to 44 transponders of 36MHz which covers all of Africa and parts of Europe.

Despite a successful launch, ground teams lost contact with the spacecraft in the days that followed. However, on 29 December Energia announced that the satellite was now communicating and that its onboard systems were functioning normally.

Angosat-1 will be operated by InfraSat which was established in 2008 as an independent business unit of Angola Telecom. InfraSat executive director Diogo de Carvalho said that the new satellite had registered a lot of interest from national operators, and that contract negotiations were ongoing.

For instance in July we reported that DRC-based satellite operator Renatelsat had signed a deal to use capacity on the satellite. It joined Angolan Public Television as one of the first two companies to sign for capacity on the USD320m spacecraft.

The deal marked the official campaign to commercialise capacity. Renatelsat executive director Richard Achinda said *Angosat-1* will allow the expansion of his company's services in neighbouring countries as well as into Angola. Multichoice Angola's communication director, Adilson Garcia, added that *Angosat-1* will enable national operators to take advantage of satcoms services locally and in national currency – unlike providers from America and Europe where payment is made in foreign currency.

Expanding services and markets

While 2017 only saw a handful of new launches for the continent (but still more than 2016 which saw significantly fewer lift-offs by comparison), it was on the ground rather than in space where most of the new market activity happened.

For example, NSSLGlobal announced that it was working with Lagos-based ISP and system integrator Coollink to bring L-band coverage to remote parts of Nigeria where mobile services are non-existent or erratic. Speaking earlier last year, Coollink's Nadim Chidiac said: "Satellite remains the only viable means of providing universal internet access beyond the reach of terrestrial communications in emerging markets."

NSSLGlobal believes that by investing in local agents such as Coollink, it is stimulating technology development and business opportunities in Nigeria which is Africa's largest economy. From its Cape Town office, the firm said it brings together the "best-in-class" satellite solutions from key market providers, offering options across L-, C, and Ka-band networks. NSSLGlobal also owns a fully operational VSAT network, including six teleports, 23 beams and 15 satellites covering 95 per cent of the Earth's surface, and with specialist services for land-, sea- and air-based applications.

iWayAfrica launched what it described as a "much needed" pan-continental Ku-band managed retail satellite service. With *Jola* – which is said to mean 'one who brings happiness' – the company said it can provide affordable satellite internet in sub-Saharan Africa, including areas with limited connectivity options. iWayAfrica claimed *Jola*'s pricing is lower than any existing Ku-band satellite service, and that it offered users flexibility to select a monthly data allowance and speed according to their needs. With pre-defined, branded packages available throughout its retail channel and extending across all user profiles, the company said the service effectively addresses both business and household needs. Some of the features offered include the *Jola SOS* business continuity service, a 1GB emergency data advance for those occasions when a user's data allowance has expired, free night usage, and others.

Gazprom Space System's (GSS) *Yamal-402* satellite was kept busier in Africa over 2017. In mid-February, the Russian operator announced that the satellite's capacity was used for the *2017 Africa Cup of Nations* football tournament that was held in Gabon at the start of the year. The event was broadcast by Equinoxe Televison Cameroun

A Zenit-2SB launch vehicle being prepared to launch Angola's first satellite.

Evolution hub technology. The two partners say their new offering provides a fully managed, customised turnkey service.

JULY

Globecomm has added the South Indian Ocean passage between the southern tip of Africa and Australia to its Ku-band VSAT network. The operator claims the expanded footprint now provides 100 per cent coverage of all major shipping routes to address new market demands. Globecomm's network already covered the Barents Sea, north of Scandinavia. The company says the extension was in response to its customers having increased transit to the South Indian Ocean area.

AUGUST

Thaicom is providing iSAT's key customers in East Africa with fully managed telecoms services via satellite, including backup of its fibre network. In the event of the company suffering any fibre outages, Thaicom will provide IP connectivity via *THAICOM 6*. The Thailand-based operator adds that its services are based on a point-to-point satellite link between its designated teleport and iSAT's remote site, thus providing uninterrupted access to the network.

SEPTEMBER

Belgium-based GlobalTT has completed an upgrade of its inbound C-band service which offers pan-African coverage. The VSAT operator says it now offers 2Mbps using a 'regular' modem or 3Mbps using a 'professional' one. It adds that download capacity is still up to 30Mbps. GlobalTT has also upgraded its inbound Ku-band capacity that is claimed to offer satellite connectivity anywhere on the continent. The service works using a small 1.2m dish and is now said to offer more than 1Mbps upload speeds as well as up to 30Mbps downloads.

using *Yamal-402*'s Southern Beam which covers sub-Sahara Africa. GSS said it will work with Equinoxe on further plans to develop business for full-time and occasional use TV broadcasting.

As the winner of the tournament, Cameroon was able to participate in the Confederation Cup that was held in Russia in June 2017. Once again, *Yamal-202* was used to arrange backup links for TV broadcasting of Confederation Cup games. It will also be deployed during the FIFA World Cup Finals due to start in Russia on 14 June 2018.

In a capacity deal signed in late April, UAE-based **HorizonSat** will use *Yamal-402* to provide internet connectivity in the Central African Republic, DRC, Kenya, Tanzania, and other countries. According to GSS, its satellite's Southern Beam offers good coverage of Central and Eastern Africa, while cross-strap with *Yamal-402*'s European Beam will enable HorizonSat to use its teleport in Munich which is connected to high-speed internet backbones.

Gilat Satellite Networks (GSN) also struck a deal with GSS in late 2016 to use *Yamal-402*'s Southern Beam to deliver services based on its *SkyEdge II-c* technology in sub-Sahara Africa. The capacity is initially being used to implement broadband connectivity in schools and deliver services to mobile operators in rural Ghana.

In February, **CETel** announced that it had upgraded its extended C-band service from **Arabsat** to meet increasing demand in the mining sector. As part of the upgrade, CETel is utilising more than 50MHz of extended C-band capacity from *Arabsat-5C* which orbits at 20°E. It is using this to deliver up to 200Mbps to critical and sensitive operations in the natural resources industry, as well as connectivity to rural areas in many countries, especially Mali, Niger, Nigeria, DRC and South Africa. CETel and Arabsat have been long-term strategic partners. For instance in 2015, they built an Earth station which uses a 9.3m antenna at CETel's teleport in Ruppichteroth, Germany.

In a separate deal, Arabsat and Office National de la Telediffusion (ONT) signed an agreement to launch a Tunisian broadcast platform on

Cameroon clinched their fifth title after defeating seven-time champions Egypt in the 2017 Africa Cup of Nations final.

Arabsat's *BADR-4*. It started operating around the end of Q217 and gives Tunisian and regional broadcasters direct access from Tunis to the growing 26°E neighbourhood with coverage encompassing MENA and Western Europe. Rohde and Schwartz was chosen for the installation and commissioning of the platform which is said to use the latest technical specifications.

Staying in Tunisia, **Globalstar** said that oil companies working in the country were turning to its satellite systems to monitor their fleets and safeguard workers.

In 2015, Arabsat and CETel built an Earth station which uses a 9.3m antenna at CETel's teleport.

Virtual Mobile Data (VMD), Globalstar's local partner, worked with local technology firm Neuron Technology Systems to design the *integrated Vehicle Monitoring System* (*iVMS*). It's claimed this switches seamlessly between Globalstar's simplex satellite network and land-based GSM/GPRS networks in the event of outages or transmission failures.

In VMD's most recent deployment, a Ukrainian oil services company is using 30 *iVMS* devices which incorporate Globalstar's *SmartOne B* simplex tracker to help its oil exploration and production customers monitor their vehicle fleets and safeguard staff across Tunisia Earlier in 2016, Tunisian civil works contractor Kilani Enterprise for Public Works deployed *iVMS* to track its fleet of 4x4 vehicles for better security and to help monitor driver behaviour. Kilani has also been using Globalstar's *SPOT* handheld devices since 2013 as its only means of safeguarding staff carrying out operations in southern Tunisia's vast desert.

In a third deployment, VMD integrated *SmartOne B* transmitters with GPRS devices from another local reseller for a Tunisian company that supports oil industry firms. The unnamed company's services include providing equipment, transportation, site maintenance and staff services. It is using 56 *iVMS* devices to track transporters and containers carrying mechanical and oil rig equipment used in petroleum production.

Monaco-based **Sonema** extended an agreement with Intelsat to provide satellite services to enterprises in Africa. Sonema is a telecoms service provider which owns and operates two teleports in France. The company said it supports more than 650 VSAT sites for banking and financial institutions across the continent, and the majority of the networks are supported by C-band services from *Intelsat 14* which orbits at 315°E and *Intelsat 904* at 60°E.

Using Intelsat's global infrastructure, Sonema said it will provide "enhanced" communications services to customers on the continent.

OCTOBER

Vivacom has signed a multi-year contract with Eutelsat for C-band capacity in order to expand its video business in Africa. According to the Bulgarian telecoms services provider, the aim is to provide contribution services for international channels seeking carriage by major African pay-TV operators. The first six channels are already being uplinked to *EUTELSAT 8 West B* via Vivacom's Plana teleport located around an hour away from Sofia. Plana is also one of Eutelsat's partner teleports, and is certified by the World Teleport Association.

NOVEMBER

ABS will expand its VSAT technology using equipment from UHP Networks. Over the last five years, the satellite operator has rolled out several UHP-based networks across Africa and APAC providing internet and VSAT connectivity. It now plans to deploy new services in the Middle East. ABS will use multiple high-density redundant *UHP-HTS* hubs and *UHP-100* remote routers for the expansion. It's claimed the technology will provide a high-availability, bandwidth-efficient and cost-effective service to ABS customers.

DECEMBER

Teledata de Moçambique will use satellite technology to backhaul its 2G, 3G and banking application sites across Mozambique. The state-owned telco will utilise two Ku-band spot beams on *Intelsat 33e* to provide web access and file transfer capability along with equipment from Newtec. The latter includes the vendor's *Dialog* platform with the *4IF* hub module at its core. Newtec says its *MDM3310* satellite modem will also be used for backhaul, while its *MDM2500* IP satellite modem will connect hundreds of ATMs at remote sites, as well as providing backup connectivity for regional bank branches.

According to Intelsat, the agreement ensures that Sonema's customers will be able to expand their operations knowing that each of their sites will have access to the same level of reliable broadband connectivity, regardless of location.

Under the multi-year extension, Sonema has integrated C-band connectivity from *Intelsat 33e* (*see New Birds, above*) to expand services to more remote regions of Africa. Sonema said the combination of the *33e* and *14* satellites will enable it to provide customised solutions, with a focus on "robustness and high quality of experience".

Speaking at the time, the company's managing director Catherine Delom said: "The banking sector is a major growth engine for Africa. As such, our customers depend on the highly reliable and secured corporate networks we deploy and maintain for them.

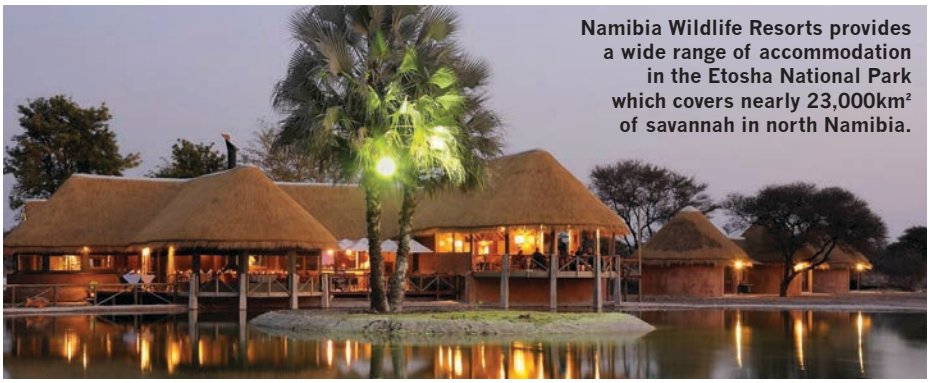
"*EpicNG* will also enable the option to offer our customers new, innovative solutions and services that can be easily delivered via C- and Ku-band spot beams to the most remote locations."

There was a further connectivity boost for Africa's banking sector with news in April that **eProcess International** will use a high throughput satellite platform to expand and strengthen its corporate banking services throughout the continent.

The company, which is a subsidiary of pan-African banking conglomerate Ecobank Group, connects head offices and affiliates across 27 countries, enabling transactions and corporate data exchanges through its network.

Given the growth in commerce across the region, eProcess needed to enhance its network to address increasing transaction volumes for its customers.

The company's HTS solution uses Intelsat's C-band spot beam capacity that is now available on *Intelsat-35e* which was launched later in July 2017. The capacity complemented eProcess' existing network at the time. This was based on wide beam C-band connectivity on *Intelsat-903* which was due to be re-deployed in late 2017.



Namibia Wildlife Resorts provides a wide range of accommodation in the Etosha National Park which covers nearly 23,000km² of savannah in north Namibia.

Claude Edmond Traoret, group manager for technology services at eProcess, said: "Our banking and mining customers across Africa will truly benefit from these latest improvements, as *EpicNG* enables us to deliver over 30 per cent more throughput, driving improved economics within our business model."

SatADSL has been helping wildlife reserves to offer Wi-Fi connectivity to tourists. The Belgium-based African VSAT specialist said it is offering a hotspot solution with multiple wireless connectivity applications to safari parks in very remote areas.

The parks often provide accommodation for tourists during safaris. These lodges are usually located within or near national wildlife reserves, and offer activities such as game drives. Different types of lodges are available, from rustic camps to luxury designs, with the latter expected to provide Wi-Fi connectivity even if they are located in remote areas.

SatADSL said it makes remote wireless network access possible with its *Safari Solution*. One of the latest users is Namibia Wildlife Resorts. It provides a wide range of accommodation in the Etosha National Park which covers nearly 23,000km² of savannah in the north of Namibia. SatADSL said its solution enables visitors to stay connected, and added that selling Wi-Fi access vouchers to tourists also generates extra profit for the parks.

In a separate announcement, the company said it had participated in a "unique and extraordinary" pilot application that involved the use of satellite telemetry to track animals in Namibia and Kenya. The pilot was made possible with the support of the *SATLAS* project and in collaboration with the European Space Agency (ESA) and SES.

SATLAS is run by the ESA and was concluded in September 2017. It served as an incubator for developers to test and refine innovative ideas over satellite, in order to verify their viability from a technical and business model perspective.

SatADSL was involved in one of five pilots that where conducted in Africa and Europe. It helped national safari parks in Namibia and Kenya who wanted to be able to determine the number of animals, locate them for protection, monitor their movements, and quickly identify sick or abandoned ones. The application it helped test also provides an alarm signal if an animal leaves a specific area. All information is stored in the animal's tracking device and communicated to orbiting satellites. ■

Lluc Palerm-Serra, Senior analyst, Northern Sky Research

The year ahead: With the arrival of HTS, satellite has found a new niche to serve in consumer broadband. According to NSR's *VSAT and Broadband Satellite Markets, 16th Edition* report, consumer broadband will add more than 11.6 million new subscribers in the next ten years, the majority of them coming from international markets.

Half of the world's population is still unconnected to the internet (ITU, 2017[4]), and satellite must step in and play a definitive role in connecting unserved and underserved populations. NSR estimates the global addressable market for satellite internet at 472 million households. With ground alternatives continuously expanding and other key barriers like affordability at play, the vast majority of these potential customers will not be captured by satellite. However, compared with today's 2.5 million active subscribers, there is still a massive opportunity ahead for satellite consumer broadband.

Most of the addressable market resides in emerging markets in Latin America, Middle East and Africa and Asia; collectively they represent 90 per cent of the potential global subscribers.

Having said that, a massive addressable market does not mean attracting customers will be easy and effortless. Several of the early projects have fallen in the 'build it and they will come' trap, not putting enough emphasis on developing strong retail channels. Early broadband offerings from Thaicom/IPStar, Yahsat, Eutelsat and Avanti (among others) were initially met with lacklustre demand and challenging growth.

Awareness is another major barrier as satellite broadband is completely unknown for many potential customers.

Finally, affordability certainly drags growth, but the industry must pay a closer look into market conditions before being discouraged by low average income levels.

[4] https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf

Daniel Losada, VP international sales, Hughes Networks Systems

Dharmendra Singh, Regional director, sub-Saharan Africa, Hughes Network Systems India

Hughes credits itself as the pioneer of VSAT technology. Today, as well running a fleet of 24 satellites that it either owns, leases or manages under the *EchoStar* name, it provides a variety of services as well as its *JUPITER* high throughput satellite (HTS) platform.

"One unique thing about us is that we are across the complete vertical market," claims Daniel Losada. "So we do everything from managed networks, we also sell hardware, and then we offer complete turnkey solutions for enterprise users as well as for consumers not only in satellite but also in terrestrial communications. So as a company we cover every part of satellite communications."

However, when it comes to running its own branded satellites and offering a network that operates under that, Hughes primarily focuses on the Americas, and company spokespersons have previously said that *EchoStar* will never fly over Africa. Why not?

"We have been doing some exciting work with the main providers here in Africa that are offering the same type of services that we offer with our satellites in the Americas," said Losada. "Locally and regionally within Africa, we work very closely with Intelsat, Eutelsat, SES, and others.

"Other providers of broadband connectivity over satellite in Africa – such as Yahsat, Konnect Africa and Global IP which is going to be launching here in the next couple of years – are all going to be doing broadband connectivity over Africa in different ways and in different approaches to the market. One might be doing trunking, the other might be doing direct retail, and another might be doing all of this through channel partners to empower the regional and in-country providers. Avanti is also on our older platform and we are working with them on their plans for new satellites, etc. [Losada points out that this is currently at the discussion stages and is therefore preliminary]. These are all Ka-band HTS providers and mostly come from outside of the region but deliver connectivity through local presences.

"In more regional networks we work very closely with, for example, Intelsat, Gondwana and other providers, as well as some local and regional telcos that have setup their own VSAT networks.

"So we work here with all of those operators on their new high throughput satellites. We partner with them and have very good coverage in terms of technology and equipment."

As a result, Losada suggests that there is therefore perhaps no need for Hughes to launch a dedicated bird for Africa when it is already being serviced by both the major operators as well as the relatively smaller Ka and other specialists. Instead, he believes that what Hughes can bring to the continent, is its technology expertise. "One of the new frontiers is trying to look at new applications for these latest satellites, like higher throughput backhauling for LTE growth, aero connectivity, and other mobility services. That hasn't been done a lot in Africa as yet but now, with these HTSs, the possibilities are great for us to really enhance what satellite does."

Losada continued by saying that advances in technology are helping to bring down the prices of satellite connectivity for the end user, but he reckons the more important story is how much more you can now do with the equipment with that price.

"The dependency that people have on being connected is growing so much that you have to have the technology to match that. With the new capabilities that we are bringing to bear with the equipment, and the integrated solutions that you see [cites Konnect Africa and its Wi-Fi integrated units], the way people access a satellite network is no longer about connecting a cable to a modem; now it's about using your own devices to connect into a satellite network.

"So the user experience has dramatically improved because you have more throughput, and people are accessing the network over their mobile device which already has a lot of optimisation built into it to address latency challenges and to support the latest applications."

In terms of industry applications, satellite has traditionally been used in Africa to provide cellular backhaul but has Hughes now seen the emphasis shift to broadcast and broadband? Here, Singh said that while the company has always offered backhaul services, this had not been the main focus. But now, he says there is a specific Hughes' team developing cellular backhaul solutions led by his predecessor, Vinay Patel.[5]

"We want to take our cellular backhaul solution over satellite to the next level, and are even looking at how we can be ready ahead of time for 5G.

"While some of the competition were talking about backhaul and announcing solutions, we were just supporting it. But now it is a primary focus for us as it might lead to satellite operators deploying a few hundred or thousand satellite terminals and that is a bigger pipe. With consumer broadband you can probably fit in around 10,000 sites in a transponder. With backhauling, the satellite operator probably ends up selling one transponder for 10 sites. So for them it is probably an easier and more lucrative business."

Losada said that Hughes is developing entry-level gateways that suit the telco's model because they allow them to have few sites with high throughput which is exactly what they have been looking for. "We have created products now that are fully focused on the kind of environment where you have high-end terminals that have high packets per second processing capability and can also manage many TCP sessions. We have combined that with a gateway that has a small footprint but packs a lot of density, enabling higher speed trunks."

According to Losada, the push for greater security – both in terms of homeland services as well safeguarding the network – is another driver for the satellite business in Africa, especially in the northern part.

"The best way to be able to do this is in a satellite environment that offers assured connectivity when you don't have line of sight connectivity or when the infrastructure might be down. Let's face it, the first thing that gets hit in a lot of attacks is the comms infrastructure. Satellite connectivity is the best way to maintain connectivity in a lot of ways, and so you are now seeing that the need to protect your communications is one of the most important things for this region.

"We have been developing a series of products and features that will allow you to have satellite connectivity on multiple platforms; that could be on an aeroplane or even on helicopters because we have a new waveform that is capable of communicating through the [rotor] blades. We have very specialised small terminals that allow you to be highly portable and move into many areas. We want to bring that to the security forces here in Africa.

"On the IP side of things and cyber protection, we are bringing in some of the knowledge that we have in protecting our own networks to some of customers. That whole mix of everything – from broadband connectivity to people communicating with their mobile devices and then also being able to secure communications for the emergency responders and the military forces – basically brings our whole portfolio to Africa. And working mostly through our partners, operators are using Hughes' technology to really connect the whole continent and the next generation."

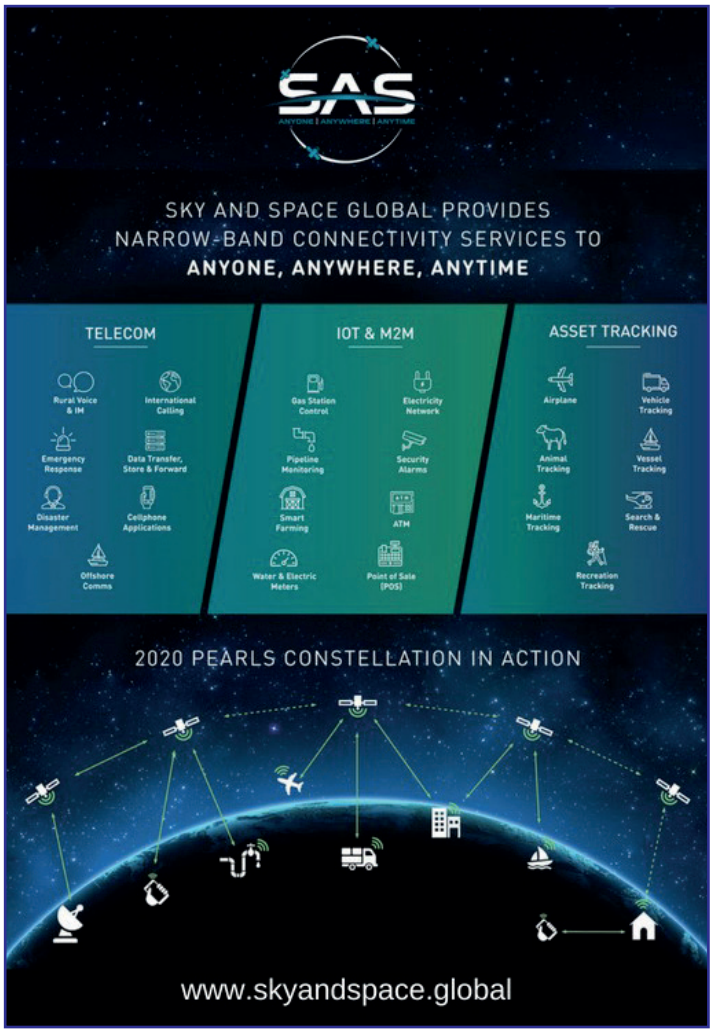
When asked what the company hopes to achieve over the course of 2018, Singh said "more face time" with customers is one priority: "That is something that we have not done for the last few years. Secondly, we want to be part of more cellular backhauling opportunities with MNOs. Thirdly, we want to create a partner network across Africa. We would like to have a partner in every country who represents us and works with the customer on a day-to-day basis."

Losada added by saying that Hughes' aim with this third priority is to capture at least one mobile operator network in each country, and enhance its presence throughout the continent.

Singh continued: "By the end of the year, you will probably see our market share growing significantly. There are two sides to it. If you talk about the number of terminals, we probably already have the highest share but you will see it as, for example, Avanti's market share, or Eutelsat's market share, or Yahsat's, etc., because what they are selling is our products. The second is the enterprise side and what we're going to do with direct sales. Our focus will not be on what percentage share we have in Africa, but on what our direct sales percentage will be."

Losada believes one of the biggest challenges here is ensuring a proper payment structure that not only enables customers to be comfortable but also means that Hughes is not exposing itself to a level of risk. "We get through the technical bits fairly quickly. What drags and takes the longest time is making sure that all the funding is coming from the right places and that the investment is happening. For example with USO programmes, you need to make sure that you don't get interrupted by elections somewhere or some disruption in the country."

According to Singh, Hughes' products have always been considered to be ideal for large or



[5] African Wireless Communications Yearbook 2015, p81.

complex networks, but he admits that for smaller networks there are probably other options. "At the beginning of 2017, Dan and I decided that for Africa we needed to have a product which has high-end specs but can start with significantly lower capex for the VSAT operators.

"We now have that product and are using it to compete in more opportunities. It is not easy to get to a VSAT operator whose competition is the incumbent. But most of them are seeing that product of ours to be very lucrative. And when it comes to their next decision-making cycle, I think we stand a very strong chance of replacing some of their existing [equipment]."

Losada concluded by saying that Hughes expects to grow, probably in the 20-30 per cent range, in 2018 in Africa. "This is based on the focus, the right product placement, and on the fact that we see a lot of interesting connectivity in the growth of newer networks here. We offer the right mix and the environment is good for us in Africa."

Dmitry Sevastiyanov, Director general, Gazprom Space Systems

Russian satellite operator Gazprom Space Systems (GSS) has been well known in the African market since 2013. It runs a fleet of four satellites of which *Yamal-402* covers the continent with Ku-band services from 55°E, as Dmitry Sevastiyanov explains.

"There are three beams on the satellite to serve the African market – Southern, European and steerable. The Southern beam has high energy characteristics and covers a significant part of sub-Saharan Africa, Madagascar and the adjacent waters of the Indian Ocean. The European beam covers North Africa and the Middle East, as well as most of Europe. Our customers are able to operate within the African coverage in the Southern beam and to use a cross-connection between the European and Southern beams. The steerable beam that can be also connected with Europe, is now pointed at Egypt."

Sevastiyanov said that *Yamal-402*'s capacity is multi-purpose and can be used for communication channels of various types, TV broadcasting services, broadband internet access, etc. And despite strong competition in the African market in recent years due to the appearance of a large number of new satellites, he claims *Yamal-402*'s capacity remains "very popular".

"Currently, the African and Middle Eastern markets account for approximately 50 per cent of all foreign currency earnings for Gazprom Space Systems.

"In 2017, many customers operating on *Yamal-402* increased their capacity utilisation to offer more satellite services to their users. In particular, Telemedia expanded its use of the satellite's capacity in order to support 'Occasional Use' services for South African TV companies (sports and political events coverage). There was also the extension of a capacity contract for Angolan state television. A new contract has been signed under which a new horse racing channel will be broadcast via *Yamal-402*.

"GSS also reached an agreement with Gilat Satellite Networks, providing broadband internet access to schools as well as services to cellular network operators in rural areas of Ghana.

"One of the leading satcom providers within the African market, HorizonSat, has been using *Yamal-402*'s capacity since 2017 to provide internet access in Central and Eastern Africa. The Southern beam has a good coverage over this region, while the cross-connection with the European beam allows the use of HorizonSat's teleport in Munich which offers a high-speed connection to European internet nodes."

Sevastiyanov continued by adding that the Southern beam's capacity is popularly used for SNG. "In most cases, it is used for broadcasting high profile social and political events in African countries, as well as sports reports. In 2017, it was used to broadcast the African Cup of Nations as well as the Kenya Championship."

Sevastiyanov said that no operators can consider 'Occasional Use' as the main source of profit. Nonetheless, he said that such use increases the orbital capacity fill rate and brings new customers to utilise the satellite's capacity on a permanent basis. "In addition, these particular services and solutions clearly demonstrate the unique capabilities of satellite communication in terms of responsiveness and global coverage."

As well as broadcasters, Sevastiyanov said large providers offering satcoms services to global energy, oil and gas companies in Africa also extended their contracts and increased the volume of capacity leased on *Yamal-402* in 2017. However, and primarily in the corporate sector, he added that satellite communication has been particularly sensitive to pressure from fibre optic networks over the last years.

"In areas where optical fibre is laid, cheaper offers for trunking appear and, accordingly, satellite capacity demand on the side of ISPs and mobile operators decreases. However, cases of cable damage, that quite often happen, indicate the vulnerability of non-redundant communication networks. For example in July 2017, an accident on an underwater fibre cable stretched along the coast of Africa deprived West African countries of internet access. A little earlier (again due to a cable break), Angola experienced problems with internet access. GSS knows this first-hand since our *Yamal-402* was engaged to remedy the situation."

Sevastiyanov said that such events and realities of life therefore suggest that satcoms will continue to be in demand despite the introduction of fibre networks across Africa.

In terms of the future, he said the optimistic forecasts about the growth in global demand for mobile data, objects and devices are forcing all the players in the telecoms industry to rethink their business strategies. "Everyone understands that future solutions will be a combination of terrestrial and satellite technologies. The obvious advantages of satellite communication will enable

it to find its place in future innovative projects. This confidence about satcom's future is shared by our industry colleagues and most experts, and this encourages us to further development."

Sevastiyanov concluded that in around a year, GSS is planning to put into operation a new satellite, *Yamal-601*. Orbiting at 49°E, this will replace *Yamal-202* which has been located here since 2003. "Despite its age, *Yamal-202* continues to attract interest from providers operating in North Africa and the Middle East. This therefore sets the scene for the subsequent successful implementation of the capacity of the new *Yamal-601* which will assume its predecessor's entire customer base."

Flavien Bachabi, Managing director, Africa, ABS

Flavien Bachabi describes 2017 as an "interesting year" for ABS which saw opportunities and challenges posed by the economic and political instabilities in key Africans countries. He also said the company did "exceptionally well" in the video market where its contracted multiple transponder deals with DTH operators.

"We saw a trend where regional DTT operators are looking to expand into the DTH services. We have three satellites serving the continent for both DTH and contribution links. *ABS-2* and *ABS-2A* have a strong video neighbourhood at 75°E. Both satellites are well positioned for video operators broadcasting in East and Central Africa. *ABS-3A*, at the strategic location of 3W°, is highly suited for pan-African coverage with excellent look angles. African pay TV subscribers are expected to grow by 73 per cent by 2023, reaching 41m with total revenues growing to USD6.6bn. Most of the channels delivered to this growing media subscriber base will be delivered via satellite due to satellite unmatched reliability, security and efficiencies."[6]

"The data market has been a bit sluggish with constant pressure prevailing on lowering the price. We saw consolidation amongst the mobile operators on the continent and an emerging trend where they consolidated the capacities on a global level with one or two vendors. We have managed to secure our position as one of the preferred vendors with some of these operators.

"We have also been successful in growing our VNO business for broadband services on both C- and Ku band though our partners. NSR believes enterprise network demand for wide-beam Ku-band will remain strong with a 10 per cent CAGR forecasted through 2022 supporting oil and gas, banking and wireless backhaul networks."

When asked how ABS saw the wireless communications market adapt and evolve in Africa in 2017, Bachabi said that although 54 countries on the continent are now connected with submarine cables, 66 per cent of the population still lives outside the 25km reach of a fibre node. "The last mile terrestrial connectivity has always been a challenge in Africa, hence we see wireless communication securing its prime position. We see the wireless market getting crowded between various competing technologies be it; WiMAX, FWA, GSM, LTE, satellite, and more."

He continued by saying African smartphone usage has been increasing as less expensive, Asian handsets have made their way to the continent. "In 2017, there was a 45 per cent increase in smartphone usage versus 2016. According to Ovum, the smartphone penetration rate will grow at 52.9 per cent year-on-year. Currently, there are 293.8 million smartphone users across the continent. Ovum predicts there will be 929.9 million smartphones by 2021.

"Data applications over mobile and handheld [devices] have pushed the demand for more bandwidth as a result of which we have seen mobile networks transformed from 3G to 4G/LTE. This has led to the increase of domestic backhaul and internet backbone capacities.

"Ka-band satellite operators have made broadband services more affordable for rural areas with lower entry cost of hardware, though we still see them struggling to get desired volumes.

"Also, we've seen a digital migration in the video sector where the terrestrial DTT networks have been replaced with satellite which have simplified operations and reduced the overhead costs of maintenance."

When it comes to the challenges in Africa for 2018, Bachabi agrees there are now too many satellite operators covering the continent and that there is a danger of over-supply. "Undoubtedly yes, there is an oversupply of satellite capacities in the region. Today, Africa is served by many satellite operators around the world flooding dedicated capacities in the marketplace, and many undersea and terrestrial fibre operators that have penetrated this region extensively. Even some African countries are looking to pursue their own indigenous satellite programmes which will further augment capacities.

"Moreover, the demand for satellite capacities has declined with the penetration of fibre in the continent, thereby dropping the price expectations for satellite bandwidth. Overall, the demand-supply gap has further increased.

"Compounding supply-demand problems is the growth of the HTS supply expected to come into the market over the next five years. NSR believes operators will launch up to 1.3Tbps of GEO and non-GEO HTS capacity into Africa through 2022."

Bachabi said that other challenges include Africa being impacted by the global economic situation. "We see countries like Nigeria, Angola, Chad, South Sudan, Ethiopia and others affected with either devaluation or struggling with a shortage of forex.

"Political instability is also a major factor that hinders growth, particularly in key markets like DRC, Zimbabwe and South Sudan."

With *ABS-2A* entering commercial service last year, ABS concluded its launch programme of three new satellites. "All these satellites have high-performance C- and Ku-band beams focused on the continent. With state-of-the-art teleports in Germany, Cyprus, South Africa and Kenya, we offer managed teleport services for our data and video clients in Africa. We hope to enhance the value proposition to our clients in the coming year with more creative services.

"Looking ahead, we see growth in the video area with media operators looking to aggregate and share ethnic contents locally (within the same countries) and regionally (within economic sub-regions and continent-wide). Video penetration is still very low in Africa, and capacity on *ABS-3A* and *ABS-2* can help the growing demand for such services. Also, the rapid expansion of terrestrial and submarine cables calls for backup capacity of satellites to make the networks more resilient and secure.

"We expect that the difficult economic and financial situation of the largest countries will ease over the next few months, and that those countries will resume investing. The mining and oil and gas industries are also sectors that drive the use of satellite bandwidth for their communication needs."

When asked if ABS is interested in LEO missions or whether they present a threat to established MEO operators, Bachabi said the company is looking at the new constellations and what impact they might have on business.

Having said that, he said ABS "excited" by the development in the industry, and looked forward to seeing the progress of LEO operators. "This could bring a big relief to operators and clients running data applications which are latency sensitive. However, LEO's success will be determined by the commercial proposition offered by the operators, both on the capex for the ground infrastructure as well as bandwidth costs. If LEO constellations are successful, they could expose many people to satellite technology and the benefits our industry can offer.

"We shall be focused on the GEO satellite business and are quite confident that there is enough market for both GEO and LEO operators. Although we see a small drift of market share to LEO (based on a successful commercial model), eventually the market size will only grow for the satellite industry.

"Most research organisations show significant growth for LEO bandwidth on the consumer side for broadband access. ABS believes enterprise network and media distribution and DTH customers will continue to demand high quality,

[6] Source: IDG Connect.

high availability GEO FSS satellite technologies to ensure their networks are up and running without the threat of significant outages."

Jacob Keret, SVP sales Europe, North Africa & Middle East, Spacecom

Despite the loss of two key satellites over the last few years,[7] Jacob Keret is keen to point out that Spacecom is neither down nor out.

"Just to give you the bottom line from the start, we have recovered from these two events. We leased *AMOS-7* from AsiaSat for four to five years and it has replaced *AMOS-6* for some customers. It has been operational since March 2017 and has allowed us to recover from the loss of *AMOS-6*."

Spacecom is planning to launch its next satellite, *AMOS-17*, in early 2019. It will replace *AMOS-5* to orbit at 17°E, and feature a digital payload that offers Ku-, Ka- and C-band services.

"It is a HTS on the C-band, and we will have 12 beams covering sub-Sahara Africa. It will also have Ku-band for broadcasters and four steerable Ka beams that can be used for either commercial or military tasks as well as broadband internet. As with *AMOS-5*, *AMOS-17* will also cover Europe so that west and central Europe can be connected to Africa, and the same goes for India and the west part of China."

Keret continued by explaining that since the loss of *AMOS-5* in November 2015, Spacecom has basically preserved or kept some of its customers on different satellites, and continued to provide them with services on these other operator's spacecraft.

"That was the immediate response. We have about 10 customers that remain with us and hopefully they will remain until we bring in *AMOS-17*. In Africa, [the loss of *AMOS-5*] caused us to develop less business and so we developed our businesses in other parts of the world, mainly in central and eastern Europe. We also expanded with *AMOS-4* at 65°E into Nepal. That was part of the company's strategy to expand business into some parts of Asia, and we will continue to develop this orbital slot which is perfect to operate over South East Asia."

When asked whether Africa's satellite industry is suffering from a perceived high cost of capacity, Keret said: "It's no secret that the prices went down over the last two or three years, and the good thing is that in 2017, from our perspective, there were less than 10 new orders for satellites. That means the satellite operators realise that there is overcapacity in the market, not only in Africa but worldwide, and basically you see fewer launches. And fewer launches mean that the prices will hopefully be more stable.

"But they went down to a level where new companies can setup, because if you sell a megahertz for USD3,000-3,500 or sell it for USD1,500, that difference allows newcomers to enter the market.

"Africa needs the capacity because the smartphones are taking a great part of it. Many low cost devices are coming into the region and they of course need voice connectivity and low rate internet. So we definitely see growth."

Many satellite operators seem to be addressing the market more for broadband and broadcast. Does Keret see this trend?

"With our C-band beam on *AMOS-17*, we are aiming to continue to try to sell services for cellular backhaul. Of course, although there are terrestrial solutions for this, there are still some uncovered places and satellite plays a role in that.

"Mobility is one of the applications in which we see growth – maybe not as yet in Africa, but it will come in terms of maritime, air mobility, as well as services on the ground.

"It is not going to be to be easy. There are quite a lot of newcomers in countries, such as Angosat, launching

[7] African Wireless Communications Yearbook 2017, p74 & 76.

satellites over Africa. But I think that the era where there is oversupply will end in 2019-2020 because this is the cycle of our industry. Sometimes the prices go up and sometimes they go down. I think the more challenging thing would be to actually acquire Tier 1 customers like we did in the past."

When it comes to having any interest in non-geo satellites, Keret said that Spacecom is looking into this segment but emphasised that it had not as yet made any decisions about this. "This is definitely on the business development side of our company, and we have to keep pace with the trend. We don't currently have any structure planned. But we are not a big company, and I would assume that if we come to non-geo satellite it will be through a partnership with other companies.

Meidad Pariente, CTO & founder, Sky Space and Global

Sky Space and Global (SAS) describes itself as the first company to plan, build and operate a commercial telecoms network using nanosatellites. According to the firm, the low mass and high capabilities of these satellites makes them the preferable choice for constellations and applications in what it terms the "New Space" industry.

SAS plan to launch 200 satellites, providing equatorial coverage and beyond. These will be placed in synchronised orbits that circle the Earth almost every 90 minutes. The satellites will communicate between each other to create a mesh in the sky where each one serves both as a base station and a router. SAS said the aim is to create a network to provide narrowband communication suitable for IoT, M2M, personal voice and messaging. It said the fleet will operate in the S-band frequency range that enables a very small device with patch antenna (8cm) or monopole antenna and low power consumption.

In 2017, SAS signed its first binding commercial contract with a wholesale customer, Sat-Space Africa. It is also working with African startups such as Universal Cyberlinks to help deliver digital services to citizens of Ghana, and BeepTool which provides mobile apps and services.

To help service providers to reach more customers, SAS has developed a dedicated *Android* application called *Chatellite* which, it's claimed, will provide affordable chat, voice and messaging services to people living in areas with poor or no network infrastructure. The app will be integrated into Social Finance Systems USD1 smartphone as well as BeepTool's mobile payments, messaging and voice app that is said to be used by more than 800,000 customers across Africa and globally. SAS is also testing connectivity solutions for farmers in Africa and other regions with its partners WeFarm which is described as the world's largest knowledge and data network for small scale farmers.

SAS was founded by Meidad Pariente who started as an engineer working with Spacecom on *AMOS-1* and went on to become deputy mission manager of *AMOS-2*, chief systems engineer of *AMOS-3*, and special engineering advisor for *AMOS-5*. Meidad was eventually appointed chief systems engineer and led a team of technicians and scientists designing the *VENUS* project, an Israeli-French hyperspectral satellite, before establishing SAS in 2015. The company made its debut at *AfricaCom* in November 2017, which is where we caught up with Pariente and asked him about what stage he had reached in SAS' mission.

"Four months ago we launched the predecessor, the *3 Diamonds*, as a technological demonstration. These are in a low Earth orbit of 500km. We proved that we could perform voice calls, data forwarding, instant messaging over the nano-satellites, and we also proved the capability to integrate to other customers. We also did financial transactions and even used a USD1 smartphone to communicate to our system.

"We are currently around five months before starting production of more than 200 satellites for the full constellation. The satellites are being built by a subcontractor in Denmark, GOMSpace, which was the same company that built the *3 Diamonds*. We already have four launches contracted with Virgin Orbit, and are currently between the preliminary and final designs of the system. Once this is finalised, we will start building the satellites at a rate of two per week. We will then start launching in batches at the end of 2018. Each and every batch can be anywhere between two to three dozen, and every quarter we will launch a batch."

Pariente said that SAS will be able to launch M2M and IoT services with the first batch, and expects to begin commercial services for these applications in early 2019. Real-time services, such as voice, are expected at the end of the following year – the *2020 Vision*, as Pariente called it. By this time, the company expects to have around 200 satellites in orbit. For real-time services, the fleet will cover the planet at 15°N and 15°S, while for M2M, the satellites will be located at between 18°N and 18°S.

"There will be five orbital planes on altitudes between 700km and 740km. We will reserve another altitude, 750km, for replacement satellites, and will replace them whenever technology improves. It is a bit like changing your smartphone where you replace a completely operational model simply because there is a new one available on the market. Technology improvements will allow us to provide better services, and so we will decommission completely working satellites and replace them with new ones. They will decay all the way down to the atmosphere and because they are small enough, they will burn just like shooting stars."

Pariente explained that a typical nanosatellite measures around 30cm x 10cm x 10cm. He said that SAS' next generation spaceraft are called the *Pearls* and are much more capable. "Each one is about half a metre long and the diameter of the solar panels is about three metres long. This satellite will provide about 100W for the payload so it is like a mini communication satellite. Its lifespan is at between three to seven years but it will be replaced after four years.

"Within our system, we have redundancy built-in. So it is okay to lose even several satellites and still keep the availability and connectivity required because they are overlapping."

All this sounds very expensive and capex intensive. But Pariente claims SAS' programme is not as expensive as conventional satellite missions for comms. "The entire system, including the redundant satellites and the launches, is USD150m. To put one of our satellites in space is about half a million dollars. As I mentioned, there are five orbital planes, and when we replace we replace a full plane so that means around 40 satellites. It will be roughly around 20-25 million dollars to replace a full orbital plane.

"The breakeven point is one million customers – and we already have two million customers signed and waiting for the service. You can find announcements about everything and all customers on the website."

In Africa, SAS plans to cover the continent's central and equatorial zones, meaning that the northern and southern regions will not benefit. But Pariente pointed out that for M2M and IoT services, the company has the ability to increase services on demand. "The first three satellites, the *3 Diamonds*, are in polar orbit. That means they can cover each and every point on the globe between 10 and two times a day depending on the latitude. The higher and lower the latitude, the more passes you have. If demand will come from Mediterranean areas or even South Africa, we have to plan to add additional satellites in polar orbits in order to allow M2M services with gaps of 10 to 15 minutes."

Why did SAS decide to focus on the narrowband market rather than broadband which is what other LEO operators are planning? "So far it was untapped and unserved because of the capital expenditure. But if you compare our capex to other satellite service providers, you will find that ours is about five to ten per cent of theirs. The narrowband communications services market is so huge that we anticipate that other players will also enter the market."

Parente goes on to say that SAS has a lab in Poland where it has developed modulation technology that will allow any kind of terrestrial protocols to be converted into the IP protocol that will be used by its network. "This process is very straightforward and we already have several successes. It allows us to be agnostic because we will have a converter between LoRa and IP, and Sigfox and IP, and so on. The converter is on the ground. The data packets going up to the satellites will already be IP and they are conveyed within the routers as IP and then converted back into the relevant protocol for the end use.

"All of our hardware uses software defined radio which is again something that is very unique. Our satellites also have the ability to change frequencies based on location. That means that the same satellites will transmit and receive in one frequency over Africa, and then in another over South America, and a third frequency over Latin America or South East Asia. And they would do that automatically based on location.

"Also very importantly, we have the ability to build *ad hoc* communication networks. Let's say you have (God forbid) a natural disaster somewhere in the world within our service area that makes all the ground infrastructure collapse. The homeland security services can connect to us and ask for a specific frequency, and our satellite will adjust to cater to their needs whenever they are above these countries and then they will switch back. Building ad hoc networks is something that the space industry has never offered to customers as far as we know, and the ability to automatically switch frequencies is also something which is quite unique."

At this point, Pariente explained that SAS' entire proposition across the board strives to be highly cost-effective. "That means that not only are the satellites affordable, the launches are affordable, the service is affordable, the end user devices are affordable, and the prices are affordable. It will vary a lot based on geographical location because we want to reach the masses. This means that we have the capability to cater to each and every need based on the fact that we have a huge margin between the current prices on the market and what we can offer and still be profitable."

But why would customer's choose SAS' satellite network over terrestrial-based services, such as cellular or fibre, for example? "We're not competing with MNOs and ground infrastructure. We are providing a complementary service in regions that have no connectivity regardless of the technology. You have a lot of areas in the world that have no cellular networks, no fibre, not even copper lines. The only technological solution is satellite connectivity but it is too expensive and that is a barrier for a lot of people as well as a lot of companies.

"We're not competing with a service that already exists. So if you are a telco, we are not trying to take customers away from you; we are trying to bring you more customers because now you can provide your services anywhere, not only just in major cities."

Pariente concluded by saying that he does not refer to other telcos and CSPs as competitors to SAS. Instead, he believes that there are only "partners" and "future partners". ■

A new world of possibilities with the new

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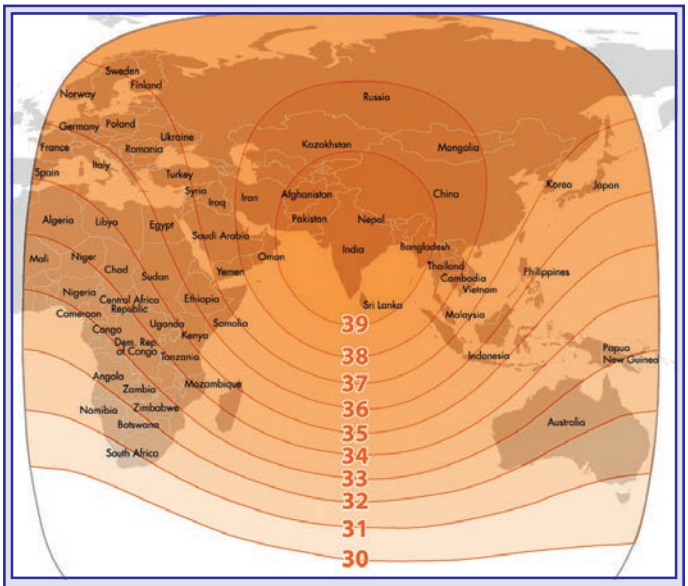
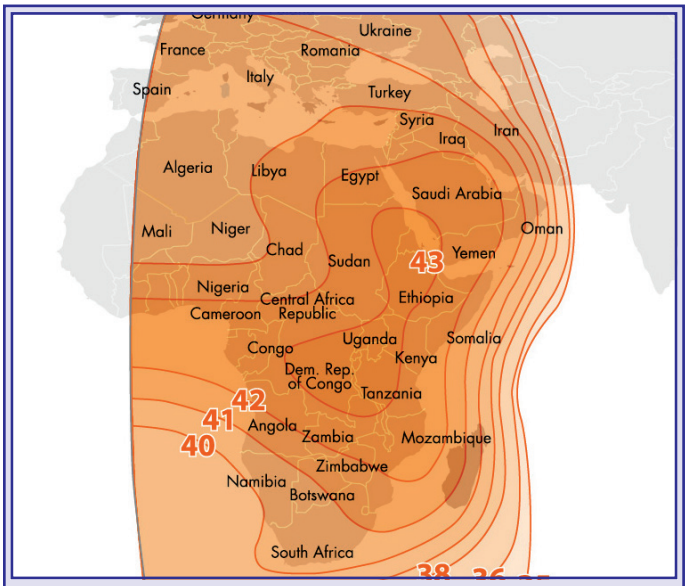


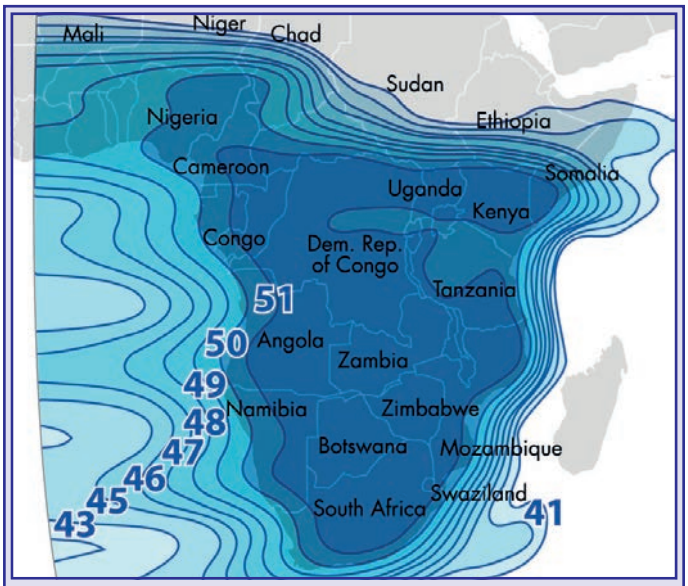
ABS-2: 75°E – Global beam

Launch date:	February 2014
Transponders:	Up to 32
Bandwidth (MHz):	36, 72, 104
Uplink/downlink frequencies (GHz):	Standard & extended
Uplink/downlink signal polarisation:	Linear horizontal/vertical
Cross-polarisation separation:	Better than 27dB
EIRP (peak):	45dBW
TWTA size:	62W
TWTA redundancy:	34
G/T (peak):	+6dB/K



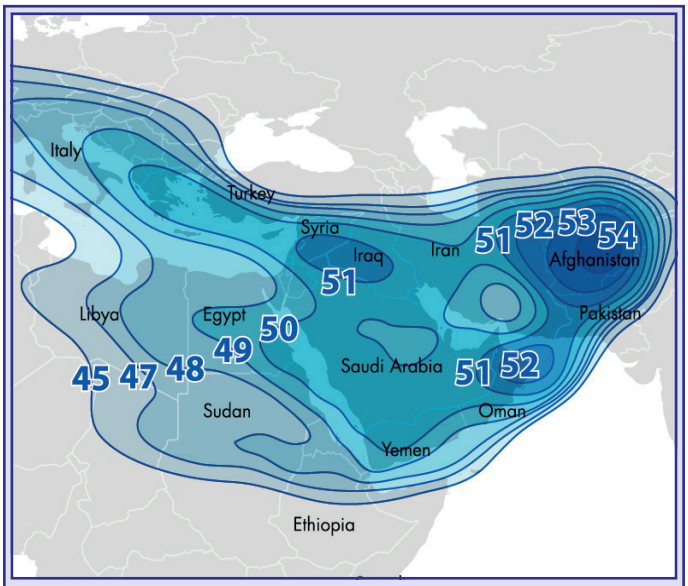
ABS-2: 75°E – West hemi beam

Launch date:	February 2014
Transponders:	Up to 32
Bandwidth (MHz):	36, 72, 104
Uplink/downlink frequencies (GHz):	Standard & extended
Uplink/downlink signal polarisation:	Linear horizontal/vertical
Cross-polarisation separation:	Better than 27dB
EIRP (peak):	45dBW
TWTA size:	62W
TWTA redundancy:	34
G/T (peak):	+6dB/K



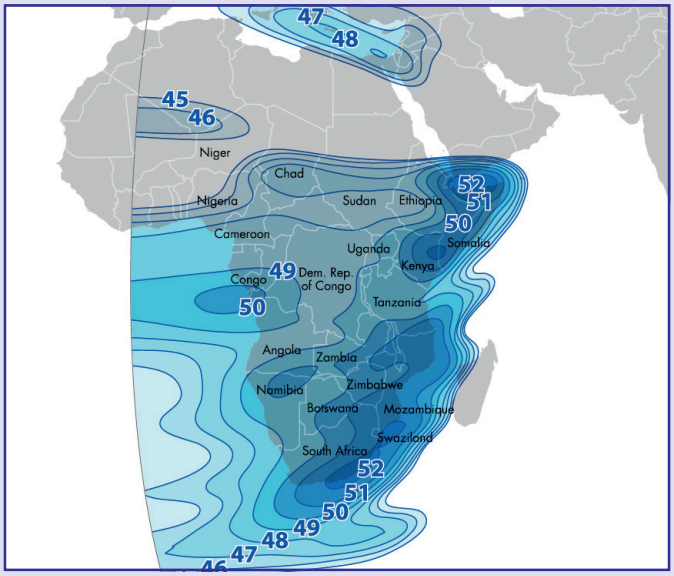
ABS-2: 75°E – South & Central Ku-band beam

Launch date:	February 2014	
Transponders:	**Ku-band**	**Ka-band**
	Up to 51	Up to 6 (commercial & military)
Bandwidth (MHz):	54, 108	435 (commercial), 225 (mil.)
Uplink/downlink frequencies (GHz):	FSS & BSS	Commercial & military
Uplink/downlink signal polarisation:	Linear H&V	Circular RHCP & LHCP
Cross-polarisation separation:	Better than 27dB	
EIRP (peak):	53dBW	49dBW
TWTA size:	143W	117W
TWTA redundancy:	52	6
G/T (peak):	+7dB/K	+2dB/K



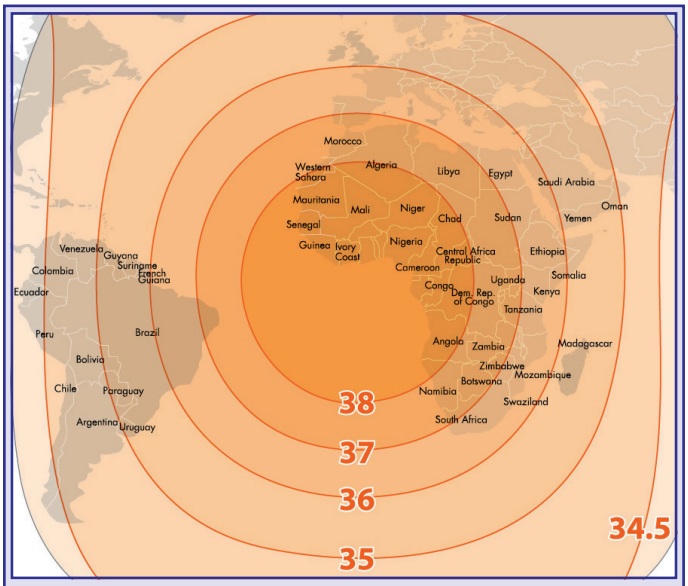
ABS-2A: 75°E – MENA Ku-band beam

Launch date:	June 2016
Number of transponders:	48
Transponder bandwidth (MHz):	54, 72, 108
Uplink frequencies (GHz):	13.750 to 14.800 & 17.300 to 18.100
Downlink frequencies (GHz):	10.950 to 11.200 & 11.450 to 12.750
Uplink/downlink signal polarisation:	Linear horizontal/vertical
Cross-polarisation separation (dB):	> 27
EIRP (peak value) (dBW):	52
TWTA redundancy:	48 for 40 (with eight active spares)
TWTA size:	150W
Uplink SFD (dBW/m2):	-96 to -74 (0 dB/K G/T)
G/T (peak value)(dB/K):	7



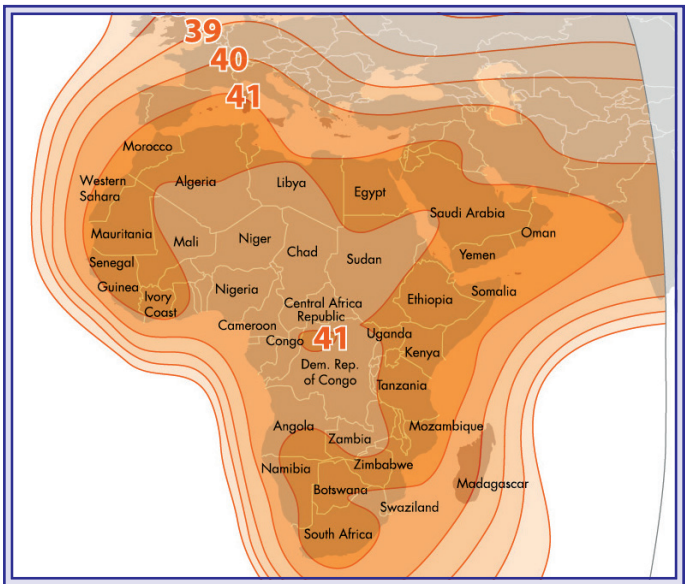
ABS-2A: 75°E – Africa Ku-band beam

Launch date:	June 2016
Number of transponders:	48
Transponder bandwidth (MHz):	54, 72, 108
Uplink frequencies (GHz):	13.750 to 14.800 & 17.300 to 18.100
Downlink frequencies (GHz):	10.950 to 11.200 & 11.450 to 12.750
Uplink/downlink signal Polarisation:	Linear horizontal/vertical
Cross-polarisation separation (dB):	> 27
EIRP (peak value) (dBW):	52
TWTA redundancy:	48 for 40 (with 8 active spares)
TWTA size:	150W
Uplink SFD (dBW/m2):	-96 to -74 (0 dB/K G/T)
G/T (peak value)(dB/K):	6



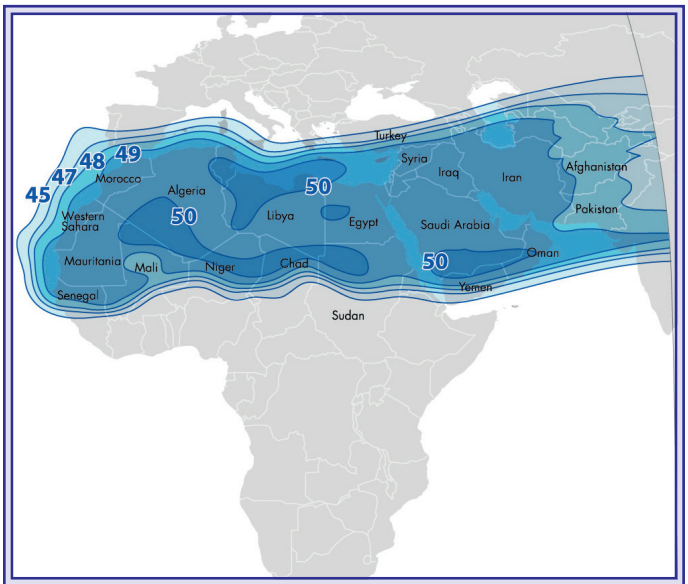
ABS-3A: 3°W – Global beam

Launch date:	March 2015	
Transponders:	24 C-band 72MHz; 24 Ku-band 72MHz	
C-band uplink/downlink:	5.850 to 6.425GHz/3.625 to 4.200GHz	
Ku-band uplink/downlink:	13.750 to 14.750GHz/10.700 to 11.200GHz	
	11.450 to 11.700GHz, 12.500 to 12.750GHz	
EIRP (peak value) (dBW):	**C-band:**	**Ku-band:**
	39 (global)	49 (Europe)
	41 (east hemi)	50 (MENA)
	42 (west hemi)	49 (SAF)
	51 (Americas)	
TWTA size:	70W	150W
Polarisation:	Linear horizontal/vertical	



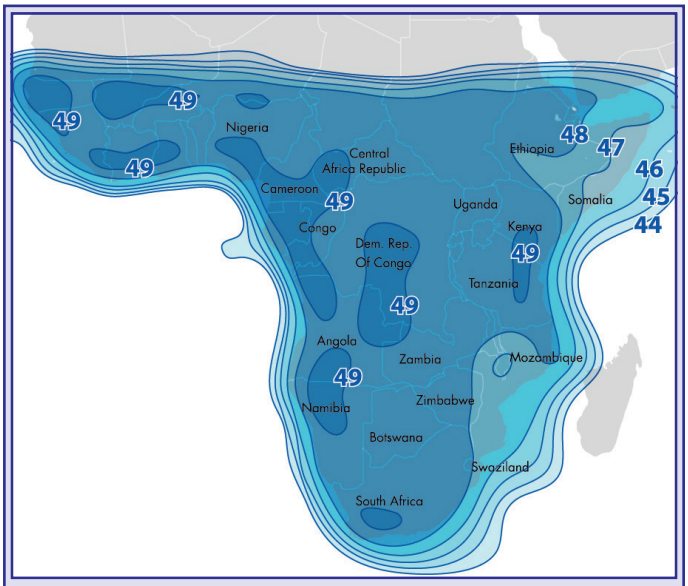
ABS-3A: 3°W – East Hemi beam

Launch date:	March 2015	
Transponders:	24 C-band 72MHz; 24 Ku-band 72MHz	
C-band uplink/downlink:	5.850 to 6.425GHz/3.625 to 4.200GHz	
Ku-band uplink/downlink:	13.750 to 14.750GHz/10.700 to 11.200GHz	
	11.450 to 11.700GHz, 12.500 to 12.750GHz	
EIRP (peak value) (dBW):	**C-band:**	**Ku-band:**
	39 (global)	49 (Europe)
	41 (east hemi)	50 (MENA)
	42 (west hemi)	49 (SAF)
	51 (Americas)	
TWTA size:	70W	150W
Polarisation:	Linear horizontal/vertical	



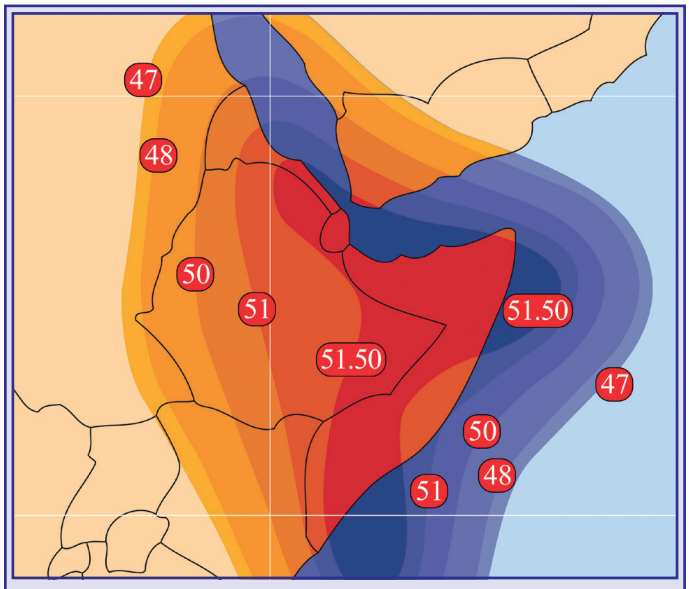
ABS-3A: 3°W – MENA Ku-band beam

Launch date:	March 2015	
Transponders:	24 C-band 72MHz; 24 Ku-band 72MHz	
C-band uplink/downlink:	5.850-6.425GHz/3.625-4.200GHz	
Ku-band uplink/downlink:	13.750-14.750GHz/10.700-11.200GHz	
	11.450-11.700GHz, 12.500-12.750GHz	
EIRP (peak value) (dBW):	**C-band:**	**Ku-band:**
	39 (global)	49 (Europe)
	41 (east hemi)	50 (MENA)
	42 (west hemi)	49 (SAF)
	51 (Americas)	
TWTA size:	70W	150W
Polarisation:	Linear horizontal/vertical	



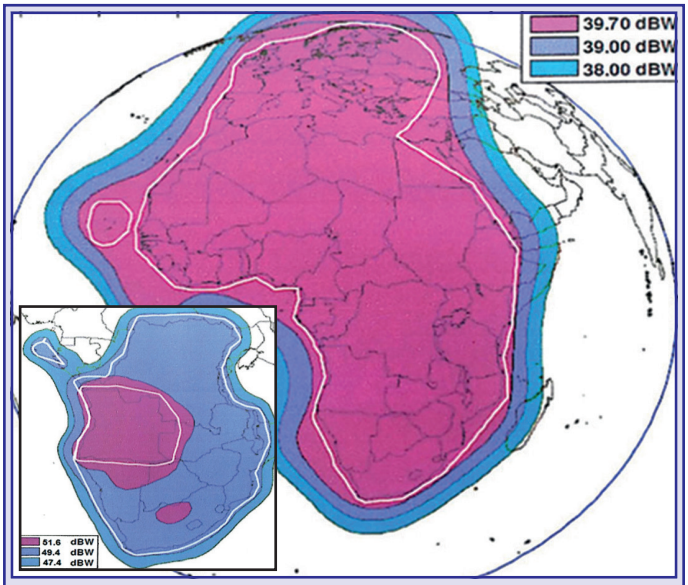
ABS-3A: 3°W – SAF Ku-band beam

Launch date:	March 2015	
Transponders:	24 C-band 72MHz; 24 Ku-band 72MHz	
C-band uplink/downlink:	5.850 to 6.425GHz/3.625 to 4.200GHz	
Ku-band uplink/downlink:	13.750 to 14.750GHz/10.700 to 11.200GHz	
	11.450 to 11.700GHz, 12.500 to 12.750GHz	
EIRP (peak value) (dBW):	**C-band:**	**Ku-band:**
	39 (global)	49 (Europe)
	41 (east hemi)	50 (MENA)
	42 (west hemi)	49 (SAF)
	51 (Americas)	
TWTA size:	70W	150W
Polarisation:	Linear horizontal/vertical	



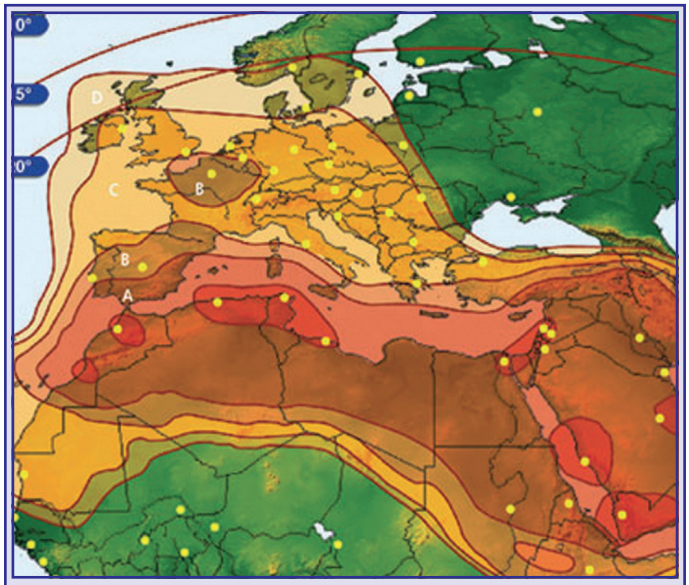
AMOS-4: 65°E

Launch date:	August 2013
Transponders:	4 x 216MHz Ka-band (steerable beam)
Band-1 uplink frequency range:	27.5 to 31.0GHz
Band-1 downlink centre frequencies:	19.875 or 20.125 or 20.375 or 20.625GHz
Band-2 uplink frequency range:	29.625 & 29.875GHz
Band-2 downlink centre frequencies:	18.325 & 18.575GHz
Uplink/downlink polarisation:	RHCP/LHCP
EIRP at beam peak (dBW):	51.4
G/T at beam peak (dB/K):	8.9 (Ka1); 9.9 (Ka2)
Saturated flux density (dBW/m2):	-72 (min) -92 (max) (Ka1);
	-75 (min) -96 (max) (Ka2)



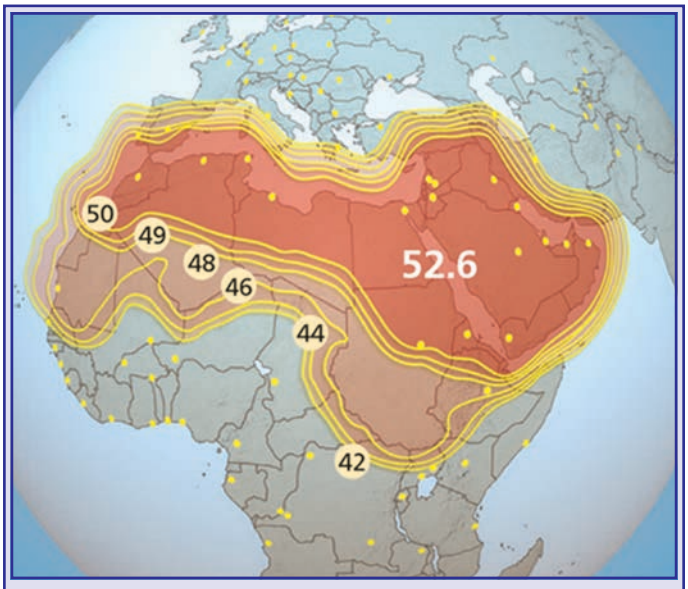
Angosat 1: 12.8°E

Launch date:	December 2017
Manufacturer:	Airbus
Lifespan:	15 years
Transponders:	16 C-band 72MHz (coverage zones: Africa & Europe, and Cape Verde); 6 Ku-band 72MHz
C-band uplink/downlink:	3570 to 4130MHz/5795 to 6355MHz
Ku-band uplink/downlink:	10990 to 11160MHz/14040 to 14210MHz
Polarisation:	Linear C-band; circular Ku-band
Minimal EIRP:	39.7dBW (C-band); 49.4 to 51.6dBW (Ku-band depending on zone)
Power consumption:	3704W
Propulsion:	8 x SPT-70 stationary plasma thrusters
Nominal SFD:	-86 dbW/m2 (C) -86 dbW/m2 (Ku)
C-band G/T:	No less than -6.0dB/k
Ku-band G/T:	No less than -0.2dB/k



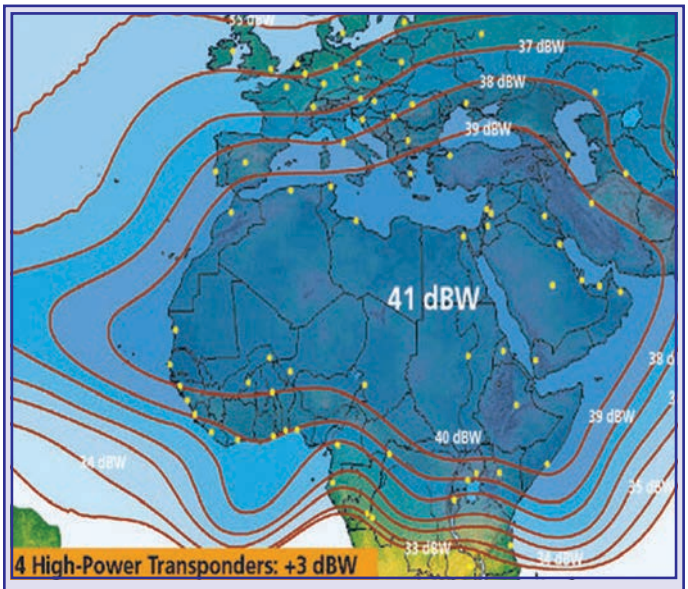
Arabsat BADR-4: 26°E

Launch date:	November 2006
Transponders:	Ku-band/FSS – 16 LTWTAs for 12 active channels
	Ku-band/BSS – 20 TWTAs for 20 (BOL) or 16 (EOL)
Bandwidth:	Ku-band/FSS: 36MHz
	Ku-band/BSS: 34MHz
Frequencies:	Ku/FSS: 13.75 to 14.00GHz (uplink); 12.50 to 12.75GHz (downlink)
	Ku/BSS: 17.30 to 18.10GHz (uplink); 11.70 to 12.50GHz (downlink)
Polarisation:	Linear horizontal/vertical
Typical G/T:	Ku-band/FSS 6.2dBK; Ku-band/BSS 3.2dB/K
Typical EIRP:	Ku-band/FSS 51.8dBW
	Ku-band/BSS 51.8dBW



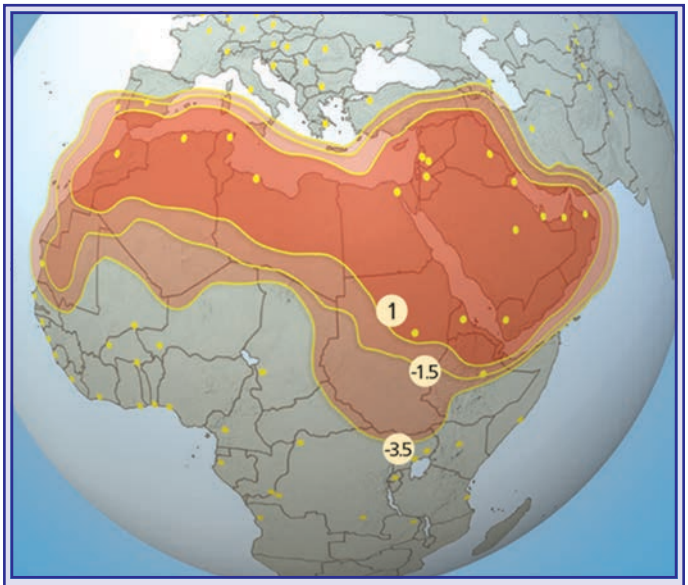
Arabsat BADR-5: 26°E

Launch date: June 2010
Frequencies: Ku-band/FSS MENA Uplink:13.75-14.00GHz
Downlink: 12.50 to 12.75GHz
Ku-band/FSS Apx-30B MENA Uplink: 13.00 to 13.25GHz
Downlink: 10.70 to 10.95GHz
Polarisation: Linear horizontal/vertical
Transponders: Ku-band/FSS switchable to Ku-band FSS Apx-30B MENA 12x36MHz
Typical G/T: Ku-band/FSS switchable to Ku-band/FSS Apx-30B MENA 2.2dB/K
Typical EIRP: Ku-band/FSS switchable to Ku-band/FSS Apx-30B MENA 52.6dBW



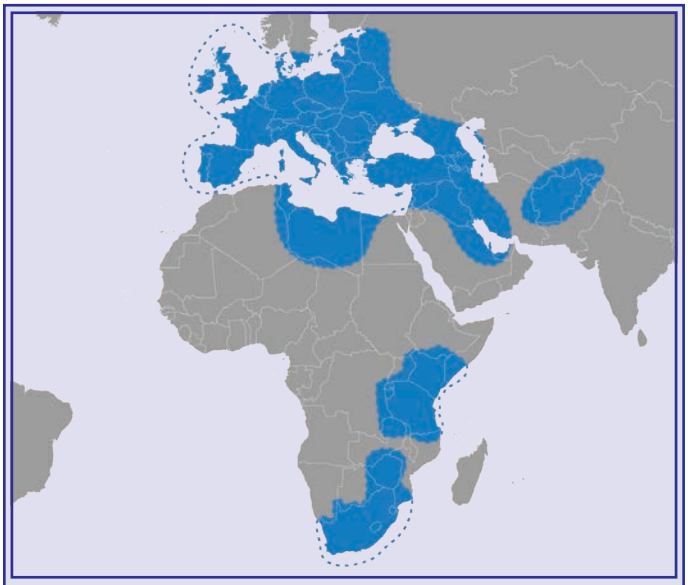
Arabsat BADR-6: 26°E

Launch date: July 2008
Transponders: Ku-band/BSS 20 (BOL) or 16 (EOL)
C-band – 30 TWTAs for 24 active channels
Bandwidth: Ku-band/BSS: 34MHz; C-band: 36MHz
Frequencies: Ku/BSS: 17.30 to 18.10GHz (uplink); 11.70 to 12.50GHz (downlink)
C-band: 5.925 to 6.425GHz (uplink); 3.700 to 4.200GHz (downlink)
Polarisation: Linear horizontal/vertical
Typical G/T: Ku-band/BSS 52.1dBK; C-band 1.2dB/K
Typical EIRP: Ku-band/BSS 52.1dBW
C-band 41dBW (medium power) & 43.5dBW (high power)



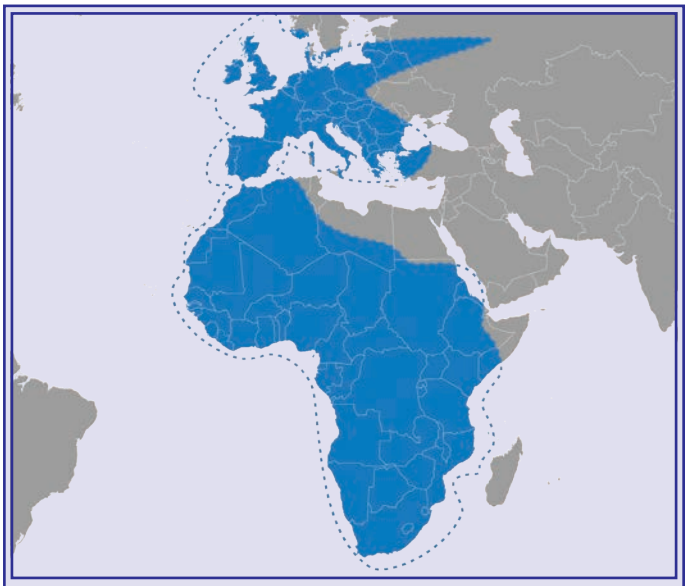
Arabsat BADR-7: 26°E

Launch date: November 2015
Frequencies: Ku-band/FSS uplinks: 14.00 to 14.25GHz; 14.25 to 14.5GHz
Downlinks: 10.95 to 11.20GHz; 11.45 to 11.70GHz
Ku-band/FSS Apx-30B uplinks: 13.00 to 13.25GHz/12.75 to 13.00GHz
Downlinks: 10.70 to 10.95GHz/11.2-11.45GHz
Polarisation: Linear
Transponders: 12 x 36MHz
Typical G/T: 5.1dB/K
Typical EIRP: 51.5dBW; 52.4dBW



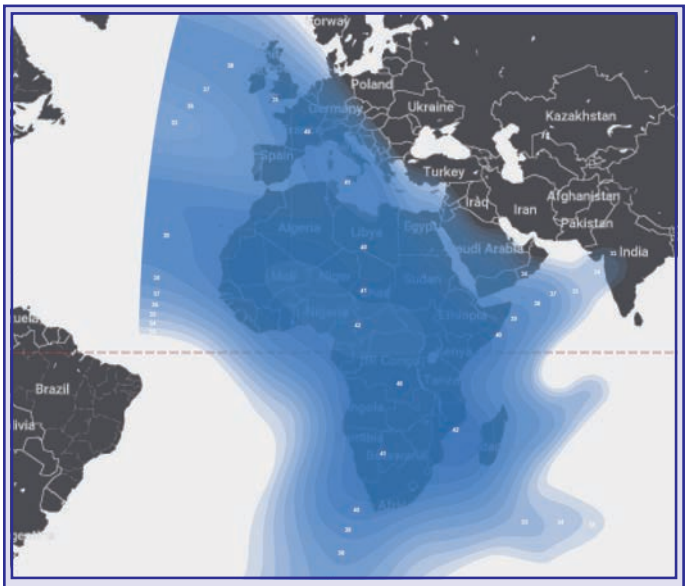
Avanti Communications HYLAS 2: 31°E

Launch date: August 2012
Ka-band uplink: 27.5GHz (forward); 29.5GHz to 30GHz (return)
Active Ka-band forward transponders: 24
Forward channel bandwidth: 230MHz per beam
Ka-band downlink: 19.7GHz to 20.2GHz (forward);
17.7GHz to 19.7GHz (return)
Active Ka-band return transponders: 6
Return channel bandwidth: 220MHz per beam
Typical 'dry beam' EIRP (at edge of coverage): up to 58dBW
G/T (at edge of coverage): up to 11.5dB/K-1
Typical 'wet beam' EIRP (at edge of coverage): up to 61.5dBW
G/T (at edge of coverage): up to 14.0dB/K-1



Avanti Communications HYLAS 4: 33.5°W

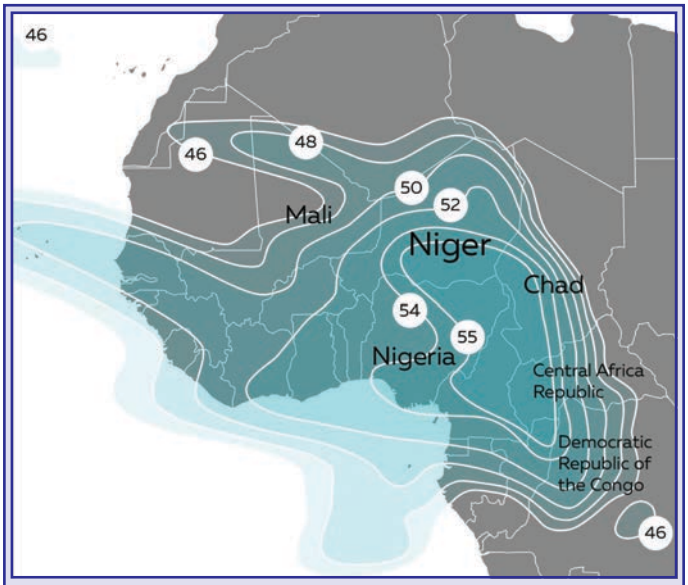
Launch date: April 2018
Ka-band uplink: 27.5GHz to 29.5GHz (forward); 29.5GHz to 30GHz (return)
Active Ka-band forward transponders: 32
Forward channel bandwidth: 220MHz per beam, 64 beams
Ka-band downlink: 19.7GHz to 20.2GHz (forward); 17.7GHz to 19.7GHz (return)
Active Ka-band return transponders: 8
Return channel bandwidth: 220MHz per beam
Typical Ka-band fixed beam performance: EIRP (at edge of coverage): up to 61.5dbW G/T (at edge of coverage): up to 14dB/K
Bandwidth per steerable beam: Fwd: 2 x 230MHz; Rtn: 2 x 230MHz; 920MHz
Steerable beam frequencies:
Civilian bands – 29.5 to 30GHz (uplink); 19.7 to 20.2GHz (downlink)
Government bands – 30.0 -31.0 HGz (uplink); 20.2- 21.2 GHz (downlink)
Broadcast only – 21.4 to 21.9GHz (downlink)
Typical steerable beam performance:
EIRP (at edge of coverage): up to 54.5dbW; G/T (at edge of coverage): up to 7dB/K



Azerspace-1/Africasat-1a: 46°E – C-band Africa & Europe

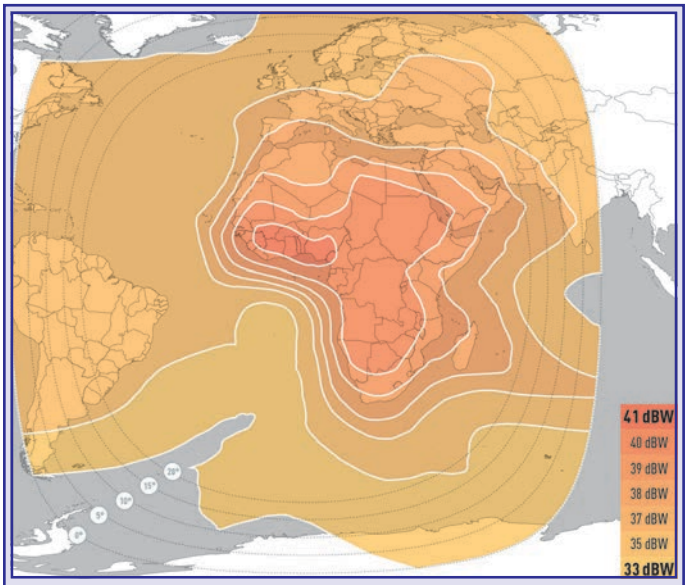
Launch date:	February 2013
Active transponders:	24 (36MHz each)
Uplink:	5925 to 6425MHz
Downlink:	3700 to 4200MHz
Beams:	Central Asia & Europe beam, Africa & Europe beam
Polariaation:	RHCP/LHCP and V/H relatively
TWTA power:	65W

All uplink and downlink channels are 4-block channel cross strap switchable between Central Asia & Europe and Africa & Europe beam.



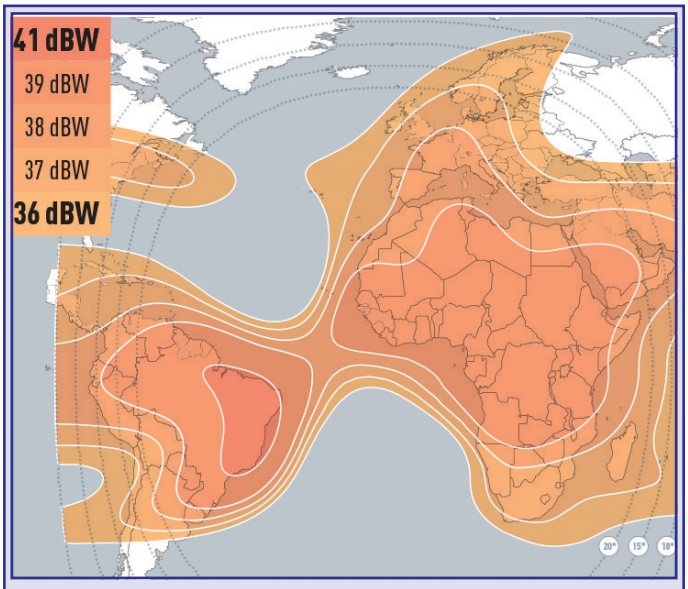
Azerspace-2: 45°E – Ku-band

Launch date:	Expected 2017
Manufacturer:	Space Systems/Loral
Bus platform:	SSL-1300
Launch vehicle:	Ariane-5ECA
Active transponders:	35 (36, 54, 72, 76MHz)
Uplink:	14000 to 14750MHz
Downlink:	11450 to 12750MHz
Beams:	Europe & Asia, Pakistan & Afghanistan, West Africa and Central Africa
Polarisation:	Linear
TWTA:	150W



EUTELSAT 3B: 3°E

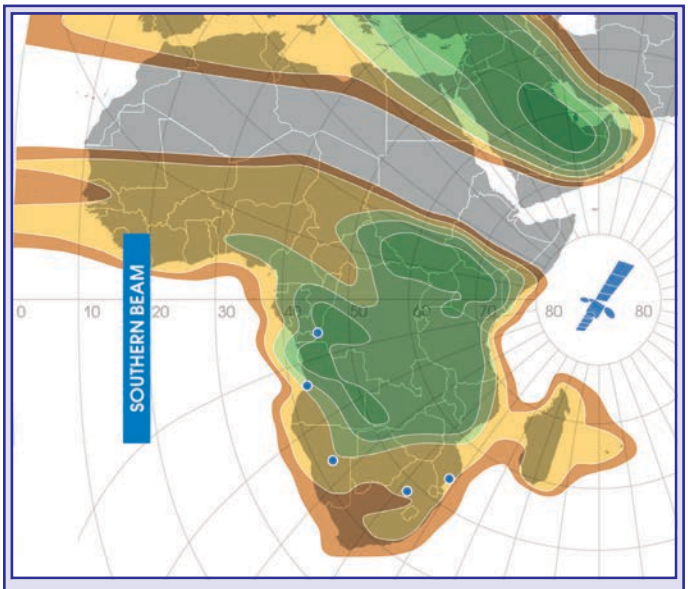
A tri-band satellite for Europe, Africa, the Middle East, Central Asia and South America, EUTELSAT 3B offers resources in Ku-, C- and Ka-band connected to fixed and steerable antennas for flexibility. It enables users to select the most relevant frequency band. Eutelsat says the Ku- and C-band capacity is optimised for broadcast and data markets, while the high throughput Ka-band beams are ideal for bandwidth-demanding markets.
Launch date: May 2014
Manufacturer: Airbus Defence and Space
Operational life: Over 15 years
Launch craft: Sea Launch AG's Odyssey
Operational transponders: Up to 51
Downlink polarisation: Ku-, Ka- and C-bands



EUTELSAT 8 West B C-band: 8°W

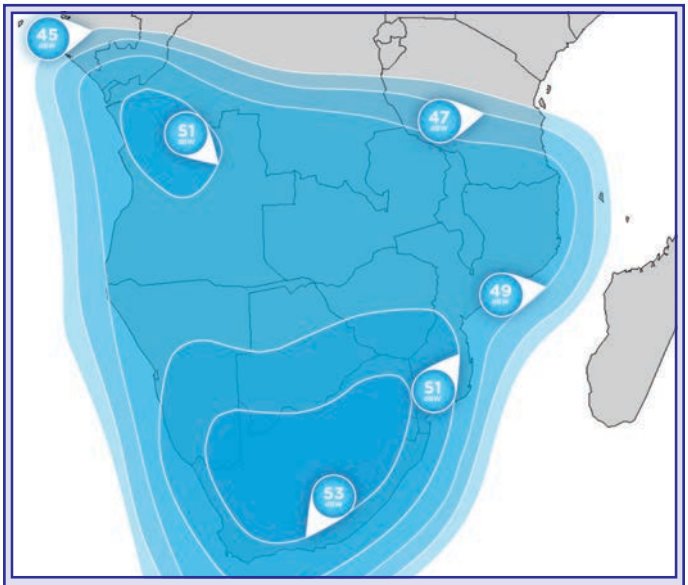
EUTELSAT 8 West B is a new high- capacity spacecraft equipped with 10 C-band transponders connected to footprints covering the African continent and reaching west to South America.

Launch date: August 2015
Manufacturer: Thales Alenia Space
Operational life: Over 15 years
Launch craft: Ariane 5
Operational transponders: 40 Ku-band, 10 C-band
Frequencies: Ku-band, C-band



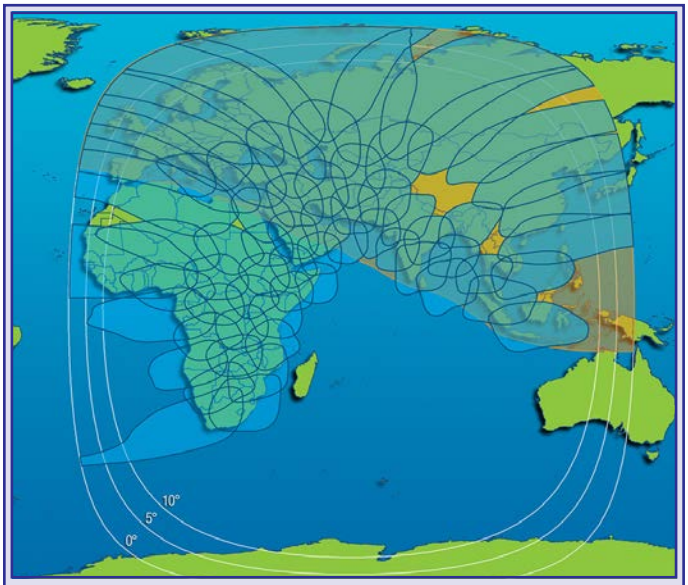
Gazprom Space Systems Yamal-402: 55°E

Launch date:	December 2012
Frequency:	Ku
Operational life:	15 years
Transponders:	12 x 72MHz; 18 x 36MHz; 16 x 54MHz
Transmitter output power:	120 to 150W
Beams:	Four fixed: Russian, Northern, European, Southern, and one steerable. Eight 54MHz transponders are operating in a wide South beam that covers sub-Sahara Africa.
Payload power:	10,800W



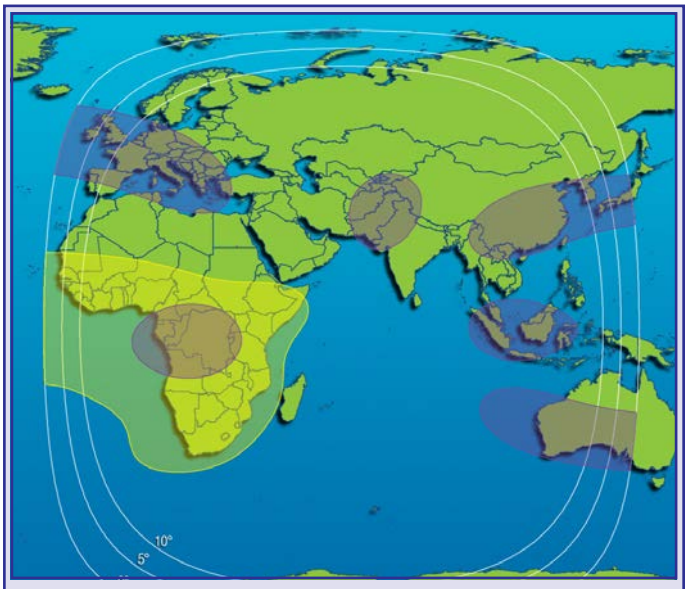
Hellas Sat 3: 39°E

Launch date:	June 2017
Coverage:	Europe, M.East and Southern Africa
Southern Africa beam	
Transponders:	12 x 36 MHz Ku-Band, 3 x 72 MHz Ku-band
Frequency:	Std & Ext. Ku-band
EIRP(S. Africa):	53 dBW
G/T (S. Africa):	+6 dB/K
Cross Strapping:	Europe to S. African beam



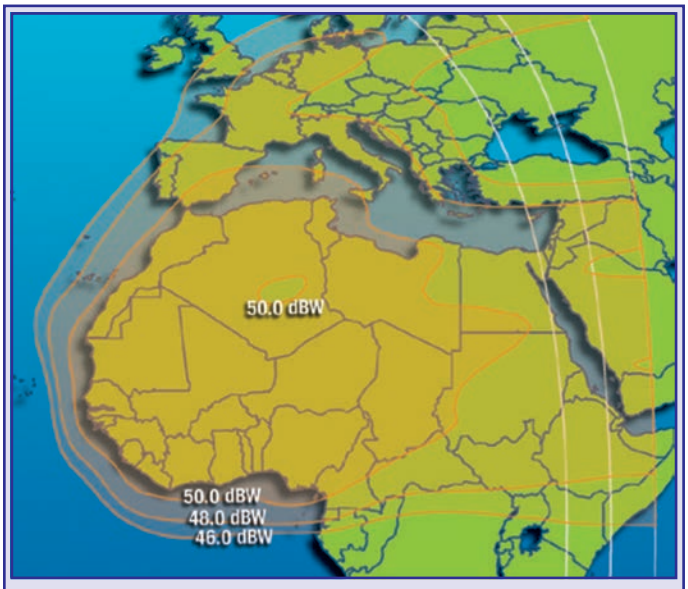
Intelsat IS-33e: 60°E – Ku-band Multi-Spot & Eurasia Beams

Launch date:	August 2016
Configurable capacity:	268 (in equivalent 36MHz units)
Polarisation:	Linear horizontal/vertical
Typical edge of coverage EIRP:	Multi-spot: 48.7 up to 61.6dBW
	Eurasia Beam: 43.6 up to 45.3dBW
Uplink frequency:	5925 to 6425MHz
Typical G/T range:	Multi-spot: 7.0 up to 17.0dB/K
	Eurasia Beam: -3.3 up to -0.7dB/K



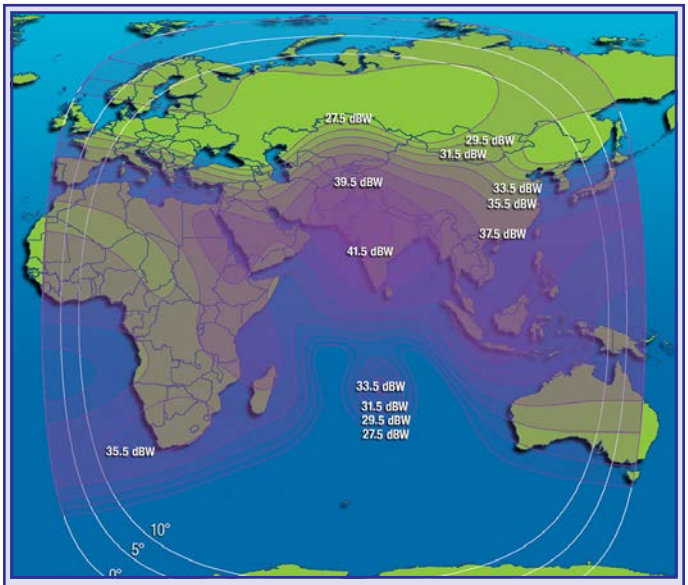
Intelsat IS-33e: 60°E – C-band Sub-Saharan & Spot Beams

Launch date:	August 2016
Configurable capacity:	79 (in equivalent 36 MHz units)
Polarisation:	Linear horizontal/vertical Circular – right hand or left hand
Typical edge of coverage EIRP:	C-band spot: 46.2 up to 52.4dBW Sub-Saharan: 41.0 up to 43.5dBW Global: 33.3 up to 37.5dBW
Typical G/T range:	C-band spot: 2.6 up to 12.8dB/K Sub-Saharan: -1.6 up to 1.5dB/K Global: -10.3 up to -7.2dB/K



Intelsat IS-35e: 325.5°E – Ku-band

Launch date:	July 2017
Configurable capacity:	39 (in equivalent 36MHz units)
Polarisation:	Linear – horizontal or vertical
Downlink frequency:	10.95 to 11.20GHz & 11.45 to 11.70GHz
Typical coverage EIRP range:	Caribbean: > 47.4 dBW Europe/Mediterranean: >45.4dBW Africa/Europe: > 47.1dBW
Uplink frequency:	13.75 to 14.50GHz
Beam peak G/T:	Caribbean: up to 10.6dB/K Europe/Mediterranean: up to11.3dB/K Africa/Europe: up to 5.1 dB/K



Intelsat 36: 68.5°E – C-band Landmass Beam

Launch date:	August 2016
Configurable capacity:	12 (in equivalent 36MHz units)
Polarisation:	Linear horizontal/vertical
Downlink fequency:	3700 to 3990MHz
Typical edge of coverage EIRP:	> 28.3dBW
Uplink frequency:	5925 to 6215MHz
Typical G/T range:	Up to 0.6dB/K

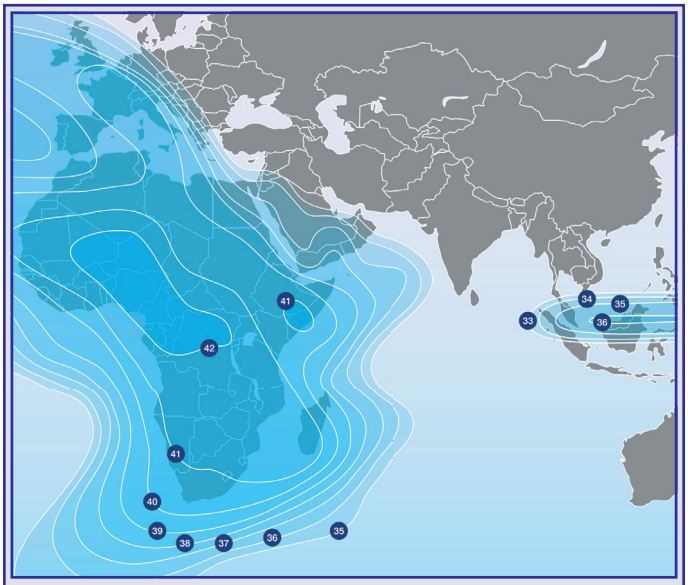
Intelsat IS-37e: 342°E – C-band

Launch date:	September 2017
Configurable capacity:	90 (in equivalent 36 MHz units)
Polarisation:	Circular – right hand or left hand
Typical coverage EIRP range:	Spots: 46.4 up to 52.2 dBW Africa/Europe: 38.1 up to 43.3 dBW Central Africa: 42.8 up to 47.6 dBW Latin America: 41.8 up to 46.3 dBW Global: 34.6 up to 38.1 dBW
Typical G/T range:	Spots: 2.0 up to 13.4 dB/K Africa/Europe: -5.6 up to -1.0 dB/K Central Africa: -2.2 up to 3.0 dB/K Latin America: -2.7 up to 0.7 dB/K Global: -9.0 up to -5.9 dB/K

O3b Networks: 45°N/S

O3b Networks has launched an initial constellation of 12 satellites. These have been placed in medium Earth orbit (MEO) and circumnavigate the planet from a height of 8,062km. O3b says its fleet will provide around 70 per cent of the world's population with fibre quality and low latency services such as internet connectivity and trunking. It has established a global network of gateways that have been strategically located on the internet backbone. SES – which now owns 100 per cent of O3b – started the next phase of launches in March 2018.

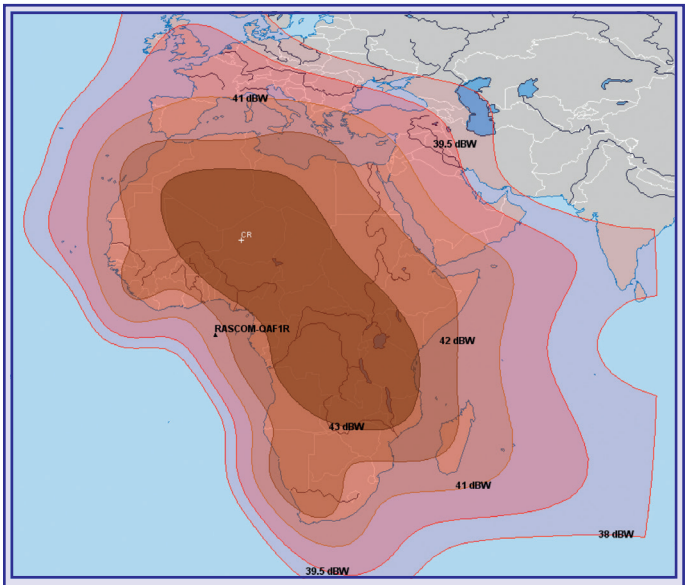
Launch dates:	June 2013 (first quartet); July 2014 (second quartet); December 2014 (third quartet); March 2018 (fourth quartet); 1H19 (fifth quartet expected)
Manufacturer:	Thales Alenia Space
Orbital inclination:	<0.1°
Ground period:	360 minutes/Four contacts per day
Beams:	Ka-band; 10 beams per region (seven regions) totaling; 70 remote beams per eight satellite constellation
Capacity:	Up to 1.2Gbps per beam (600Mbps x 2); 84 Gbps available per 8 satellite constellation
Beam coverage:	700km diameter
Transponder bandwidth:	216MHz; 2 x 216MHz per beam



MEASAT AFRICASAT-1A/AZERSPACE-1: 46°E

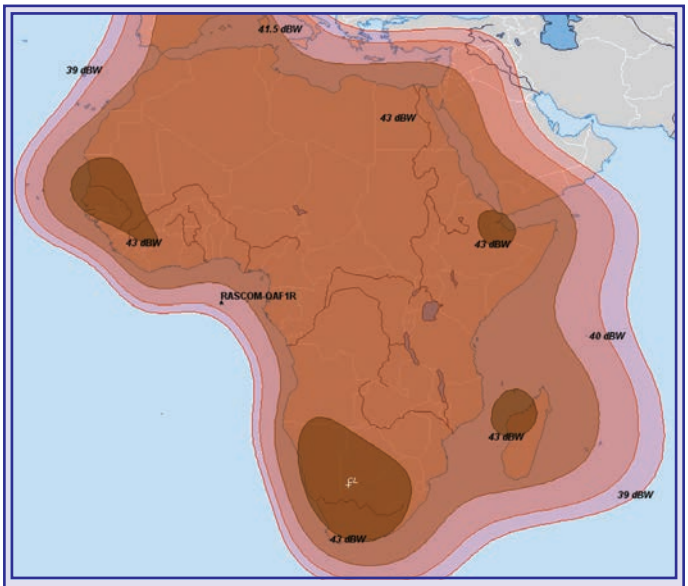
AFRICASAT-1a / Azerspace-1 is the result of a collaboration between Malaysia-based MEASAT Satellite Systems and the Azercosmos Joint Stock Company set up by the government of Azerbaijan. It provides high-powered services across Africa, central Asia and Europe. As well as C-band capacity across Africa with connectivity to Europe, the Middle East & South East Asia, Ku-band services are also offered across South East Asia.

Launch date: February 2013
C-band transponders (36MHz equivalent): up to 24
Typical EIRP beam coverage: 42dBW (max)
G/T (dB/oK): -1 (max)
TWTA power: 65W **Polarisation:** linear



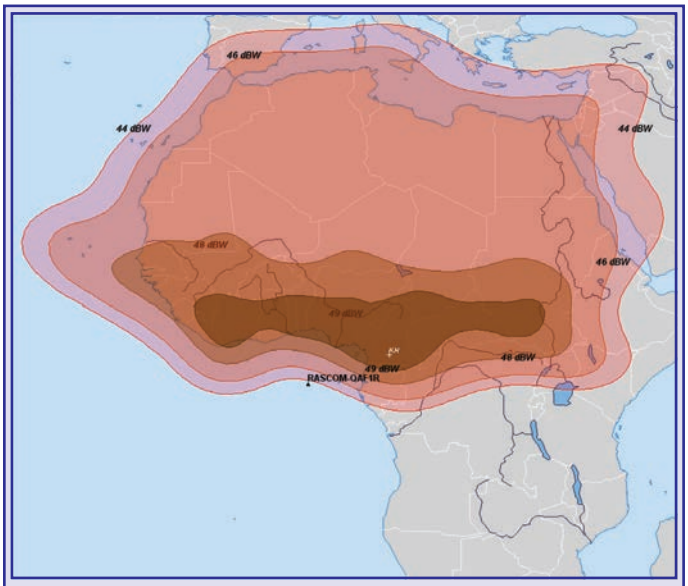
Rascomstar-Q1R: 2.9°E – Standard C-band EIRP

Launch date:	August 2010
Launch vehicle:	Ariane 5
Platform:	TAS Spacebus 4000B3
Bands:	C-band standard & planned; Ku-band planned
C-band beam peak EIRP (dBW):	45
Uplink (MHz):	6190 to 6425
Downlink (MHz):	3965 to 4200
Polarisation:	Circular



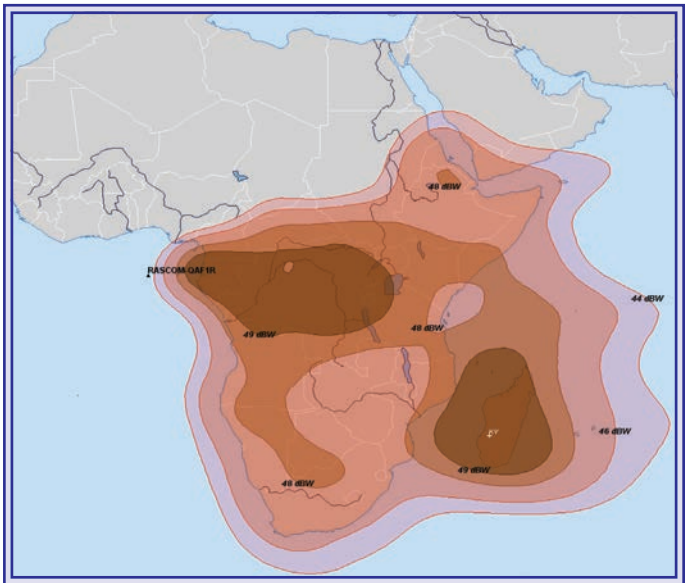
Rascomstar-Q1R: 2.9°E – C-band (still showing as "planned" at rascomstar.com)

Launch date:	August 2010
Launch vehicle:	Ariane 5
Platform:	TAS Spacebus 4000B3
Bands:	C-band standard & planned; Ku-band planned
C-band beam peak EIRP (dBW):	44
Uplink (MHz):	6725 to 7025
Downlink (MHz):	4500 to 4800
Polarisation:	Circular



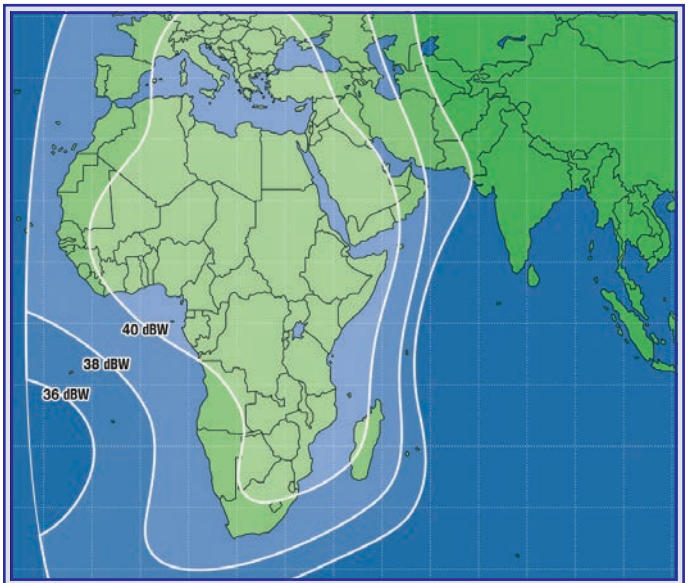
Rascomstar-Q1R: 2.9°E – Ku North beam EIRP

Launch date:	August 2010
Launch vehicle:	Ariane 5
Platform:	TAS Spacebus 4000B3
Bands:	C-band standard & planned; Ku-band planned
Ku-band North Beam peak EIRP(dBW):	49.4
Uplink (MHZ):	12750 to 13250
Downlink (MHz):	10270 to 11450
Polarisation:	Linear



Rascomstar-Q1R: 2.9°E – Ku South beam EIRP

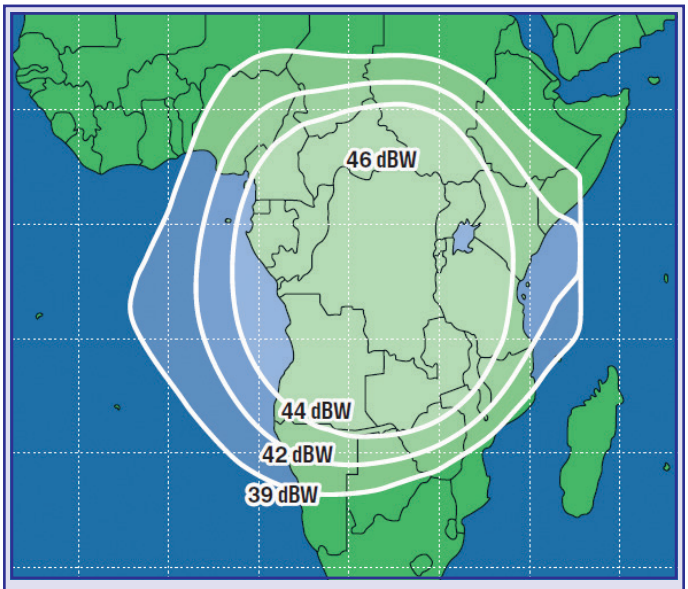
Launch date:	August 2010
Launch vehicle:	Ariane 5
Platform:	TAS Spacebus 4000B3
Bands:	C-band standard & planned; Ku-band planned
Ku-band South Beam peak EIRP(dBW):	50
Uplink (MHz):	12750 to 13250
Downlink (MHz):	10270 to11450
Polarisation:	Linear



RSCC Express-AM6: 53°E – C-band, fixed beam, EMEA

Express-AM6 satellite is designed for TV broadcasting, enterprise networks, disaster recovery and business continuity, IP trunking, cellular backhaul, oil & gas and mobility applications.

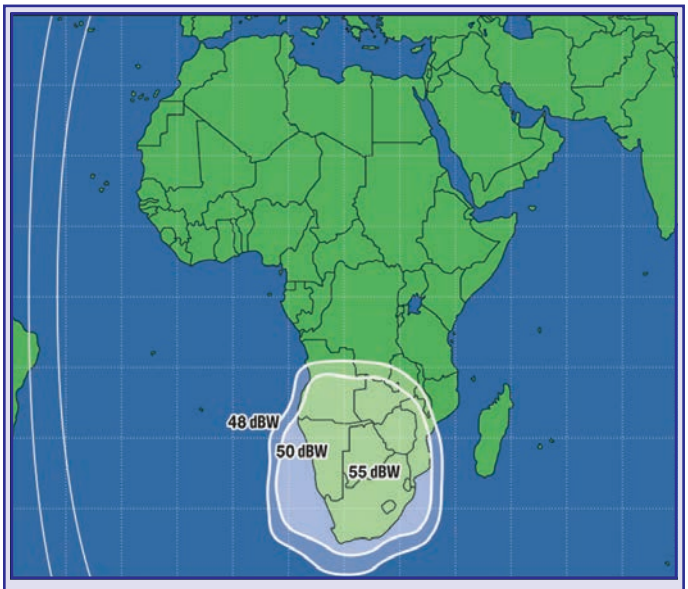
Launch date:	October 2014
Coverage:	Russia, EMEA, sub-Saharan Africa
Operational life:	15 years
Operational transponders:	C, Ku, Ku-/Ka-, Ka, L



RSCC Express-AM7: 40°E – C-band, steerable spot beam, optional pointing: West Africa

Express-AM7 is designed for TV broadcasting, enterprise networks, cellular backhaul, oil & gas, and government applications.

Launch date:	March, 2015
Coverage:	Europe, Middle East, sub-Saharan Africa, Russia, South-East Asia
Operational life:	15 years
Operational transponders:	C, Ku, L



RSCC Express-AM7: 40°E – Ku-band, steerable spot beam, optional pointing: East Africa

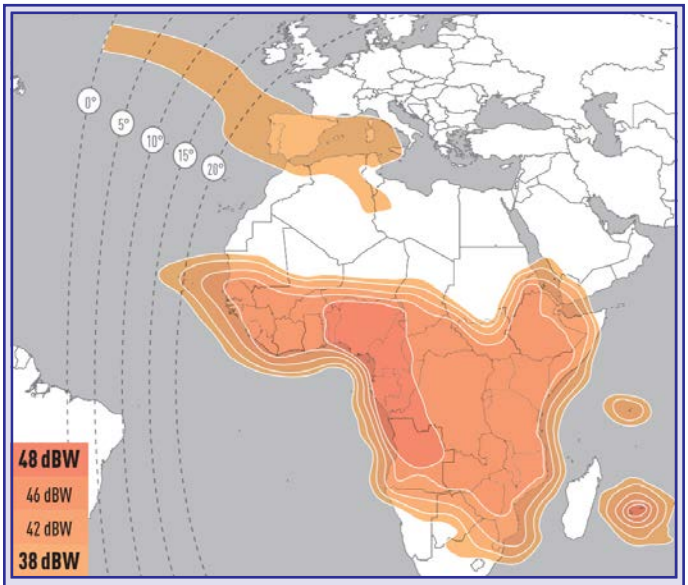
Express-AM7 is designed for DTH, enterprise networks, broadband Internet access, USO, telemedicine and distance learning applications.

Launch date:	March, 2015
Coverage:	Europe, Middle East, sub-Saharan Africa, Russia, South-East Asia
Operational life:	15 years
Operational transponders:	C, Ku, L

RSCC Express-AM8: 14°W – Ku-band, fixed beam, MENA & East

Express-AM8 is designed for TV broadcasting, enterprise networks, broadband Internet access, USO, telemedicine and distance learning applications.

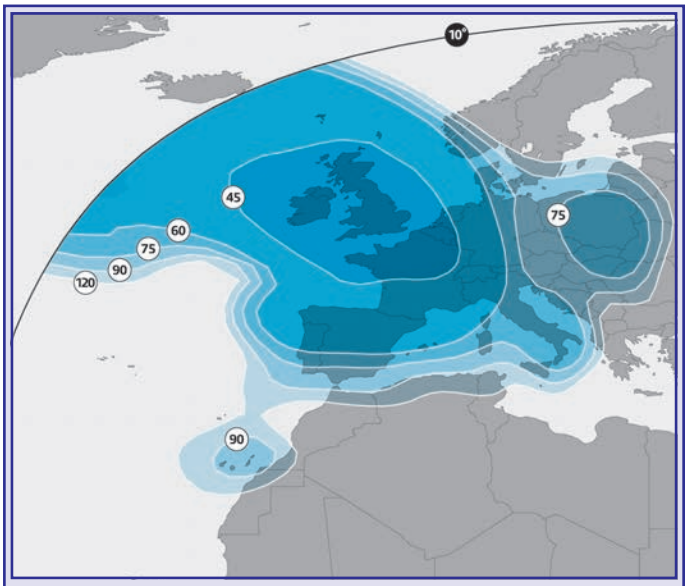
Launch date:	September, 2015
Coverage:	Europe, MENA, sub-Saharan Africa, Latin America
Operational life:	15 years
Operational transponders:	C, Ku, L



RSCC Express-AMU 1/Eutelsat 36C: 36°E

Express-AMU1 has up to 70 transponders in Ku- and Ka-band. It provides service to Russia and continuity and growth for broadcast markets developed by Eutelsat in sub-Saharan Africa under the name Eutelsat 36C.

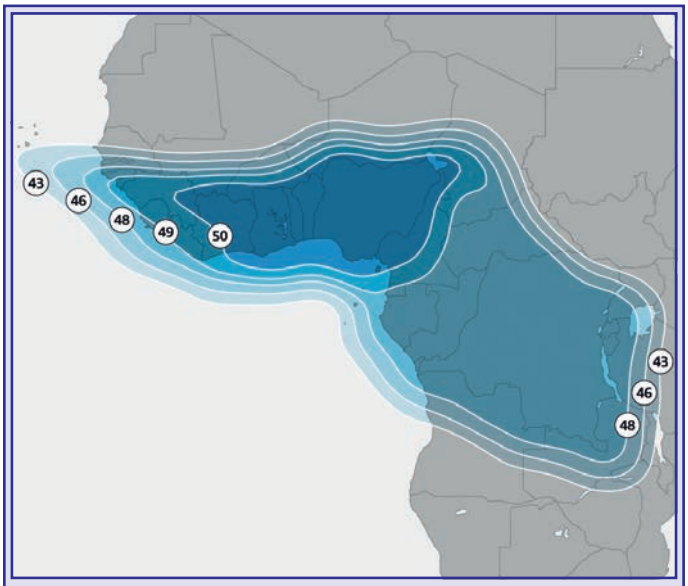
Launch date:	December 2015
Coverage:	Russian, sub-Saharan Africa
Launch vehicle:	Proton-M
Operational life	15 years
Manufacturer:	Airbus Defence and Space
Polarisation:	Ku-band: linear; Ka-band: circular
Total transponders:	70 Ku- and Ka-band



SES ASTRA 2E: 28.2°E/28.5°E

Delivers broadcast, VSAT and broadband services in Europe, Middle East and Africa, and carries Ku- and Ka-band payloads at a prime dual orbital location. Middle East beam provides a Ka interconnect feature.

Launch date:	September 2013
Coverage:	Middle East , North Africa, Europe
Launch vehicle:	Proton
Operational life:	15 years
Manufacturer:	EADS Astrium
Polarisation:	Ku-band: linear; Ka-band: circular
Total transponders:	Ku-band: 42 (Europe); 12 (Middle East). Ka-band: 4 (250MHz, 500MHz and 600MHz)



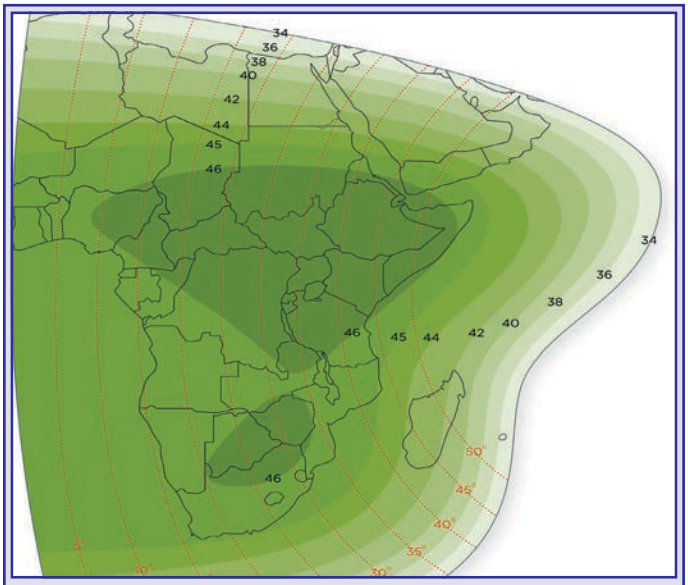
SES ASTRA 2F: 28.2°E/28.5°E

Serves to deliver next-generation broadcast, VSAT and broadband services in Europe, Middle East and West Africa, and carries Ku- and Ka-band payloads.

Launch date:	September 2012
Launch vehicle:	Ariane 5 ECA
Operational life:	15 years
Manufacturer:	EADS Astrium
Polarisation:	Ku-band: linear; Ka-band circular
Total transponders:	Ku-band: 40 (Europe); 12 (Africa) Ka-band: 3 (500MHz & 600MHz)

Singtel ST-3: 75°E – Africa C-band

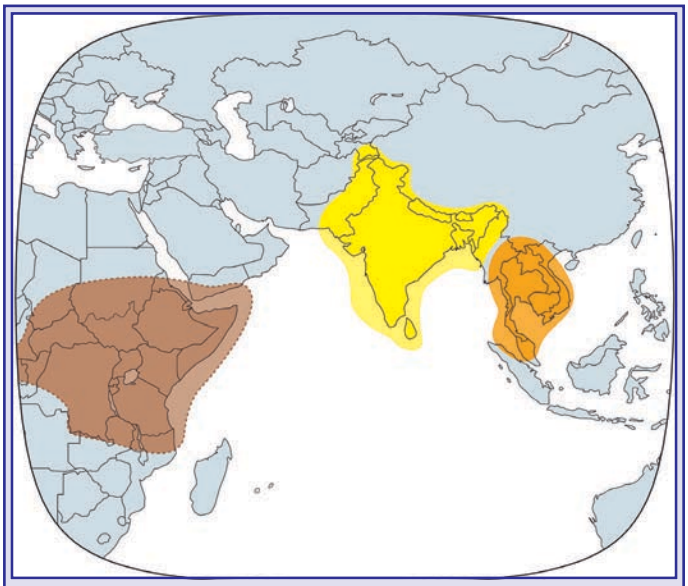
Launch date:	February 2014
C-band Payload:	13
Frequencies:	Uplink: 5.950 to 6.385GHz Downlink: 3.680 to 4.200GHz
Transponder bandwidth (MHz):	36 & 72
Polarisation:	Dual linear
Cross-polarisation separation (dB):	Better than 27
EIRP (peak value) (dBW):	45
TWTA size:	62W
TWTA redundancy:	34 for 26 primary TWTA
G/T (peak value) (dBK):	+6



Thaicom 6/Africacom-1: 78.5°E – C-band Africa Beam

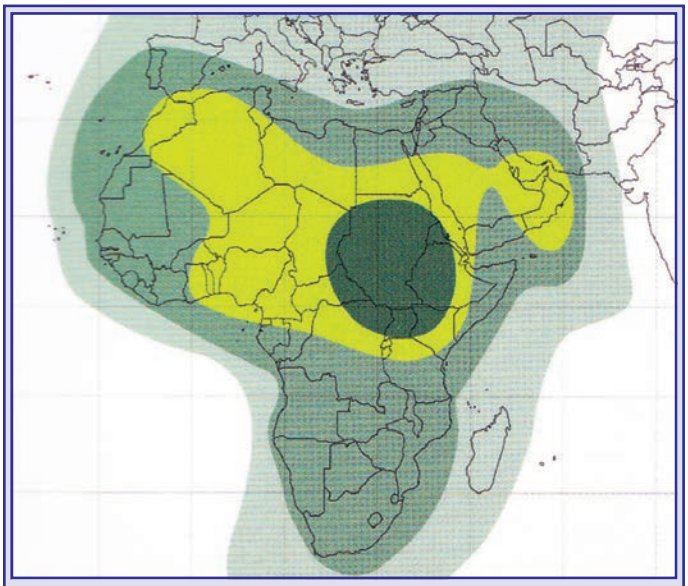
Thaicom 6 has 18 active C-band and 8 active Ku-band transponders. The satellite's African capacity, 6 C-band transponders each with 72MHz bandwidth, is being marketed under the AfriCom 1 designation.

Launch date:	January 2014
Operational life:	≥ 15 years
Solar arrays:	Three panels per array, UTJ Gallium Arsenide cells
Stabilisation:	3-axis stabilised; zero momentum
Propulsion:	Liquid bi-propellant transfer orbit system; monopropellant (hydrazine) on-orbit system
Transponder capacity:	Asia C-band 12 x 36MHz; Asia Ku-band 2 x 54MHz, 6 x 35MHz; Africa C-band 6 x 72MHz



Thaicom 8: 78.5°E

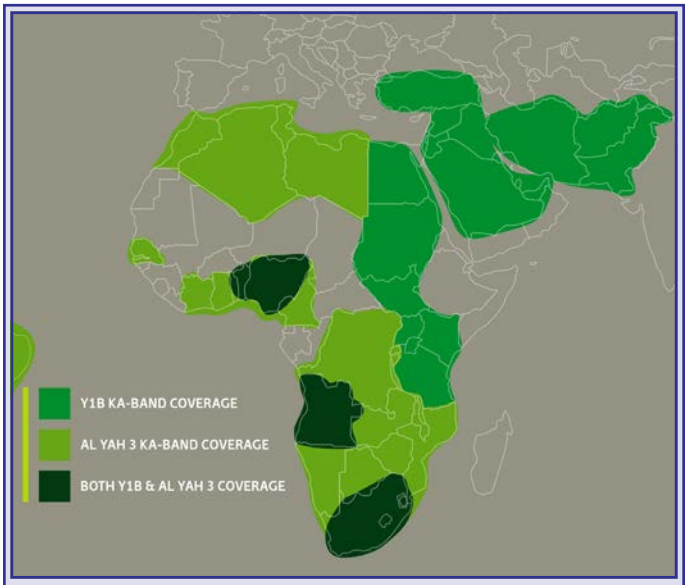
Launch date:	May 2016
Operational life:	≥ 15 years
Altitude control:	3-axis stabilised
Launch mass:	<3,200 kg
Solar arrays:	Two 4-Panel Solar Wings with UTJ cells
Stabilisation:	3-axis stabilised, using thrusters and reaction wheels; zero momentum biased
Propulsion:	Liquid bi-propellant transfer orbit system; monopropellant (hydrazine) on-orbit system
Payload:	Ku-band repeater: 24 active transponders
Antenna:	Three deployable single offset reflectors, 2.4 m, 2.6 m, and 2.5 m x 2.7 m



Yahsat Y1A: 52.5°E – C-band

Yahsat claims to be the first company in Africa and the Middle East to offer hybrid satellite services to the region with the Y1A. Its tri-band coverage connects users to more than 85 countries across Africa, the Middle East, Europe, & South West Asia. It also offers the possibility of inter-beam connectivity.

Launch date:	April 2011
Number of transponders:	C-band 8 x 36MHz plus 6 x 54MHz Ku-band BSS 25 x 33MHz Ka-band secure Military 21 x 54MHz
Primary power:	10,900W
C-band power:	>37dbW to >43dbW



Yahsat Y1B: 47.5°E

Launch date:	April 2012
Launcher:	ILS Proton
System Supply Contractor:	EADS Astrium & Thales Alenia
Operational life:	15 years
Capacity:	Ka-band: government payload Ka-band: commercial payload: 60 spot-beams
Payload power:	9.7KW
Gateway locations:	Europe and UAE

Yahsat Al Yah 3: 20°W

Al Yah 3 carries 53 active Ka-band user beams and four gateway beams. It provides multipurpose solutions for broadband, broadcast, government and communications use across Africa, Brazil, the Middle East, Europe, and Central and Southwest Asia.

Launch date:	January 2018
Launcher:	Arianespace
System supply contractor:	Orbital Sciences Corp.
Operational life:	15 years
Payload:	58 Ka-band spot beams
Primary power:	Approx. 7.5kW, electrical
Gateway locations:	Brazil, Greece, Luxembourg, Spain, UAE