chapter 6 Satcoms

Africa enters a new space race in 2017

Michèle Scanlon, New business development, Gondwana International Networks

African telecoms has always typified the view that first to market often brings success. The world of satellite is no different, and as such satellite connectivity in Africa is facing a new race in 2017.

The ultimate prize is giving the continent full coverage with high throughput satellite (HTS) services. Long thought destined to be obsolete as mobile and fibre networks have grown in footprint, satellite services are making something of a commercial comeback.

This new era has been driven by HTS Ka-band spot beam services with the likes of Avanti and YahSat providing cost-effective solutions for markets previously unable to afford space connectivity. Based on spot beam coverage, these services are typically deployed using smaller antennas from 74cm delivering consumer grade services to new audiences.

However, these Ka-band services have not yet been able to deliver ubiquitous coverage of the continent, focusing instead on key areas. Both Avanti and YahSat have strong East and Southern Africa footprints, but are limited beyond that until their respective new satellites are launched. Although delayed by funding, Avanti's *HYLAS-4* appears back on track with an estimated launch by Q317; and YahSat's *Al Yah 3* is due to be launched by June 2017 to provide coverage to Africa and Brazil through 58 spot beams.

Not to be outdone, global satellite leader Intelsat has focused on the launch of *IS-33e*, part of its *EpicNG* series of high throughput satellites that feature high Ku-band spot beams with full continental coverage.

Like most battles of competing technologies, first to market also needs to be accompanied by a viable commercial proposition. Think CDMA versus GSM, or Betamax versus VHS. First to market brings market attention, but a commercial proposition brings long-term sustainability. The combination of the two will drive market success.

So what does this mean for the internet satellite service provider and end-user? Ultimately, the launch of ubiquitous spot beam coverage, regardless of technology band, should lead to more cost effective satellite services delivering faster speeds with more user-friendly dimensioned equipment.

New market dynamics

The traditional satellite project typically took 20 years from design conception to end of its lifecycle in space, while terrestrial projects and technology evolve and are adapted significantly quicker. Yet, as the final race is on for market penetration of every remote corner of Africa, new dynamics are emerging among traditional and new satellite players.

For example earlier in 2017, Intelsat announced a merger with OneWeb [also see p80], while global OTT players like Facebook and Google also see satellite as key for extending broadband services and for their own continued service dominance in a connected world.

The loss of Spacecom's *AMOS-6* in September 2016 seriously set back Facebook's planned expansion of its free *internet.org* services via satellite to Africa. Founder Mark Zuckerberg has previously said: "Connectivity changes lives and communities. We're going to keep working to connect the entire world – even if that means looking beyond our planet." At the annual *Satellite 2017* conference in Washington D.C. in March 2017, Facebook re-affirmed its commitment to satellite as a means of access when Wesley Wong, head of strategic technology partnerships and sourcing, noted the company's "belief that the space industry can play a very important role in reaching every last individual out there".

Eutelsat's *Broadband for Africa* initiative (now branded *Konnect*) also suffered setbacks from the loss of *AMOS-6*. But following a capacity deal with YahSat, the service will still launch in 2017 based on the current Ka-band footprint of YahSat's *Y1B* satellite and is to be complemented by further Ka-band spot beams on the company's *Al Yah 3* later this year.

Meanwhile, SpaceX and Tesla founder Elon Musk is planning to launch more than 4,000 satellites to provide blanket internet coverage across the planet. Whilst pursuing its own low-orbiting service, Google has backed Musk's plans with a USD1bn investment. Putting that ambition into perspective, the United Nations Office for Outer Space Affairs noted that in August 2016, there were more than 4,256 satellites in space with the most launches in any annual period being 240 in 2014, followed by 221 in 2015. A third of these are considered operational with 50 per cent focusing solely on providing communication services.

60 years ago in October 1957, the then-Soviet Union launched *Sputnik I* as the world's first artificial satellite sparking a space race for what was considered the final frontier. However in 2017, the real frontier for new market share is back on Earth in pursuing HTS spot-beam satellite services for broadband connectivity to the furthest reaches of the African continent. The race is on.

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The importance of satellite

The year kicked off with the satellite industry breathing a sigh of relief as delegates at the ITU's World Radiocommunication Conference 2015 (WRC-15) agreed to preserve spectrum that is primarily used for satcoms.

The most controversial item on the agenda for 2015 had been the possible re-assignment of C-band spectrum. Terrestrial wireless operators had lobbied for additional frequencies in C-band that include the 3.4GHz to 4.2GHz spectrum used for satellite receive/downlinks.

Naturally, the satellite industry opposed this. In rallying its supporters earlier last year, the Global VSAT Forum (GVF) said operation of IMT in the C-band could cause "excessive" levels of interference, and might preclude future use by broadcasters and many other industries that depend on satellite services supported by C-band.

At WRC-15, representatives from the world's governments overwhelmingly agreed that satellite provides vital and irreplaceable services. Among the key decisions made during the conference, delegates reconfirmed the need to protect critical fixed-satellite service (FSS) services throughout the world using C-band.

But the lower 200MHz of the C-band downlink frequencies (3400-3600MHz) were identified for IMT in ITU Region 1 (EMEA) and Region 2 (Americas). In Region 3 (APAC), some countries will sign a footnote allowing potential IMT use of 200MHz, although the vast majority of the region will continue using this band for satellite.

Anywhere that IMT is deployed, it will be subject to adherence to strict protection requirements with neighbouring countries. WRC-15 declined to consider a proposal for IMT systems in the C-band uplink frequencies (5925-6425MHz).

Delegates at WRC-15 acknowledged the global importance of satellite services. Around 3,300 participants, representing 162 out of the ITU's 193 member states, attended the month-long conference held in Geneva in November 2015.

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Despite campaigning for the use of C-band spectrum for terrestrial mobile broadband, the GSM Association welcomed the decisions taken at the conference. John Giusti, the association's chief regulatory officer, said that he believed global harmonisation of spectrum bands through the WRC process was key to driving the economies of scale needed to deliver low-cost, ubiquitous mobile broadband around the world.

Satcoms received another boost later in 2016 when the Global VSAT Forum (GVF) said that satellite-based solutions should not just be bound to last-mile or rural environments. The pronouncement came during the inaugural *Future-Sat Africa Summit* held in Ethiopia on 4-6 October. Delegates heard how satellite communications should be part of the overall landscape of the telecoms offering for all types of users and all locations.

According to the GVF, satellite offers a crucial and core element of the connectivity solution needed to meet Africa's application needs. Speaking at the two-day summit, GVF correspondent for Europe Julián Seseña called upon the industry to cooperate with their future users to ensure "close and mutual trust" in highly evolving scenarios due to technology trends and new business routes. He said: "African countries have developed their national plans towards enhancing the penetration of telecom services, broadcast and broadband. The satcom industry should contribute to ensure that the value of the satellite component is fully appreciated when designing and implementing the national plans."

But the GVF warned that for many countries, the big challenges lie with policies and regulations that do not adapt and evolve as fast as the technology they relate to. It said that Africa's networks need to make use of all available technologies, fully integrated and operating seamlessly.

Disaster strikes

At 9.07 EST on 1 September 2016, Spacecom suffered a blow as the SpaceX *Falcon 9* rocket that was due to carry its *AMOS-6* satellite into orbit exploded on lift-off.

While the launch vehicle and the satellite were both lost, the pad was clear and no human injuries were reported. On 5 September, the company issued a press statement which said that it was developing a plan of action following the loss of the satellite. CEO David Pollack said: "Our programme includes, among other measures, exploring the possibility of procuring and launching a replacement satellite. Working quickly and efficiently, management is engaging with current and potential partners to move forward."

He added that Spacecom will serve all of its current and future financial

JANUARY 2016

ISP iWayAfrica is using Yahsat's *YahClick* service to provide broadband coverage across Uganda. The two companies say they are offering packages designed to cater to the needs of business and home users, and claim subscribers can now instantly connect to the internet anywhere in the country using a small satellite dish and satellite modem. iWayAfrica says satellite technology is providing reliable internet services, even in the remotest places, without the need for terrestrial infrastructure.

FEBRUARY

Eutelsat has signed a three-year deal with the Broadcasting Authority of Zimbabwe (BAZ) for Ku-band capacity on *EUTELSAT 3B*. It will be used to deliver 12 free-to-view channels to a nationwide network of 48 DTT transmitters so that viewers in the country can benefit from improved picture quality and programme choice. The service is currently being tested and is due to launch during 1Q16. BAZ is working with Zimbabwe's national signal carrier Transmedia, state broadcaster ZBC, and Huawei for sourcing digital equipment. Huawei will also uplink the digital multiplex from BAZ's teleport in Harare to *EUTELSAT 3B*.

MARCH

SpeedCast International will use capacity on Gazprom Space System's *Yamal-402* to provide high-performance services to global oil and gas companies across Africa. The company claims customers will benefit from the Russian Ku-band satellite's "high-performance" and "excellent look angles" for the region. SpeedCast adds that with the uplink based in Germany, customers will be able to land their traffic directly into Europe and take advantage of high-speed interconnection throughout that continent.

APRIL

Ooredoo and Arabsat will work together to develop new satellite services for customers. Under the terms of a strategic partnership agreement signed around mid-April, the two companies will review the current satellite projects they have in progress. They will then collaborate on technology and design, and on

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commitments. Some of the company's current Ku-band clients on *AMOS-2* that were to be relocated to *AMOS-6* were moved to *AMOS-3*. For others, the company said it was planning to help find capacity on other satellites or possibly on a satellite that will be relocated, either permanently or temporarily, to 4°W.

In collaboration with Facebook, Eutelsat had contracted a multi-year deal to lease *AMOS-6*'s Ka-band payload covering sub-Saharan Africa, with a view to launching broadband services from early 2017.

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

An "anomaly" caused SpaceX's *Falcon 9* rocket to explode on the launch pad. Both the vehicle and its cargo – Spacecom's *AMOS-6* – were lost in the inferno that rapidly engulfed the rocket just moments after it was cleared for lift-off.

The future is bright

Spacecom's SpaceX *Falcon 9* explosion delayed Iridium's plans for its *NEXT* launch. The satellites had been tested and transferred to Vandenberg Air Force Base and were being processed by SpaceX before their launch, which was originally targeted for 12 September.

The explosion put pay to that timeline and it was actually on 13 January 2017 before the satellites went into orbit when the *Falcon 9* rockets resumed active service.

"After more than seven years of effort, the first of our next-generation satellites are finally ready for space," said Iridium CEO Matt Desch. "This programme replaces the largest commercial satellite constellation in space with state-of-the-art technology and new capabilities, allowing Iridium to support the connectivity needs of today, as well as those yet to be imagined."

NEXT will comprise 66 cross-linked satellites in low-Earth orbit (LEO) to deliver mobile voice and data coverage over the planet's entire surface, including oceans, airways and polar regions.

Each satellite will link-up with four others to ensure a continuous and ubiquitous meshed connection. Iridium said the large number of fast-moving spacecraft with multiple overlapping spot beams minimises missed connections and dropped calls. It added that with each satellite orbiting at just 476 miles (780km) away from the surface, transmission paths are shorter and signal attenuation is reduced.

All 66 orbiters are expected to be launched by late 2017. Starting in 2018, Iridium said the constellation will enable Aireon's satellite-based system to provide global aircraft surveillance in real time.

Not to be left out, Thales Alenia Space and LeoSat Enterprises moved into the second phase of their project to develop a low Earth orbit satellite constellation. The signing of their phase B contract in September 2016 followed the initial stage which resulted in the preliminary definition of the constellation. The companies said this validated the technical feasibility of the system and its compatibility with other Ka-band services.

Phase B concerns the definition of the overall system architecture and performance specs, including both the ground and space segments. It will finalise the manufacturing plan, paving the way for the production and deployment of the entire constellation of 78 to 108 high-power Ka-band satellites.

LeoSat's programme brings together a range of tried and tested systems for the first time. They include optical inter-satellite links, gigabit class onboard processors, flexible steerable antennas, and RF over printed circuit boards.

On 24 August, Intelsat launched the first bird for Africa that uses its *EpicNG* high throughput satellite (HTS) system. Built by Boeing, *Intelsat33e* is equipped with what's claimed to be the "most advanced" digital payload on a commercial spacecraft. It has extended Intelsat's high throughput capacity in both C- and Ku-band from the Americas to include Europe, Africa, the Middle East, Asia Pacific, the Mediterranean and Indian Ocean regions. The company said *IS-33e* is the first multi-spot beam, Ku-band HTS to serve these regions, and will be its second to use *EpicNG* following *IS-29e*'s launch earlier this year for coverage across the Americas and North Atlantic.

Initially due to go into service Q4 2016, *IS-33e* suffered a malfunction in its primary

future projects to deliver cutting-edge satellite services, particularly VSAT. Qatari-based Ooredoo offers mobile, fixed, broadband internet and corporate managed services across markets in MENA and South East Asia. Its mobile operations in Africa include Algeria and Tunisia.

MAY

Arianespace will design, qualify and supply 21 payload dispenser systems for the deployment of OneWeb's satellite constellation. The systems will first secure the spacecraft during their flight to low Earth orbit and then release them into space. They are designed to accommodate up to 32 spacecraft per launch, allowing Arianespace to deliver the bulk of the OneWeb constellation over a period of 18 months, starting in 2018. Swedish firm RUAG Space will be the prime contractor in the development and production of the systems.

JUNE

The Centre de Dépistage et de traitement de l'Ulcère de Buruli (CDTUB) in the remote area of Allada in Benin has deployed SES' *SATMED* telemedicine system. It will be used by Fondation Follereau Luxembourg (FFL) to communicate with doctors and medical experts globally, access online training tools, and establish facilities such as video conferencing, data collection and analysis. The deployment is part of FFL's efforts to establish a consultation office at CDTUB to improve communication between patients and medical staff, raising further awareness of tropical diseases.

JULY

Arabsat has exclusively launched the Mauritanian TV bouquet in the Middle East, North Africa and Europe on board *BADR-4*. Thanks to its "excellent" footprint which covers the entire region on the same frequency and using a minimum receive dish size, Arabsat says the satellite will contribute to the delivery of Mauritanian broadcasting to large numbers of viewers. *BADR-4* was launched in 2006 and orbits at 26ºE from where it delivers services via Ku-band.

AUGUST

Metro Telworks is using a GPS-based tracking system provided by Econz Wireless to monitor its engineers. The bulk of Metro Telworks' work is performed by field engineers who are

thruster which meant that the orbit raising took longer than planned. It eventually started commercial operations on 29 January 2017.

Connecting remote villages

Being able to connect the unconnected can be particularly challenging across Africa's diverse and challenging terrain. One solution came from Gilat Satcom which launched services to bring voice and high-speed data to 10 villages in the states of Adamawa, Borno, Kano, Katsina, Oyo and Yobe in Nigeria. The company's *Village Island* was used to provide a full communications system that includes VSATs, Wi-Fi routers, solar power, two communal tablets per village, and service management.

Gilat Satcom also supplied the satellite connectivity to its VSATs in each village. The integrated Wi-Fi networks then provide local connectivity for data and VoIP to the tablets as well as to devices already owned by villagers and local businesses. The entire setup is housed in the 'Community Hub', a purpose-built communications block in each village.

Nigerian systems integrator Total IT Solutions rolled out the networks using *Village Island* as the infrastructure and service platform for these hubs. The company's CEO Muhammad Yahya Sanda said: "*Village Island* is an extremely well-designed, self-contained system and key to the success of this project. [It] enables us to build low-cost networks which can easily scale with demand."

In a separate deployment, Dizengoff selected Gilat Satellite Networks (GSN) to implement a turnkey solution for the delivery of broadband and cellular services via satellite throughout rural Ghana. Dizengoff Ghana is a subsidiary of Balton CP, a UK-based international corporation that provides products and solutions in communication technology, agriculture and electro-engineering.

GSN deployed various platforms to meet the rural communications requirements of the Government's Ghana Investment Fund for Electronic Communications (GIFEC) initiative. The company supplied its *SkyEdge II-c* hub which is capable of supporting multiple applications, and *Gemini* VSATs which now deliver broadband services to schools. GSN's *Capricorn* VSATs, in conjunction with its solar-powered *CellEdge* small cells, were also implemented to extend cellular services for several leading mobile operators in Ghana.

"Gilat was the only company capable of providing us with a full turnkey solution for the delivery of broadband to schools, as well as cellular service expansion, all on a single platform," explained Patrick Attia, general manager, communication at Dizengoff Ghana in July 2016. "The demanding rollout calls for installation and operation by November."

Underserved areas also received a boost with Solarkiosk and SES Techcom Services teaming up to deliver high-quality connectivity to communities around the world. Under its agreement with SES Techcom, Solarkiosk is using satellite connectivity to provide internet access to underserved areas, initially in Africa. This is being done via Solarkiosk's *E-HUBB* structures which use solar technology to provide electricity to all systems, including the satellite dish. The company said *E-HUBB* could then enable a wide range of connectivity services to the local community.

The two partners said their deal was the first of many steps to deliver off-grid connected solar infrastructure solutions for communities worldwide, targeting individual users, businesses, schools, medical centres and farms. Prior to its agreement with SES, Solarkiosk had already deployed several *E-HUBB*s in Ethiopia. They include two kiosks in the villages of Belela and Mero Qebado which are in the country's southern Awassa region. The *E-HUBB*s were manufactured locally in Addis Ababa and are run by local women who were trained by Solarkiosk.

The 'Community Hub' is a dedicated comms block used for Gilat's *Village Island* system in each Nigerian village.

Power to the people

As well as providing services like internet and voice connectivity, satcoms has been powering other solutions across Africa. For example, TerniEnergia is using Ka-band satellite technology from Avanti Communications to provide high-speed broadband connectivity to its photovoltaic renewable energy plants in South Africa.

Part of the Italeaf Group, TerniEnergia claims to be Italy's first smart energy company operating in the renewables and efficiency market. It is using Avanti's

driven each day along specific network routes to check signal strength for 2G, 3G, and 4G on behalf of operators such as Vodacom and Cell C. Metro needed to know where they were, if they used the correct route, and which hours they worked. Other issues for the company involved speeding, robberies of expensive equipment from the vehicles, misreported hours worked, damage to vehicles, and accidents.

SEPTEMBER

Yahsat and VT iDirect are working together to introduce VNO services across the existing footprint of *YahClick*, Yahsat's satellite broadband service. Based on what's claimed to be the "industry changing" capability of VT iDirect's *Evolution* platform, Yahsat says the VNO offering will leverage the "high-speed and economical capacity" of *YahClick*'s Ka-band network. It says service partners will be able to purchase their own bulk capacity which they can then fully manage and configure themselves to offer differentiated services. They will also be able to commission, control and monitor their own remote sites, while designing and configuring their end-to-end IP network.

OCTOBER

The African Telecommunications Union (ATU) has welcomed two new associate members. They include Germany-headquartered radio monitoring and spectrum management consultant LS telcom. Its MD Jean-Paul Chaib said: "As the leading provider of solutions to regulators, it is a natural step for LS telcom to join the ATU." The second new member is satellite operator Iridium. It will help the ATU prepare for ITU assemblies such as WRC 19, as well as satellite policies and other relevant matters.

NOVEMBER

Angola Telecom's business unit, INFRASAT, says it will invest to improve signal coverage for mobile and fixed telephony operators and provide internet service in the most remote regions of the country. While the company pointed out its turnover of USD27m in 2015, it did not say how much it planned to invest. But as part of efforts to contribute to the development of ICT in Angola, INFRASAT said it aimed to become a satcoms leader in the country.

satellite service to provide high-speed broadband connectivity to its solar power plants in Paleisheuwel in the Western Cape, and Tom Burke in the Northern Province. The sites cover a huge area ranging from 195 to 240 hectares, and are being constructed for a major Italian utility firm.

TerniEnergia deployed a VPN using Avanti's *HYLAS 2* satellite which offers complete coverage of South Africa. It now delivers high-speed internet connectivity that facilitates vital data exchanges between the photovoltaic plants, whilst providing operational support and remote reporting capability.

Satellite technology is also being used for the regular and timely monitoring of Kenya's forests. Working with local company Ukall and the UK's University of Leicester, the Ministry for Environment, Natural Resources and Regional Development Authorities and the Kenya Forest Service (KFS) are developing a prototype for a near-real-time forest monitoring service using data from the European Space Agency's *Sentinel-1* and *Sentinel-2* satellites.

The measurement, reporting and verification (MRV) service will be delivered directly in an easily accessible reporting format via a smartphone app. It will help Kenya in its preparations for REDD+ (Reducing Emissions from Deforestation and forest Degradation), the UN's framework on climate change.

The University of Leicester's Professor Balzter said the initial prototype of the monitoring system will focus on a national forest reserve in Kenya: "Our aspiration is to support participatory forest management strategies to enable Kenya to manage its forests more sustainably and achieve its national forest cover target of minimum 10 per cent by 2030."

The 400 cyclists covered over 400km of remote and harsh terrain where mobile communications are either limited or non-existent, making satellite the only reliable option.

Satellites have also been supporting desert races across the continent. The organisers of the 2016 Titan Desert event, said to be the toughest mountain bike race in the world, used *SPOT Gen3* satellite trackers to enhance the safety of the 400 competitors.

The eleventh Titan Desert race took place in late April. It saw extreme cyclists ride more than 660km across Morocco's cold Middle Atlas mountains followed by vast expanses of searing hot desert. Mobile comms in this remote and harsh terrain are either limited or non-existent, making satellite the only reliable option.

Each competitor carried a small and robust *SPOT Gen3* tracker, enabling organisers, support teams, family, etc., to precisely track their location via the internet. Athletic gear and tracking specialist WAA Tracking provided the customised online solution.

Morocco is also the location for the Rallye Aïcha des Gazelles. Taking place in March every year, the competition is a women-only race which attracts more than 120 teams from 30 countries. It covers 2,500km in six legs across the Western Sahara Desert in Morocco, making reliable satellite and radio comms services a top priority for both logistics and safety.

A deal saw Marlink, which has been the event's turnkey communications provider for 25 years, signed up to provide critical comms to the event for another five years.

The company said its engineers ensured the smooth functioning of all comms services deployed in the field, with Marlink satellite links used to enable internet access for the organisers and media working in the camps. Satellite connectivity was also used to provide VoIP at the control centre. As well as enabling recreational services, this allowed competitors to stay in touch with family and friends.

Organisational vehicles, such as those used by medical and support teams, were equipped with radio receivers so that they could communicate with HQ and be dispatched for prompt assistance to injured or stranded competitors.

Marlink also provided airborne radio networks for communications between field staff and the local control centre. Two helicopters covered each leg, transmitting duplex radio to fixed terrestrial relay stations.

Tracking and safety services were provided by the company's satellite-based *Iritrack* system. This enables real-time tracking of competitors, and also enables them to send alarms to HQ in the event of an emergency.

DECEMBER

Eutelsat is planning a new satellite for the key 5°W orbital position. It has contracted Airbus Defence and Space to build the payload while the platform will be manufactured by Orbital ATK. To be launched in 2018, *EUTELSAT 5 West B* will replace *EUTELSAT 5 West A* which predominantly targets the French, Italian and Algerian broadcast markets. *EUTELSAT 5 West A*'s C-band mission, serving mainly data customers in sub-Saharan Africa, will be discontinued. The company says service continuity will be provided by similar C-band capacity available on its other resources, thereby optimising capacity utilisation rate across the group's fleet.

Michèle Scanlon, New business development, Gondwana International Networks

The year ahead: As always in a technological race for market share, the technology itself may not actually be the key differentiator. Instead, access to local markets via licensed operators on the ground, speed to market, and deployment in rural Africa, is the ultimate aim.

With strong competition and increasing capacity, satellite broadband pricing is expected to decline faster over 2017/8 than in previous periods. Supply and demand will dictate new price points, bringing affordable broadband.

At *Satellite 2017* held earlier this year in Washington, Wesley Wong, Facebook's head of strategic technology partnerships and sourcing, hinted at the social media giant's potential involvement in lowering that cost per unit. He reiterated the need for standardisation and mass scale to enable those without connectivity to achieve this with satellite services.

However, prices of the satellite modems required by end users typically start from USD170, with full price kit from USD400 inclusive of antenna and RF unit. Then there is a further USD300 to pay for consumables and installation fees. So until the market sees reductions in pricing or innovative financing approaches for all this, the utopian goals of mass-scale broadband penetration in Africa may be limited.

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1957

1967

2017

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Jean-Philippe Gillet, VP, EMEA sales, Intelsat

In the 2016 edition of *The African Wireless Communications Yearbook*, Jean-Philippe Gillet spoke at length about the need for the economics of the industry to change.[1] He called for the industry mindset to switch from selling megahertz to megabits. So has he seen any progress since then?

"The vision for Intelsat is all about making it more affordable for the consumer. You will not capture the growth if you are not able to make it more affordable. And I am not only talking about the affordability of the bits or 'package of data' – it's also about the affordability of the equipment that you have on the ground."

Gillet believes it is therefore important to look at the strategy around all of that and companies such as OneWeb which was setup by O3b Networks founder Greg Wyler a few years ago. OneWeb's mission is to develop and launch hundreds of LEO satellites in its quest to fully bridge the digital divide by 2019,[2] and when it was announced in 2015 its investors included Airbus, Hughes Network Systems, Intelsat, Qualcomm, amongst others. At the end of February 2017, Intelsat announced a merger agreement with OneWeb.

"If you don't think the business in a different way then you don't change the accessibility and affordability. Why is it important for all these companies to be involved with OneWeb? Because they do things in a different way. If you get Qualcomm involved you also think about chips, and Qualcomm doesn't think thousands, they think hundreds of thousands or millions. Airbus is thinking about building a satellite a week. So we are re-thinking the way we do business – instead of producing a satellite every two years you produce one every week.

"If you want to unlock new opportunities for the satellite industry you need to look at it in a different way. You need to have an approach which is not about how you do a bit of squeezing here and a bit of squeezing there. Of course, this is important and has to be part of your basic day-to-day business. But satellite is now more about how you're going to be able to reach thousands of schools, or how you're going to have a dish that will be deployed on a brand-new Toyota. The dish won't have any movable parts. This is exactly what Kymeta[3] is doing. When they look at their product they look at mass production – the antenna is going to be produced in a way such as the mass production of TVs is done. So the whole logic is shifting.

"Yes, we need to address the market as it is, and yes we need to squeeze as much as possible to deliver broadband in a more cost-effective way. But at the same time we need to focus on the applications of the future. How do we go to the Internet of Things? How do we think 5G? How do we connect a car? How do we provide a service that mobility customers are really looking for?"

Intelsat has been successful as a satellite operator for more than 50 years. So why does the company feel that things should change now. Gillet said that the market's fundamental requirement is about being connected all the time and consuming more bandwidth. "We believe there is going to be a constant explosion of demand. We also believe the technology is ready because all of the innovation is there to make it affordable. It's as simple as that.

"You must also time your innovation in the right way – even if the customer is not ready for it today, you need to develop the right product that can carry gigabits or terabytes of capacity in the future."

When asked if the African market is tough for Intelsat at present, Gillet retorts by saying those who do not want to be challenged should not work in any developing countries.

"This comes with the territory. In Africa, the middle class is evolving and I think 70 per cent of the population is below 25 years old. So all of the fundamentals of market demand are there. We didn't decide to come to sell services in Africa last week; it was part of the foundation of Intelsat to provide services into developing countries. So okay, we might have a little bump in the road, but if you are in it for the long run then you have to deal with that little bump in the road."

Last August, Intelsat launched two satellites for Africa including *IS-33e*, it's first spacecraft for the region to use the *EpicNG* high throughput system. The satellite is a replacement for *IS-94* which will be redeployed.

"It's a combination of C-band and spots, Ku-band and spots, so it serves a number of different applications. At the same time, we're working with a number of customers in other regions where we have more traditional applications. I am a great believer in rural connectivity. The challenge here is to deliver services in a cost-effective way and this is where we offer something that is different. You need to make it more affordable. So in order to do this is via a high throughput satellite is to bring a higher efficiency."

IS-33e was Intelsat's second *EpicNG* satellite and joined the first, *IS-29e*, which was launched for the North and Latin America and North Atlantic region in January 2016. Gillet said that the "beauty" of having the second satellite is that you can use the first one to do a lot of testing. "So we tested with existing equipment to see what the additional efficiency was. At the end of the day that doesn't really mean anything except that if before you were able to transmit 1.2 bits in 1Hz and now you can transmit 1.5 bits in the same Hertz, you save money. And if you keep your own equipment, you gain 15 to 30 per cent. We worked with all the major equipment providers and had told them what we were launching, and advised them to get their acts together and develop the right products. And the results are new products that can double the efficiency.

"The second challenge you have in rural connectivity is access to power. Very often, the main constraint for mobile operators is how to provide the fuel into the tower in order to deliver continuous service. One of the great things about next-generation satellites is that you can reduce the size of the kit, and the minute you do that you reduce the requirement of power. And at that point, you can put in solar panels, wind turbines, or whatever you want, but you're not going to have to rely on having diesel generators.

"So you can't just look at the satellite as one component. As the operator, we have done our bit in terms of the innovation on the satellite which is good, but then after that you have to look at the power, what is the best option for the customer, what is the overall cost. I heard from one customer in Africa that 30 per cent of their operational expenditure is fuel – and that is one of the large telcos operating in 20 countries. If you can save 10 per cent of this, you are not talking about megahertz, megabits, you are really looking at the total cost for the customer. So if you find a way to save them 10 per cent, the service you provide adds value for them."

[1] African Wireless Communications Yearbook 2016, p68.

[2] Southern African Wireless Communications, May-Jun 2015, News pp12-23: *Digital divide will be "fully bridged" by 2019.*

[3] Editor's note: Kymeta specialises in leveraging satellite network capacity for high bandwidth communication access while on the move. On 7 March 2017, Intelsat announced that it had acquired an unspecified equity stake in Kymeta. Additionally, Intelsat CEO Stephen Spengler has joined Kymeta's board of directors.

So does that mean to say that working in partnerships is key here for Intelsat in Africa? Here, Gillet said different satellite operators have different philosophies, and Intelsat decided to adopt an open system. "An open system means that we want to be able to work with all the technologies; it means we want all of the teleports and all of the value-added resellers to be able to use our system. It's a bit more work for us. For instance, right now we have been having discussions with Newtec. We visit them and tell their team about our plan and the design of our satellite, and that it's all confidential and that they can't share that with our competitors. And then we do the same with iDirect, Comtech, UHP and Gilat, etc., because we want all of them to develop the technology to deliver the additional efficiency of what we provide.

"We do not want to do the deployment by ourselves and have no intention of being on the equipment side. We want our value added reseller to integrate that in their offering. So it is all about how you partner and how you select the right partner; it is about them challenging us at the same time as we challenge them."

Andrey Kirillovich
Director of integration & projects, Russian Satellite Communications Company

2016 was a pivotal year for RSCC's business in Africa, according to Andrey Kirillovich. "Our recently launched satellites, *Express-AM6*, *AM7* and *AM8* in 14°W, 40°E and 53°E, respectively, have been loaded with enterprise, cellular backhaul, IP trunking, maritime and consumer broadband customers from Africa, or doing business there.

"We prepared our entry into this new regional market very thoroughly and those preparations started bringing real value last year. The number of the telecom and broadcasting projects that we've been involved in rose dramatically. Some of them ended successfully with new contracts and some of them not. But now we feel that RSCC has become an integral part of an African satcoms landscape, and we have been fully integrated into satellite telecom and broadcasting infrastructure on the continent.

"RSCC has now been working in the sub-Saharan region for two years, and the market conditions have been improving since we entered in 2015. Customers have got used to operating and expanding networks under lower budget conditions. Plus, an overall drop in bandwidth and equipment pricing was of great help to them for obtaining new clients and entering new verticals. The broadcasting business remains strong and we also see some rise in the backhaul and corporate sectors."

According to Kirillovich, the challenges in Africa in 2016 remained the same as in previous years: lack of qualified engineering staff at the customer's side; payment collections; overall slowdown of business activities in the oil-dependent economies; and total instability in the region. But it was not all doom and gloom, and he says "good signs"

of recovery appeared in 2016 which leads to hopes for a new rise of satcoms in Africa.

"Some networks that we gained in 2016 were migrations from other satellites, but there were also a few new networks deployed from scratch. Moreover, existing customers are slowly but steadily expanding their networks. With the continuous penetration of fibre more backup is required, and we have seen some good satellite backup deployments last year.

"In 2017, RSCC plans to enhance its marketing and sales activities in the West and Southern Africa regions. We want to get more deeply involved in ground segment integration and offer turnkey solutions to a few verticals, such as maritime, enterprise and cellular backhaul. We also plan to continue supporting our customers throughout Africa and meet their requirements of building cost-effective satellite networks across the continent.

"Besides that RSCC, being one of the world's first satellite operators established in the market, is celebrating a tremendous milestone in November 2017: its 50th anniversary."

Dmitry Sevastiyanov, Director general, Gazprom Space Systems

Gazprom Space Systems (GSS) has been active in Africa's telecoms market since 2013. At present, the Russian company's orbital constellation includes four satellites: *Yamal-202* located at 49°E; *Yamal-300K* at 183°E; *Yamal-402* at 55°E; and *Yamal-401* at 90°E. All operate in C- and Ku-bands, and the fleet's total capacity is about 9GHz.

Dmitry Sevastiyanov explains that while this capacity is increasingly used on the Russian market, the *Yamal* satellites' footprints not only cover the territory of that country and its neighbours, but also Europe, the Middle East, Southeast Asia, the northern Pacific, and a significant part of the African continent.

"Approximately one third of total capacity is concentrated in the beams serving the areas outside Russia. About fifty foreign service providers use this capacity, providing services in more than 100 countries. A significant part of GSS' international business is focused on emerging markets in Africa and the Middle East."

For instance, Sevastiyanov said *Yamal-402* was designed to serve Africa. Launched in December 2012, he describes the Thales Alenia Space manufactured spacecraft as a "modern, powerful and reliable satellite".

"The wide Southern beam of this satellite offers high-energy performances (EIRP 46-51dBW) and covers a significant region of the continent, particularly sub-Saharan Africa, Madagascar and neighbouring areas of the Indian Ocean. The European beam provides coverage for North Africa, the Middle East and most parts of Europe. There are also inter-beam connections between the European and Southern beams.

"In addition, there is a more powerful steerable beam which can also connect with Europe covered by the Northern beam. The steerable beam is focused on the countries of central Africa (DRC, Angola, Tanzania, Zambia) to meet the needs of clients in addition to the Southern beam."

Sevastiyanov said *Yamal-402*'s capacity can be used to setup different kinds of communication links, TV services, broadband internet access, etc. He added that quality of service for customers is determined by the satellite's high performance characteristics and good elevation angles under which the satellite is visible from Africa.

"Despite strong competition on the African market in recent years due to the appearance of a large number of new satellites, *Yamal-402* is very popular. In 2016, many GSS customers operating through the satellite, increased capacity utilisation volume and, consequently, the amount of satellite services for their users.

"The Southern beam is much in demand for Angolan TV broadcasting services, Cameroon and Lesotho TV channels. About a dozen African TV channels broadcast via Telemedia, a well-known provider of television services from South Africa.

"*Yamal-402*'s capacity is widely used by broadcasters to organise television reports (SNG services). Optimal coverage of the continent together with the Africa-Europe inter-beam connection enables broadcasters to arrange TV news reports as well as transfer content quickly and qualitatively both in Africa as well as from Africa to Europe.

"For example, in early 2016, the contract was signed with a major German telecom operator that provides occasional use *Yamal-402* capacity for the transmission of television and other content in Nigeria. At the beginning of 2017, a Cameroonian TV company broadcast the 2017 Africa Cup of Nations hosted by Gabon via the satellite."

Sevastiyanov continued by saying that in 2016, major service providers offering satcoms services for global companies in the energy, and oil and gas industry in Africa extended their contracts and increased the amount of leased capacity on *Yamal-402*.

"Many telecom operators use the European beam to provide services to large oil and gas enterprises being situated in the Middle East, as well as communications with vessels in the Mediterranean Sea. The most popular trend is connectivity from Europe to Africa, and the most popular application here is providing internet for remote regions of Africa."

An example here is UK-based NSSL Global which is leveraging *Yamal-402*'s power. "Responding to new market needs, it significantly expanded the coverage of its global network in 2016, and increased its capabilities to provide more stable services using the Southern beam. In particular, it is focused on telecom services for cruise ships in the Indian Ocean, and for customers on the continent which it regards as a strategically important region.

Also during last year, Gilat Satellite Networks began to use the Southern beam capacity for services in sub-Saharan Africa based on its *SkyEdge II-C* technology. During the first stage, the company used the capacity to provide broadband internet access in schools as well as services to mobile network operators in rural areas of Ghana.

As in recent years, Sevastiyanov said the African market was quite difficult for satellite operators in 2016.

"There are plenty of satellites from different global and regional operators. As a result, the market is highly competitive.

"The situation is complicated by political and economic instability, significant currency fluctuations, and falling energy prices. These are the factors that have a negative impact on the business activities of consumers of satellite services worldwide, especially in the corporate segment – one of the main consumers of satellite services.

"Capacity oversupply and drop of demand caused significant competition and a sizeable decrease (20 to 30 per cent) in prices for satellite capacity and telecom services.

"But despite all the difficulties, Africa's telecommunications market demonstrates the potential for growth. It gives optimism, and Gazprom Space Systems hopes for the further filling of the beams serving this region. We are confident that as soon as the positive trends in the economy appear, *Yamal-402*'s capacity will be contracted completely.

"GSS believes that its position in these markets has increased significantly thanks to the development in 2016 of partnerships with major service providers working here, and cherishes these partnerships. Looking to the future, the company plans to launch a new satellite to the 55°E orbital position to expand its business in the region.

"Finally, in 2017 Gazprom Space Systems is going to celebrate the 25th anniversary of its business. The company confidently entered the year, continuing to show stable growth of income. In 2016, revenue amounted to RUB5.5bn – nine per cent more than the previous year. Thirty six per cent of the total revenue was received from the sales of satellite capacity in international markets outside Russia."

Farhad Khan, Chief commercial officer, Yahsat

Farhad Khan joined UAE-based Yahsat in October 2016, having previously worked with big name cellcos such as Airtel Africa where he was also CCO, as well with MTN. In his view, Yahsat is the "go-to" resource for satellite broadband internet in Africa.

"By investing in the uniquely designed and technologically advanced *Al Yah 3* satellite, we will expand our commercial Ka-band coverage to an additional 19 markets in Africa, reaching 60 per cent of the population, and offer cost effective high-speed satellite broadband service, even in the remotest of areas. Additionally, on-ground relationships with partners will also provide premium service and support to customers directly in-market."

Partnerships are crucial for Yahsat and indeed, Khan's predecessor David Murphy, previously stated that they are a key for the company's success.[4] Last year therefore saw a raft of partnership agreements for the company, as Khan explains.

"2016 has been an exciting year for us, our partnerships with industry peers went from strength to strength. We signed a multi-year capacity agreement with Eutelsat Communications, giving *Konnect Africa*, Eutelsat's African broadband venture, access to high-performance commercial Ka-band capacity for broadband services across sub-Saharan Africa.

"We also partnered with UK-based teleport, satellite and terrestrial network operator Talia, providing them capacity on *Al Yah 3* alongside existing services on the *Y1B* satellite. This unique arrangement will provide Talia's customers in the Middle East and Africa with a tightly integrated offering and a tailor-made solution to fit the changing demands of their customers.

"Earlier in 2016, we signed an MoU to explore the possibility of new joint opportunities with an existing partner, IEC Telecom Group. IEC Telecom is one of the world's leading mobile and fixed satellite communications service providers and the MoU has enabled us to explore ways to offer *YahClick* broadband products, services and value-added solutions to users in Africa.

"We also partnered with VT iDirect for the introduction of VNO services across *YahClick*'s existing footprint. The VNO offering is based on the industry changing capability in VT iDirect's *Evolution* platform.

[4] African Wireless Communications Yearbook 2016, p72, David Murphy, Yahsat.

It allows service partners to purchase their own bulk capacity which they can fully manage and configure themselves to offer differentiated services. This will facilitate our partners in the provision of broadband across the region."

While African internet penetration has historically been lower than many other markets worldwide, Khan said data demand has exhibited an unprecedented increase on the continent as a result of the prolific growth of affordable smart devices.

"Africa's internet penetration is expected to reach 50 per cent by 2025 as smartphones hit a forecasted 360 million, increasing significantly from 16 per cent and 67 million, respectively, in 2013. However, there is still room for sub-Saharan African governments and ICT regulators to participate in global discussions to ensure regulations and processes are in place for facilitating connectivity for the users."

Khan's view is that the market has definitely become more competitive with telcos and broadband providers diversifying their offerings and launching products such as multi-vendor IT services and internet packages. "Due to the availability of multiple options, customers now have the choice to select preferred services based on pricing and experience. This is in addition to the increased investment telecoms operators are committing into rural areas, hence extending broadband reach beyond urban borders."

Furthermore, Khan said the rollout of Ka-band services and the development of more innovative, high-speed solutions has opened up the consumer space, particularly in regions like South Africa, Angola, Nigeria and East Africa.

Africa has experienced significant growth over the past few years, and Khan cited Nigeria as a good example where more than 94 million users are connected to broadband internet. But even though the region's mobile telecoms and broadband market is one that exhibits immense growth potential, he said it is also intertwined with unique regional challenges.

"In terms of telecoms infrastructure, Africa still faces a significant struggle to connect all the population with quality broadband in the suburbs of major cities, smaller towns and rural areas. Hence, there are opportunities for satellite broadband providers to cater to the increasing internet demand from a growing population. Satellite broadband providers can deliver high-speed broadband, at reduced service cost, by commercial exploitation of higher frequency bands.

"Other challenges that can put pressure on markets include currency fluctuations and lack of regulations that govern business practices. That said, markets are adaptable at overcoming such challenges, and we're seeing the development of a business conductive environment.

"On a macro-level, the rate of socio-economic development can pose further challenges that are unique to the region. *YahClick* is present in multiple African countries and works together with service providers in those markets, to not only deliver reliable broadband services but to also accelerate the pace of development. We've also launched campaigns in South Africa and Nigeria where we provide broadband services to allow remote communities to access basic facilities such as education, healthcare, and financial services.

"Africa is a high-priority for us as we will expand into new markets later this year with our third satellite, *Al Yah 3*. With its launch, we will triple our existing presence in Africa serving home and business users as well as government entities, and NGOs. We will continue to work closely with our existing service partners to expand our satellite broadband services across Africa and to focus on bringing connectivity to people living in remote areas where there is still no connectivity. We also have plans to further expand *YahClick*'s VNO services in Africa, which will benefit our service partners and end users."

Ahmed Gettani, Head of African & Middle Eastern sales, Anacom Inc.

Africa poses unique challenges and opportunities for a satcom market that combines both settled infrastructure as well as myriad growth opportunities, according to Ahmed Gettani.

He believes that there are many opportunities still expanding in Africa with a fast-growing population, combined with continually increasing domestic and foreign investment. "The growth in wireless communications and massive landlocked territories in Africa mean there will be a continued and increasing demand in satcom development. AnaCom is well positioned to be one of the prominent suppliers of equipment."

Internet and broadband demand exists along a wide range of different industries and users – from local businesses and the oil and gas industries, to home and small offices. The continent's size makes satellite the only feasible way to meet this demand across the entire continent. As countries in the interior continue to grow in population and industry, satcom development will have to increase to meet the needs of all facets of African life and community.

In addition to its vast geography size, the continent provides unique challenges due to different, sometimes clashing, cultures. The one thing in common throughout the region is the need for people to stay connected to each other and to the rest of the world. Locally grown businesses and industry, as well as outside corporations and foreign investors, depend on reliable communication to compete in the global economy.

Gettani says one such major challenge is the potential danger to economic infrastructure due to instability and violence. "[They] will negatively impact the African economy in some areas, destabilising some regions, with millions of refugees potentially streaming from one area to another."

The need for stability in the face of potentially volatile circumstances provides another reason why Africa is posed for continued opportunities in satcom investment, and the continent is AnaCom's largest addressable market due to the urgency of building satcom infrastructures.

The company has partnered with the State of California's Office of Emergency Services with their emergency service networks, giving them a personal insight into the need for reliable network communications across a variety of terrain and weather climates. This is a necessary goal for any satcom plans due to Africa's own wildly varied climates and topography. Potential health and regional emergencies necessitate a clear and reliable plan for communication between emergency responders, NGOs, and local governments.

As world culture continues to shape and be shaped by global networks, reliable satcom infrastructure allows African countries to have the opportunity to add their unique voices to online communities via social media and various online communities on the internet.

Major satellite operators have provided the opportunity for Satcom manufacturers such as AnaCom, Inc. to expand their reach in the African markets. With an unprecedented number of satellites having been launched in recent years, satcom development still has plenty of room to grow throughout the continent.

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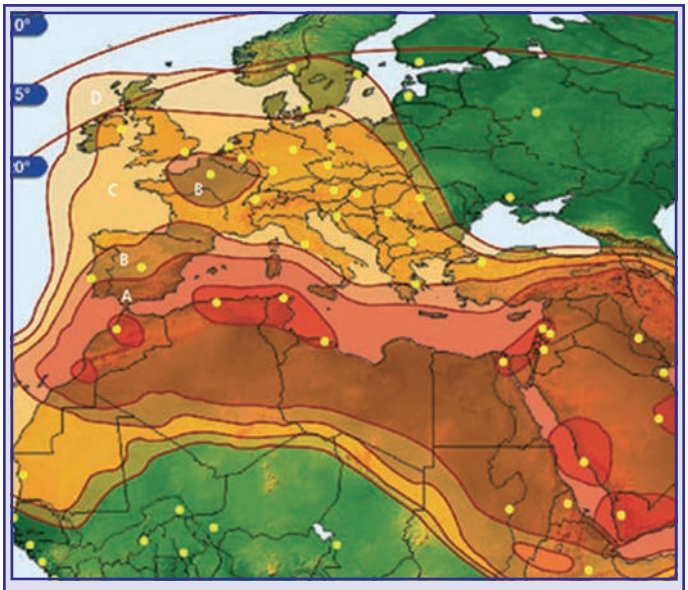
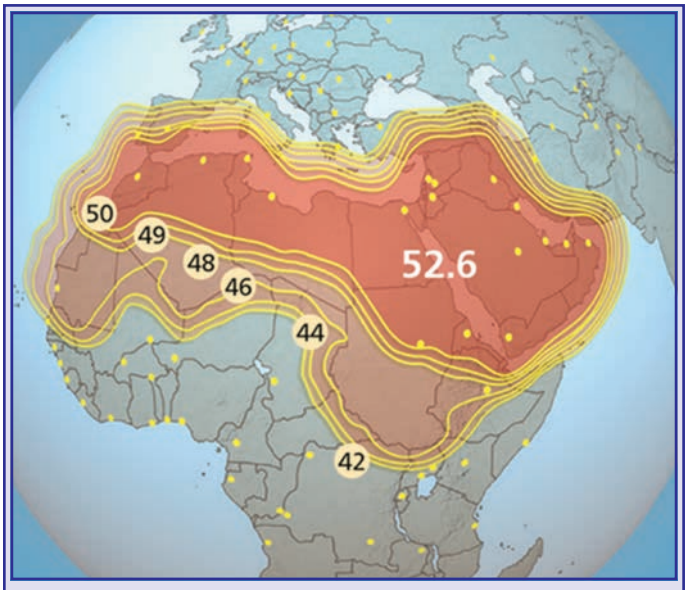


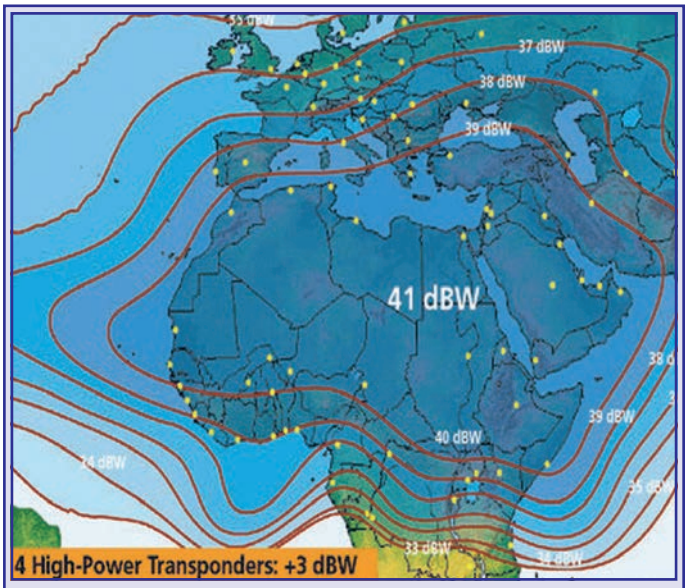
Arabsat BADR-4: 26°E

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



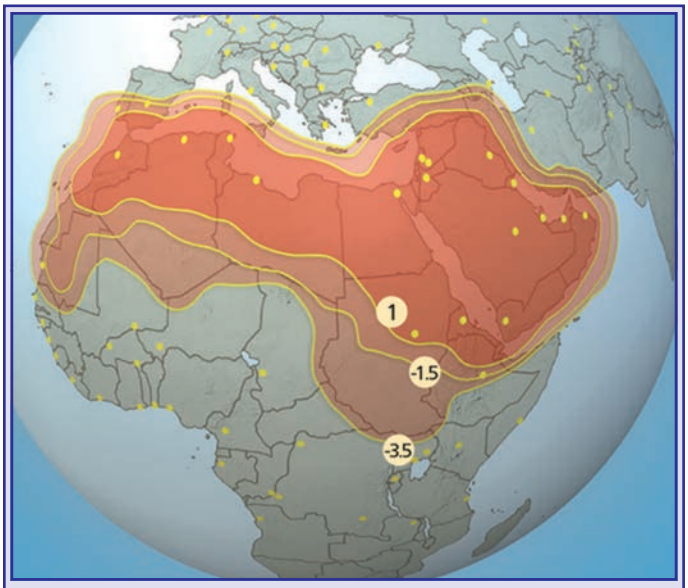
Arabsat BADR-5: 26°E

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



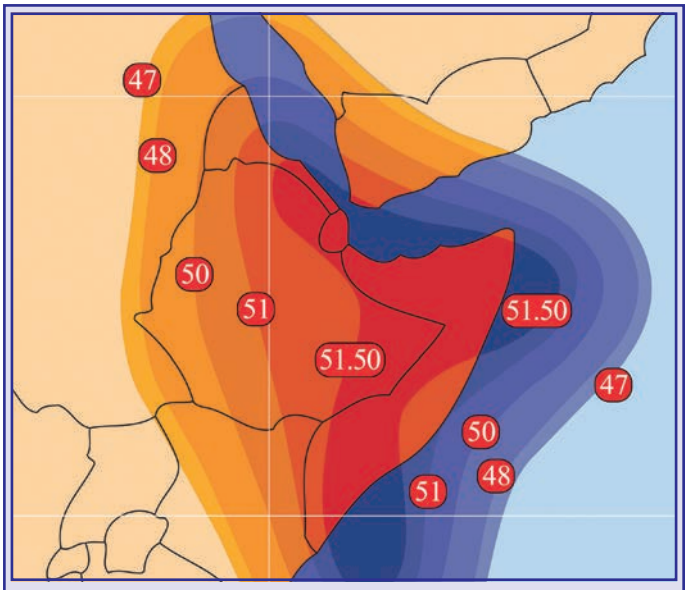
Arabsat BADR-6: 26°E

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)



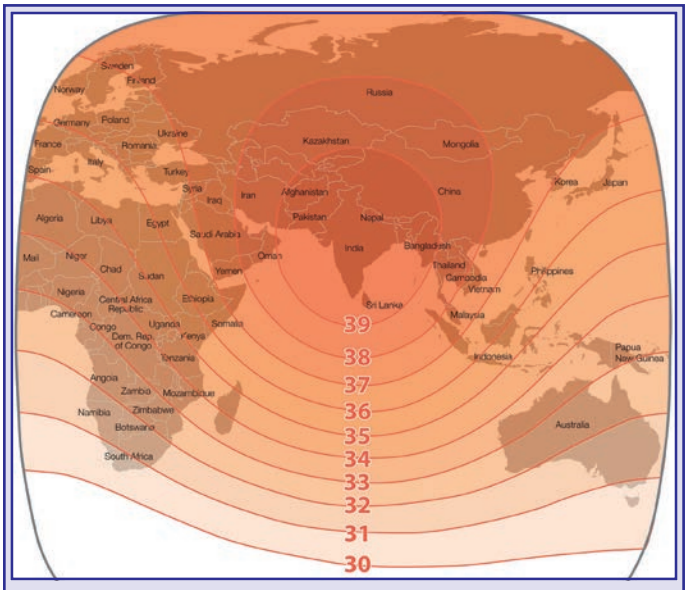
Arabsat BADR-7: 26°E

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



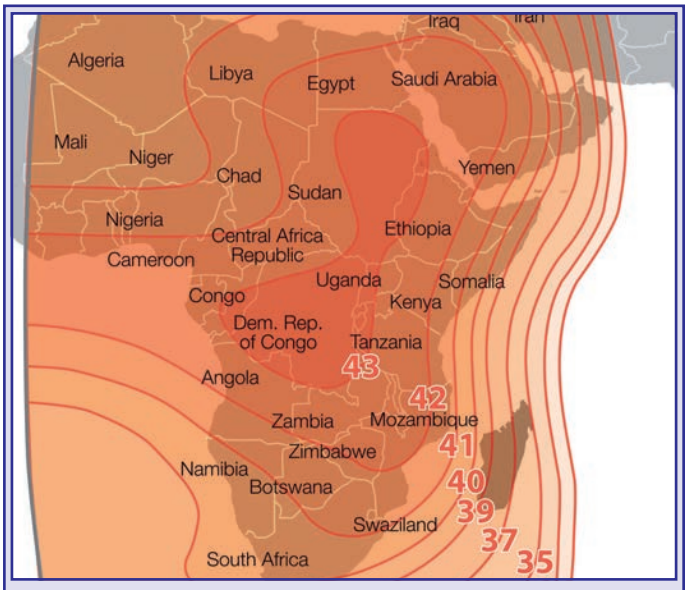
AMOS-4: 65°E

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)



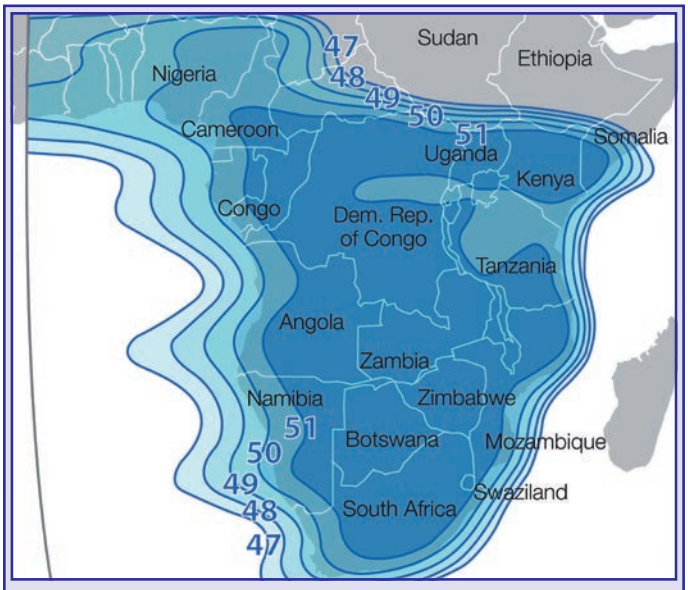
Asia Broadcast Satellite ABS-2: 75°E – Global C-band beam

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



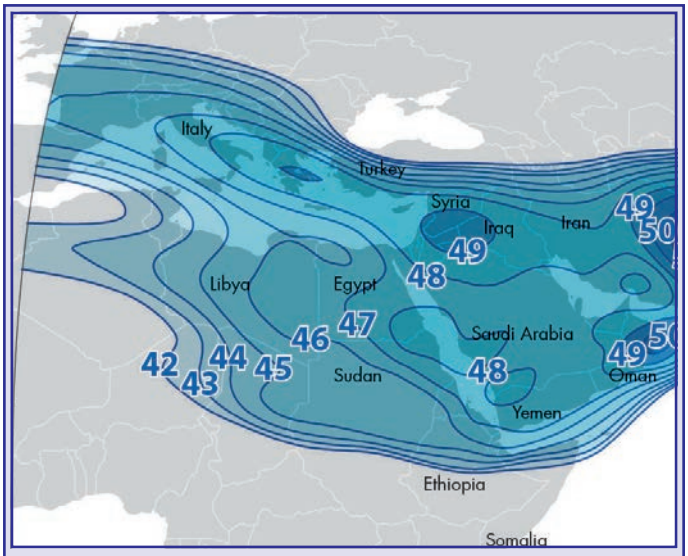
Asia Broadcast Satellite ABS-2: 75°E – West Hemi C-band beam

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



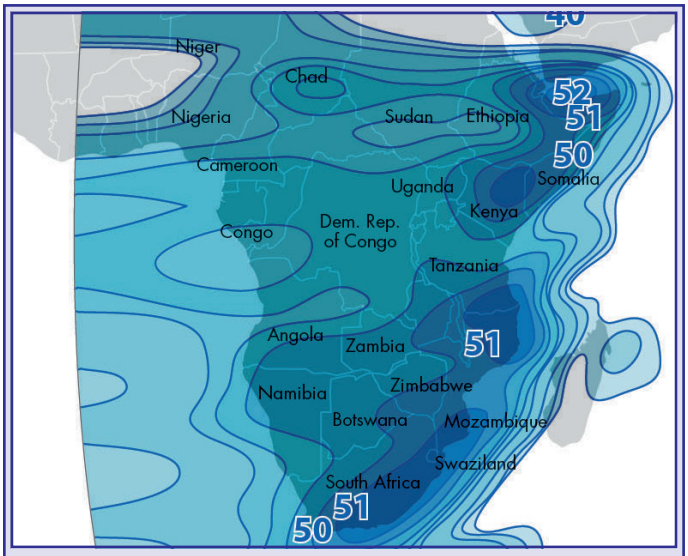
Asia Broadcast Satellite ABS-2: 75°E – South & Central Ku-band beam

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



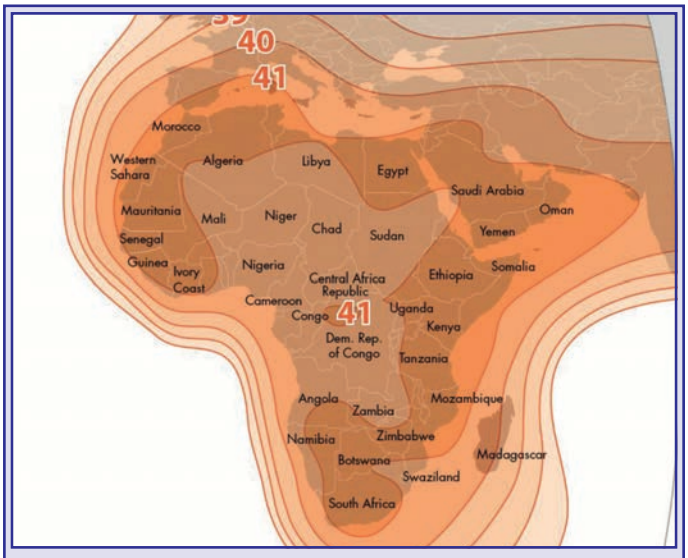
Asia Broadcast Satellite ABS-2A: 75°E – MENA Ku-band beam

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



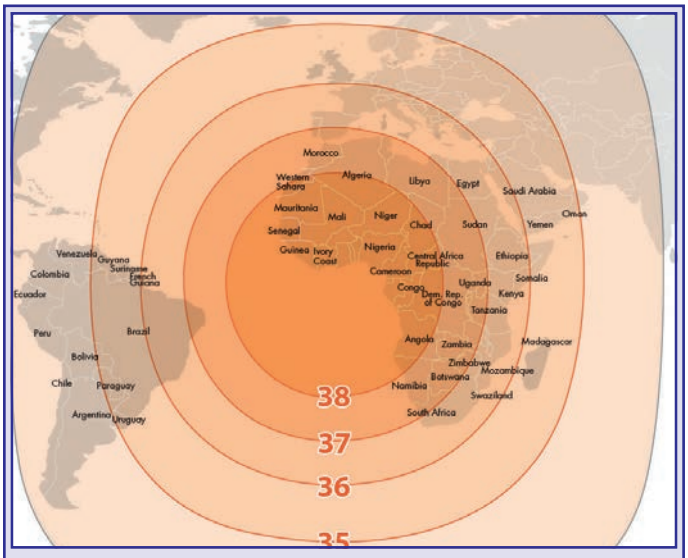
Asia Broadcast Satellite ABS-2A: 75°E – Africa Ku-band beam

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



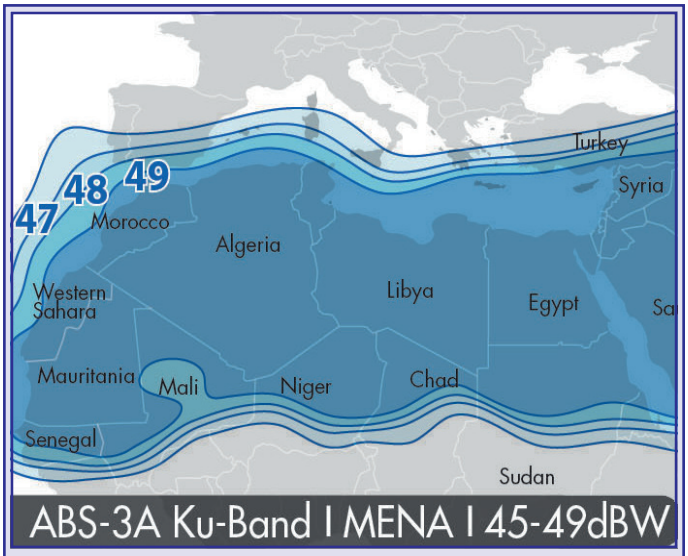
Asia Broadcast Satellite ABS-3A: 3°W – East Hemi C-Band beam

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	



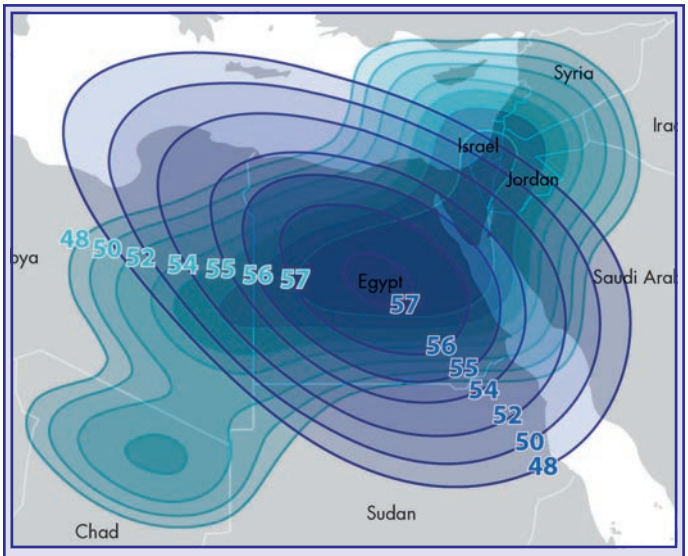
Asia Broadcast Satellite ABS-3A: 3°W – Global C-Band beam

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	



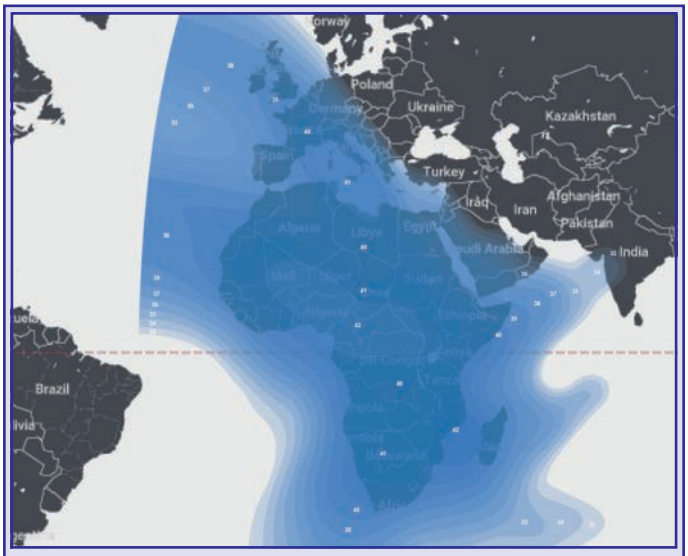
Asia Broadcast Satellite ABS-3A: 3°W – MENA Ku-Band beam

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	



Asia Broadcast Satellite ABS-4/Mobisat-1: 3°W – MENA Ku/Ku Band West Beam & East Beam

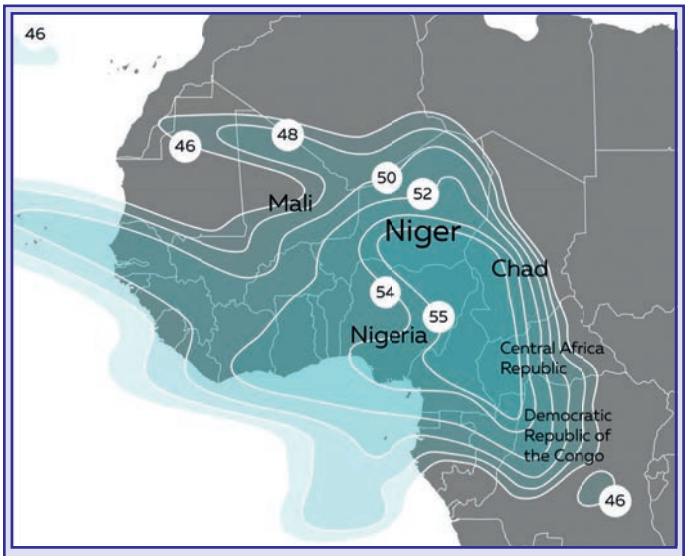
Launch date:	March 2004	
Transponder bandwidth:	25MHz	
Uplink/downlink:	13.824 to 13.849/12.214 to 12.239GHz	
Signal polarisation:	Linear	
EIRP (peak value) (dBW):	57 (East Beam)	57 (West Beam)
TWTA (Watts):	150 (East Beam)	130 (West Beam)
TWTA redundancy:	2:1 (East Beam)	2:1 (West Beam)
Uplink SFD (dBW/m2):	-105 ~ -85 at 7.2 dB/K G/T (East Beam)	
	-105 ~ -85 at 11.0 dB/K G/T (West Beam)	
G/T (peak value) (dB/K):	14.5 (East Beam) 14 (West Beam)	



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

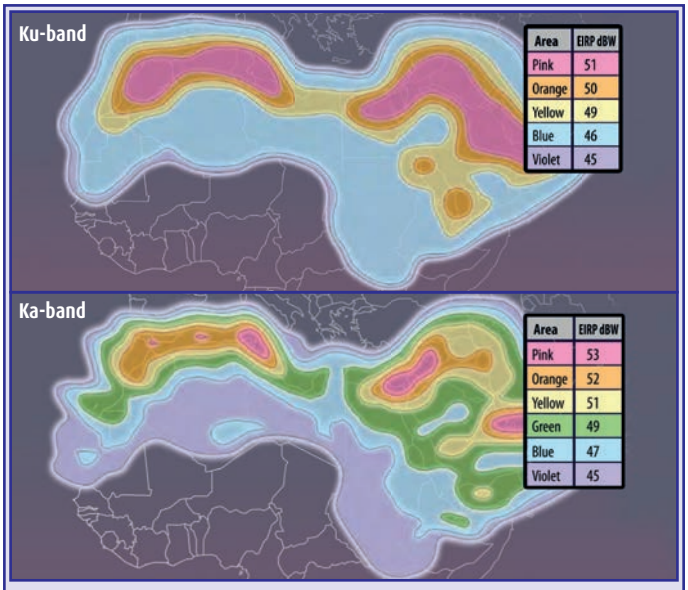
Launch date:	February 2013
Active transponders:	24 (36MHz each)
Uplink:	5925 to 6425MHz
Downlink:	3700 to 4200MHz
Beams:	Central Asia & Europe beam, Africa & Europe beam
Polariaation:	RHCP/LHCP and V/H relatively
TWTA power:	65W

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



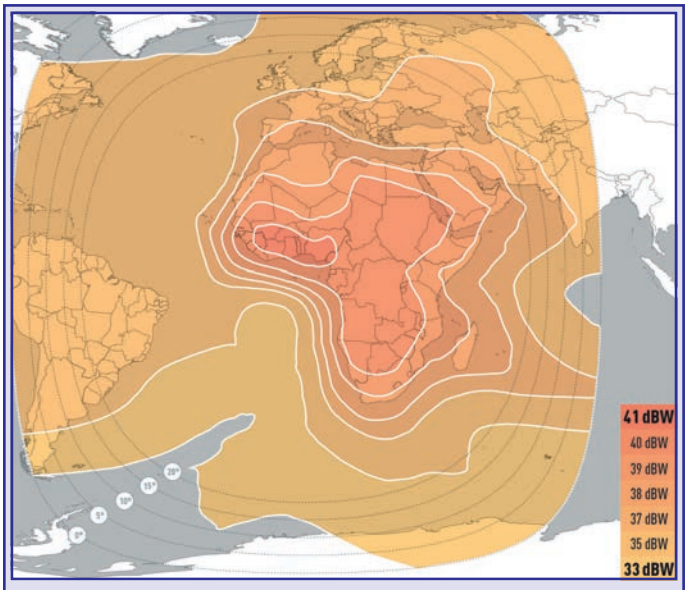
Azerspace-2: 45°E – Ku-Band

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



Es'hailSat-1: 25.5°E

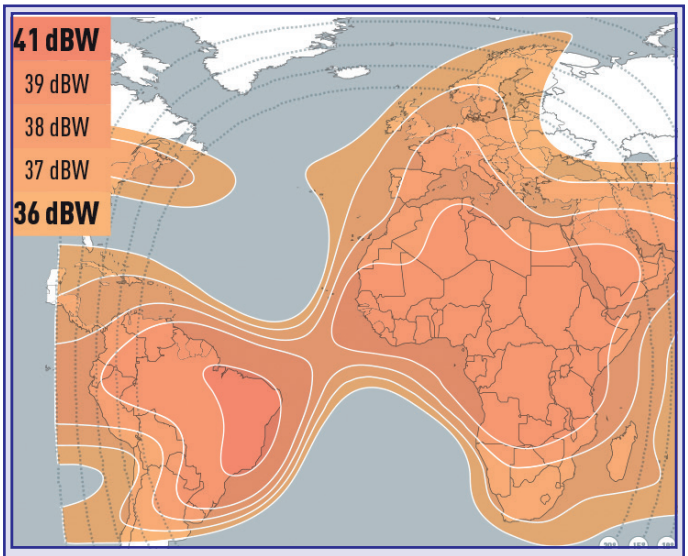
Launch date:	August 2013	
Parameter:	Ku-band	Ka-band
Coverage:	MENA	MENA
Number of transponders:	Up to 8	7
Transponder bandwidth:	33MHz and 50MHz	33MHz and 50MHz
Polarisation:	Dual linear	Dual linear
Uplink frequencies:	Standard 14GHz band	18.1-18.4GHz
Downlink frequencies:	Standard 10/11GHz band	21.4-21.7GHz
EIRP (peak):	51-52dBW	50-51dBW
G/T (peak):	+5dB/K	+5dB/K
Uplink sfd:	-95 to -65 dBW/m² (location dependent, 22dB dynamic range)	



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.

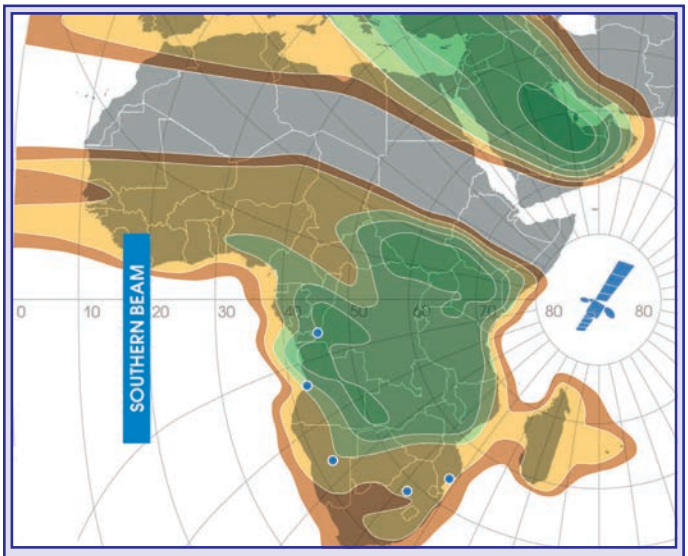
Launch date: May 2014
Manufacturer: Airbus Defence and Space
Operational life: Over 15 years
Launch craft: Sea Launch AG's Odyssey
Operational transponders: Up to 51
Downlink polarisation: Ku-, Ka- and C-bands



EUTELSAT 8 West B C-band: 8°W

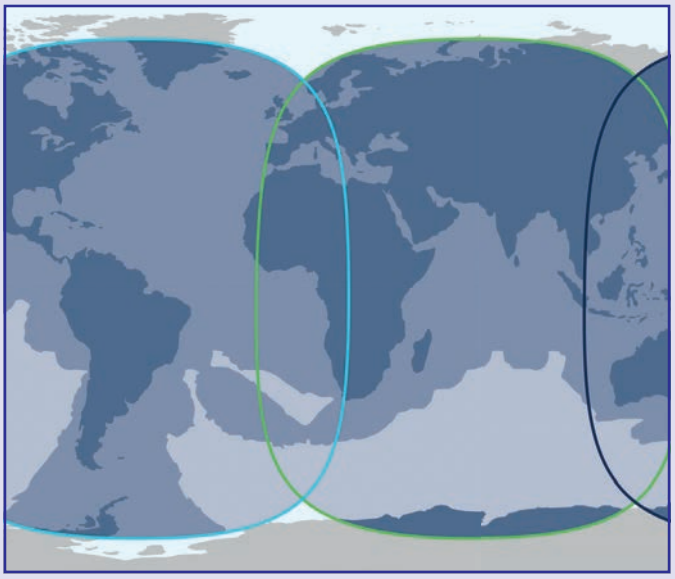
EUTELSAT 8 West B is a new high- capacity spacecraft equipped with 10 C-band transponders connected to footprints covering the African continent and reaching west to South America.

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



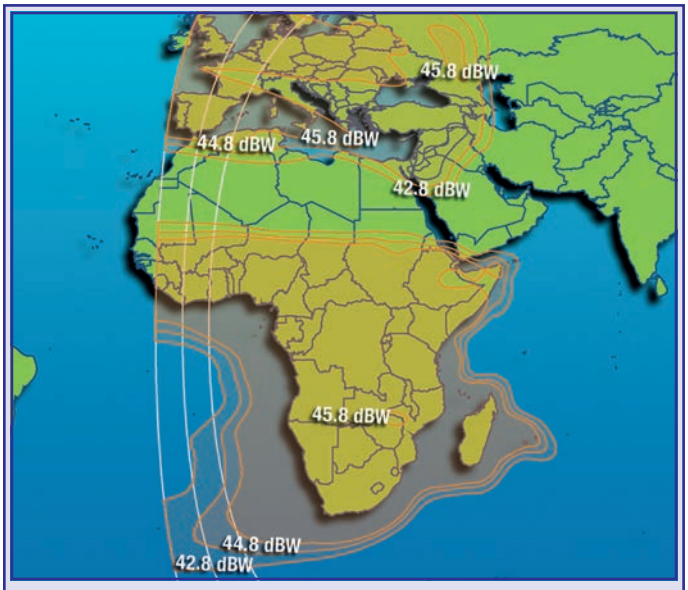
Gazprom Space Systems Yamal-402: 55°E

Launch date:	December 2012
Frequency:	Ku
Operational life:	15 years
Transponders:	12 x 72MHz; 18 x 36MKHz; 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



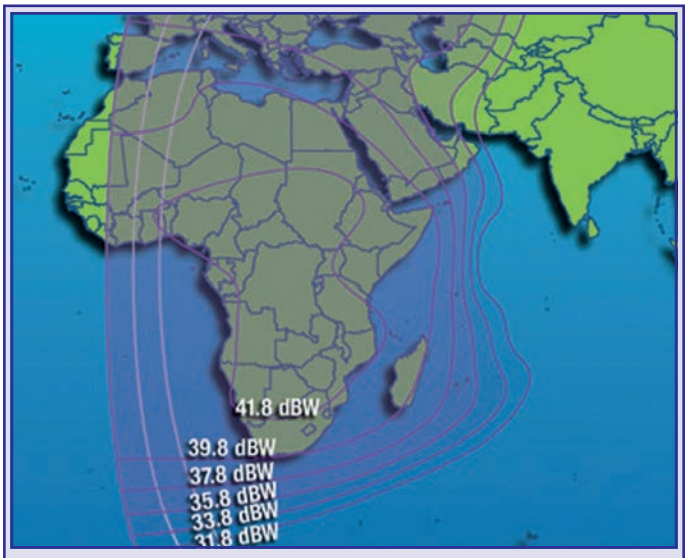
Inmarsat Global Xpress 63°E

Satellites: I-5 F1; I-5 F2; I-5 F3
Launch dates: Dec 2013; Feb 2016; Aug 2015
Launch site: Baikonur Cosmodrome
Launch vehicle: Proton M
Launch mass (kg): 6070
Manufacturer: Boeing (Hughes)
Model (bus): BSS-702HP
Orbit: GEO
Operational life: 15 years



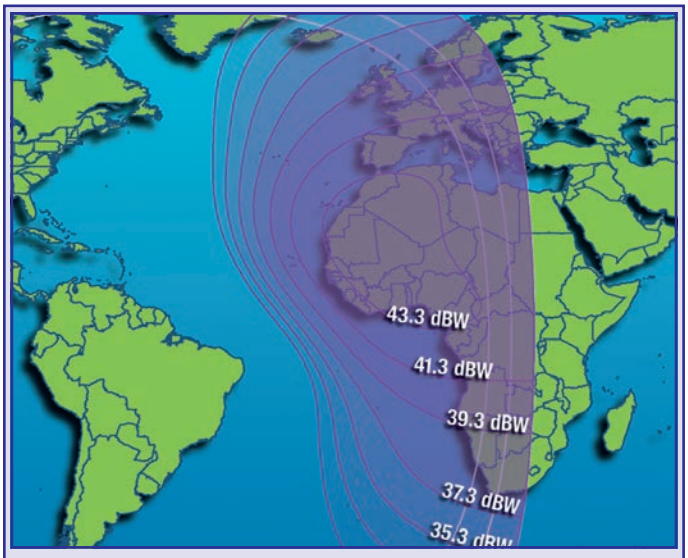
Intelsat IS-20: 68.5°E

Launch date:	August 2012
C-band total transponders:	8 x 54MHz; 16 x 27MHz; 12 x 36MHz C/Ku cross-strap
Polarisation:	Linear horizontal/vertical
Uplink:	5850 to 6425MHz
Downlink:	3700 to 4200MHz
EIRP (typical edge of coverage):	> 30.7dBW
G/T range:	> -10.6dB/K
Edge of coverage SFD range:	-97.0 to -68.0dBW/m2 (at G/T = -10.6dB/K)
Ku-band total transponders:	48 x 36MHz, 6 x 72MHz
Ka-band total transponders:	1 x 500MHz



Intelsat IS-22: 72°E

Launch date:	March 2012
Transponders:	C-band: 24 x 72MHz Ku-band: 12 x 36MHz, 6 x 72MHz
Polarisation:	circular right/left hand (C-band); linear horizontal/linear (Ku-band)
Downlink frequency:	3625 to 4200MHz (C-band) 11.45 to 11.70GHz (K-band)
C-band G/T range (edge to beam peak):	-3.3 up to 2.6db/K (East Hemi) -1.9 up to 3.6dB/K (West Hemi)
Ku-band G/T range (edge to beam peak):	-1.5 up to +4.9db/K (MEA) -0.9 up to +2.3dB/K (Mobility)

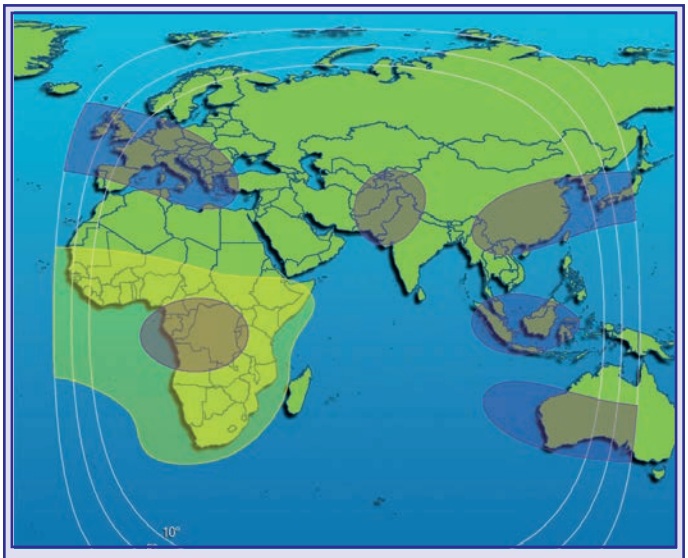


Intelsat IS-23: 307°E

Launch date:	October 2012
C-band total transponders:	24 active in combination of 36, 41, 72MHz channels (up to 46 equivalent of 36MHz units)
Polarisation:	circular – right/left hand
Downlink frequency:	3700 to 4200MHz
Edge of coverage EIRP:	West Hemi: > 32.6dBW; East Hemi: > 33.2dBW Global: > 31.7dBW
Uplink frequency:	5925 to 6425MHz
Edge of coverage G/T range:	West Hemi: -8.4dB/K East Hemi: -7.6dB/K Global: -9.6dB/K
Edge of coverage SFD:	-97.0 to -76.0dBW/m

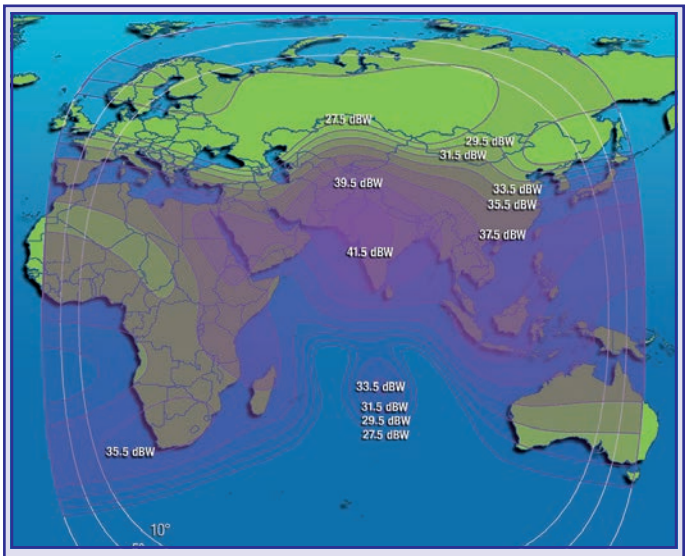
Intelsat IS-33e: 60°E – Ku-Band Multi-Spot & Eurasia Beams

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



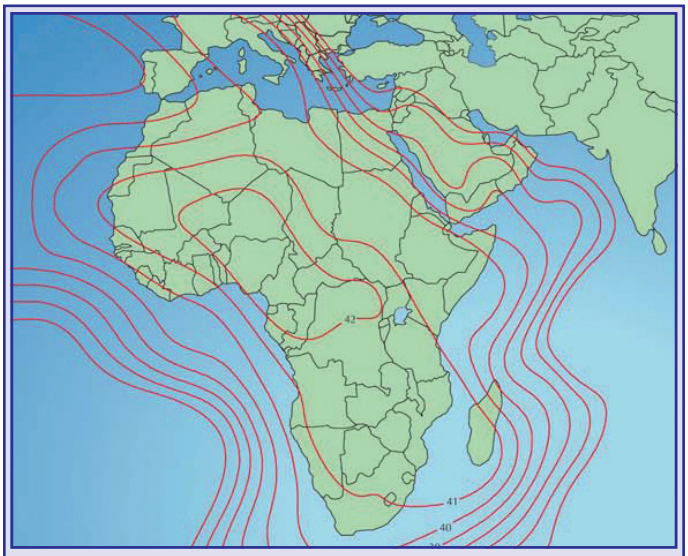
Intelsat IS-33e: 60°E – C-Band Sub-Saharan & Spot Beams

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 36: 68.5°E – C-Band Landmass Beam

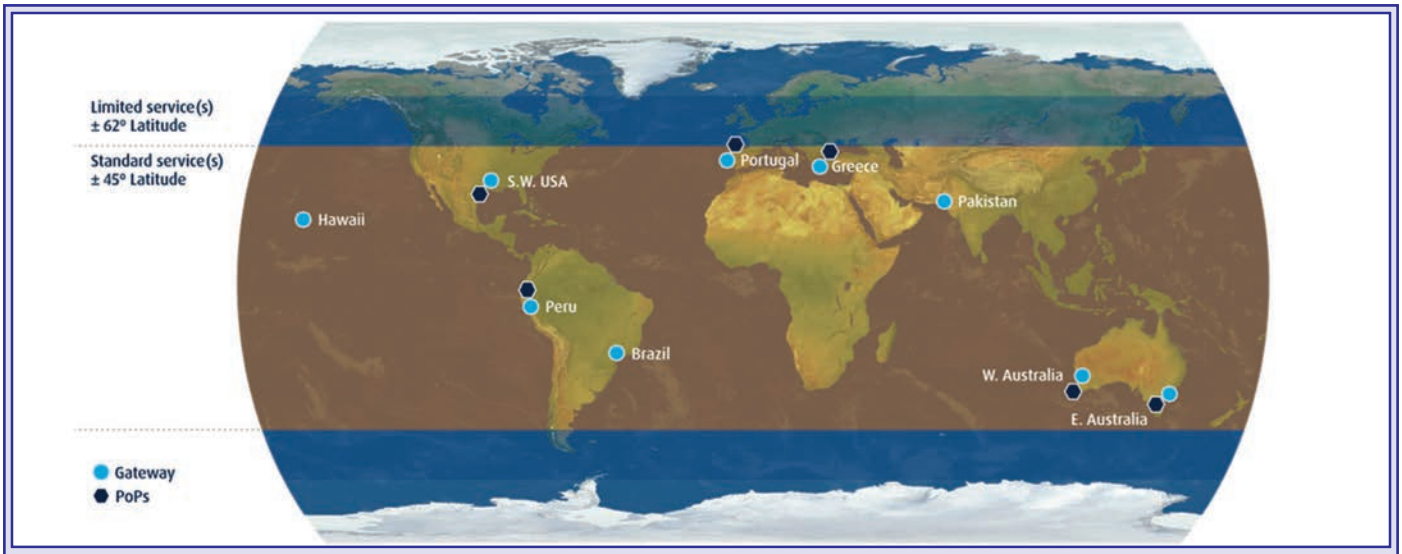
Launch date:	August 2016
Configurable capacity:	12 (in equivalent 36MHz units)
Polarisation:	Linear horizontal/vertical
Downlink fequency:	3700 to 3990MHz
Typical edge of coverage EIRP:	> 28.3dBW
Uplink frequency:	5925 to 6215MHz
Typical G/T range:	Up to 0.6dB/K



MEASAT AFRICASAT-1A/AZERSPACE-1: 46°E

Africasat 1a/Azerspace-1 is the result of a USD300m, three-year collaboration between Malaysia-based MEASAT Satellite Systems & the Azercosmos Joint Stock Company set up by the Government of the Republic 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.

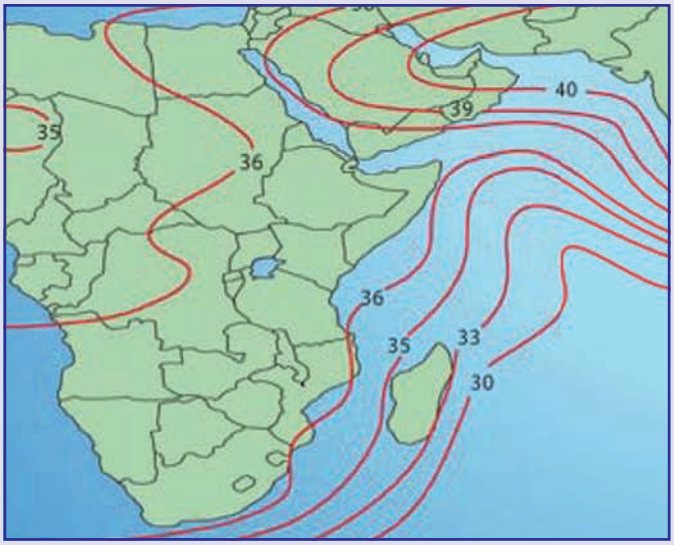
Launch date: February 2013
C-band transponders (36MHz equivalent): up to 24
Typical EIRP beam coverage: 42dBW (max)
G/T (dB/oK): –1 (max)
TWTA power: 65W **Polarisation:** linear



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 MEO 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.

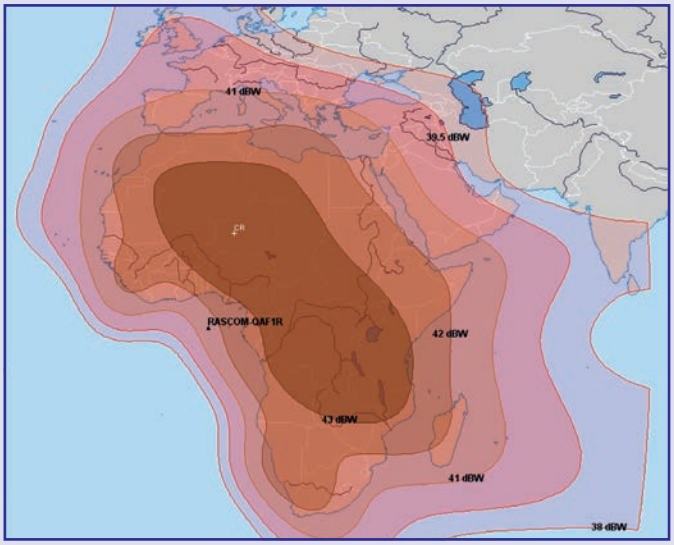
Launch dates:	June 2013 (first set of four); July 2014 (second set of four); December 2014 (third set of four)
Manufacturer:	Thales Alenia Space
Orbital inclination:	<0.1°
Ground period:	360 minutes/Four contacts per day
Beams:	Ka-band; 10 beams per region (seven regions) totaling; 70 remote beams per 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 3A: 91.5°E

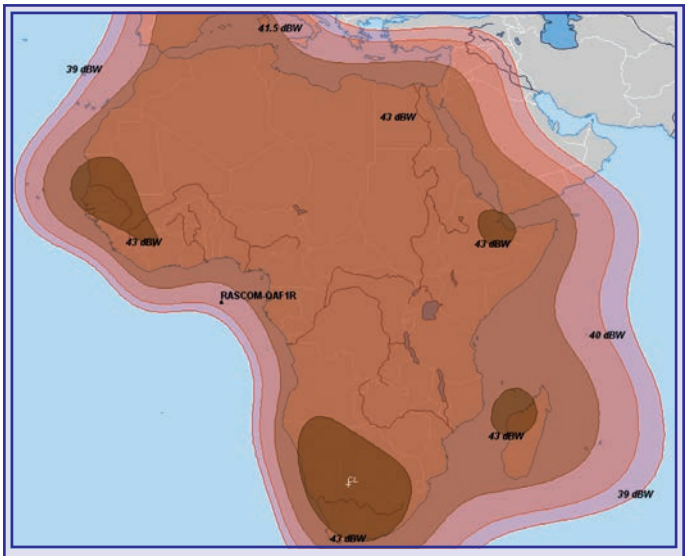
MEASAT-3a carries 12 Ku- & 12 C-band active transponders along with three antennas. It covers Asia, the Middle East & Africa, serving C-band markets throughout the region with a global beam, & Ku-band beams that support broadcasting markets in southeast Asia. MEASAT-3a generates approximately 3.6kW of payload power.

Launch date: June 2009
Manufacturer: Orbital Sciences Corporation
C-band transponders (36MHz equivalent): 12
Typical EIRP beam coverage (C-band): 42dBW
G/T (dB/oK) (C-band): +1.3 (max)
TWTA power (C-band): 60W
Polarisation: linear



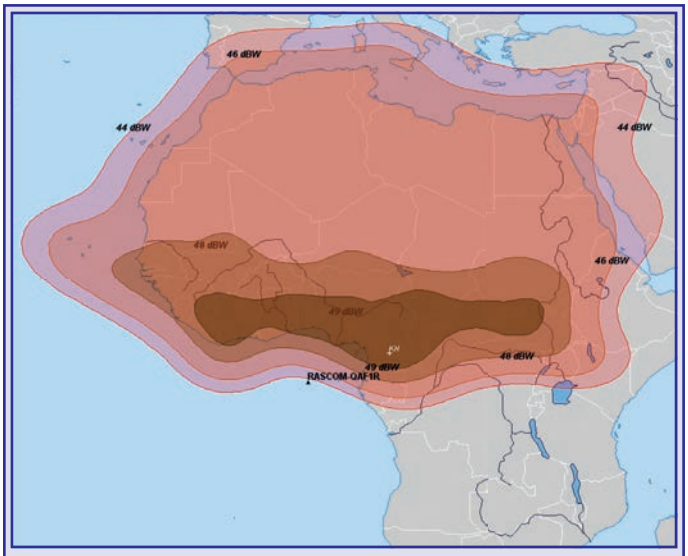
Rascomstar-Q1R: 2.9°E – Standard C-band EIRP

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



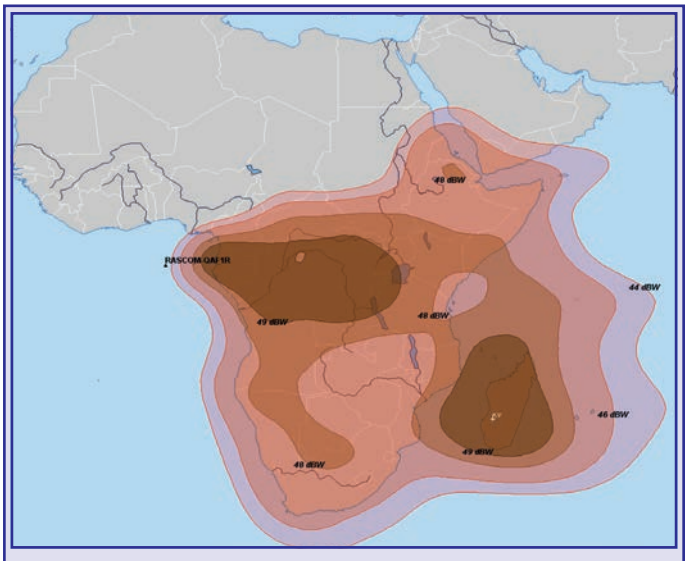
Rascomstar-Q1R: 2.9°E – Planned C-band EIRP

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):	44
Uplink (MHz):	6725 to 7025
Downlink (MHz):	4500 to 4800
Polarisation:	Circular



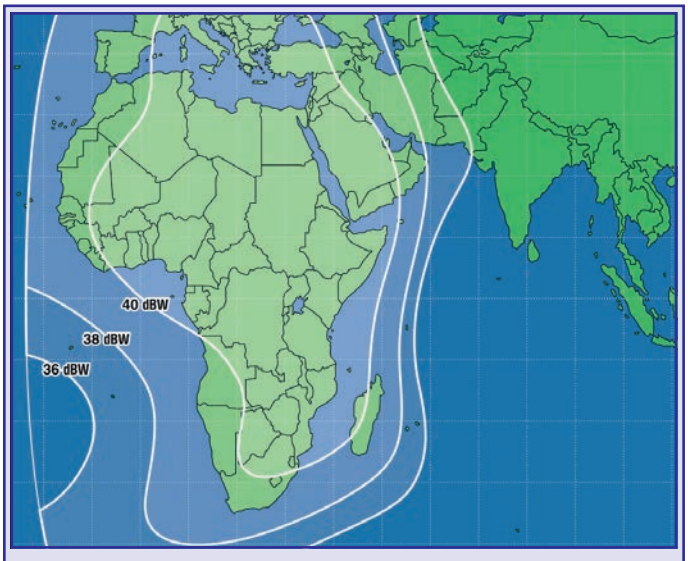
Rascomstar-Q1R: 2.9°E – Ku North beam EIRP

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

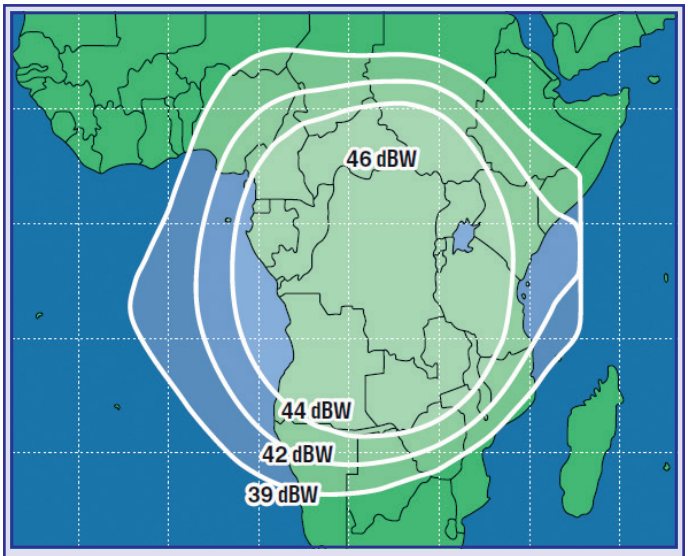
Launch date:	August 2010
Launch vehicle:	Ariane 5
Platform:	TAS Spacebus 4000B3
Bands:	C-band standard & planned; Ku-band planned
Ku-band South Beam peak EIRP(dBW):	50
Uplink (MHz):	12750 to 13250
Downlink (MHz):	10270 to11450
Polarisation:	Linear



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.

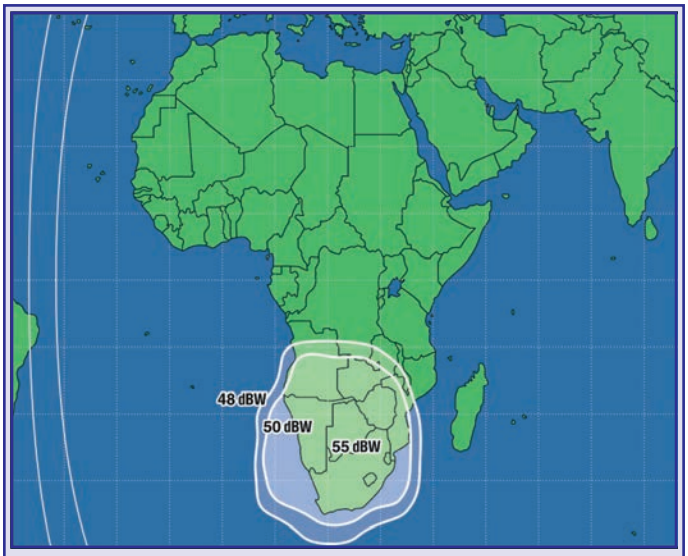
Launch date:	October 2014
Coverage:	Russia, EMEA, sub-Saharan Africa
Operational life:	15 years
Operational transponders:	C, Ku, Ku-/Ka-, Ka, L



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.

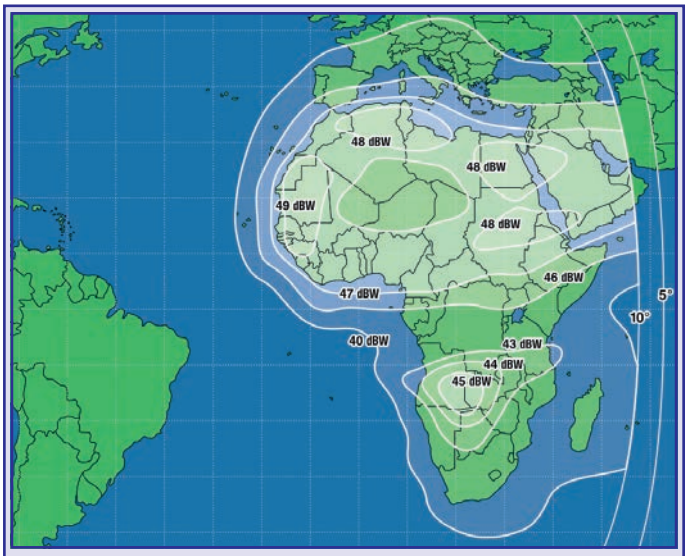
Launch date:	March, 2015
Coverage:	Europe, Middle East, sub-Saharan Africa, Russia, South-East Asia
Operational life:	15 years
Operational transponders:	C, Ku, L



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.

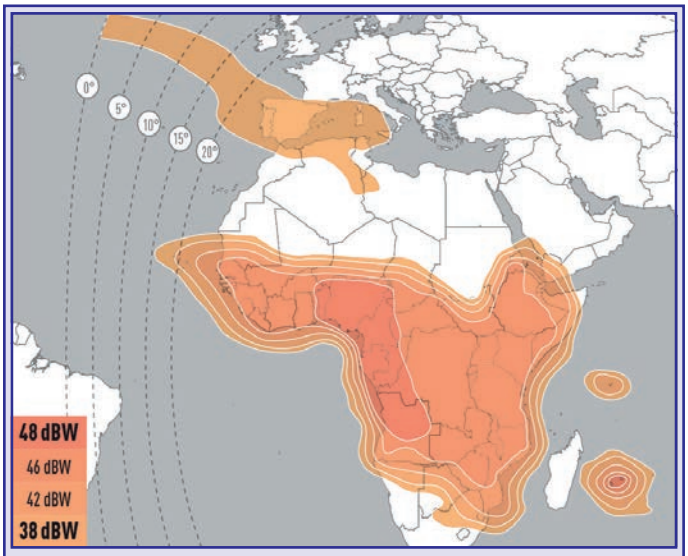
Launch date:	March, 2015
Coverage:	Europe, Middle East, sub-Saharan Africa, Russia, South-East Asia
Operational life:	15 years
Operational transponders:	C, Ku, L



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.

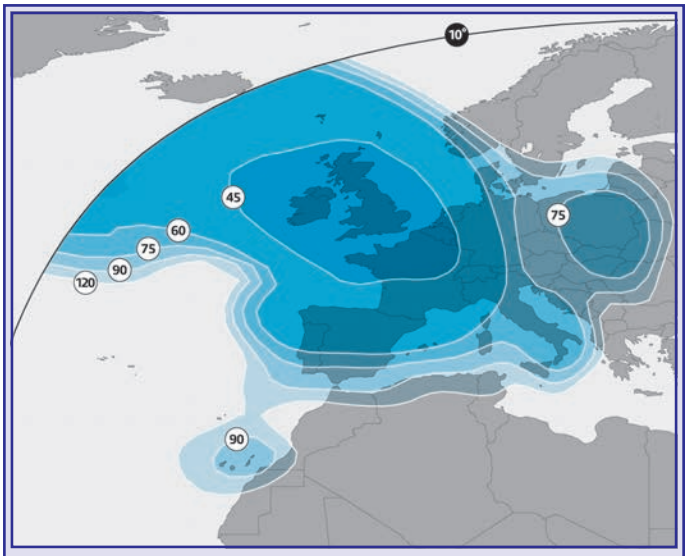
Launch date:	September, 2015
Coverage:	Europe, MENA, sub-Saharan Africa, Latin America
Operational life:	15 years
Operational transponders:	C, Ku, L



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.

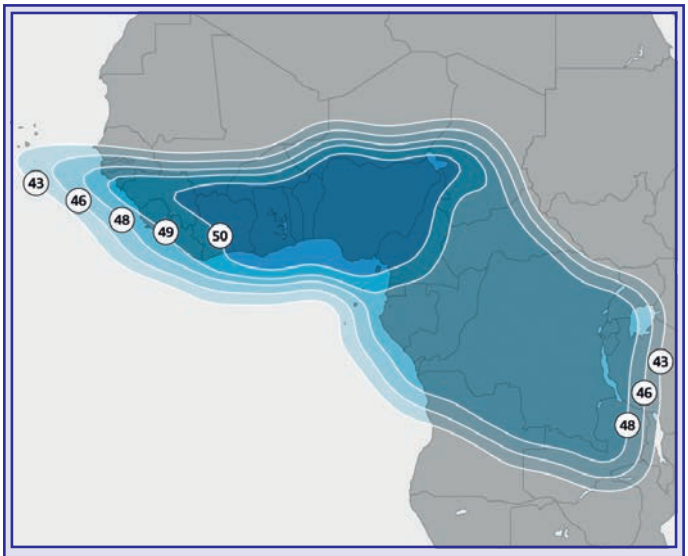
Launch date:	December 2015
Coverage:	Russian, sub-Saharan Africa
Launch vehicle:	Proton-M
Operational life	15 years
Manufacturer:	Airbus Defence and Space
Polarisation:	Ku-band: linear; Ka-band: circular
Total transponders:	70 Ku- and Ka-band



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.

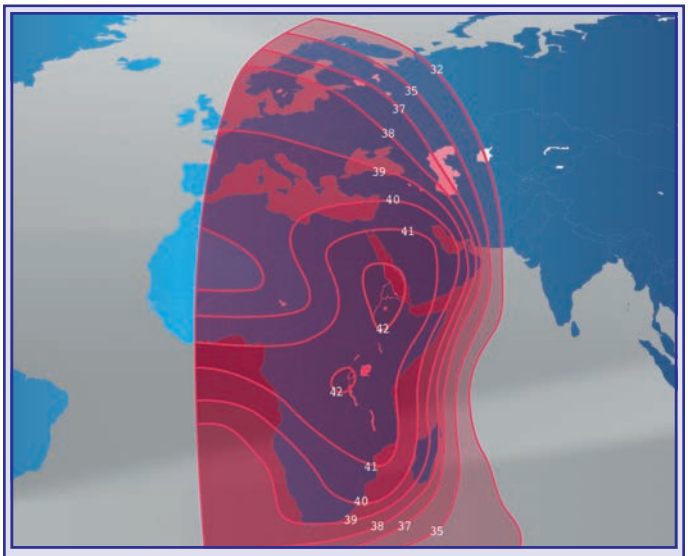
Launch date:	September 2013
Coverage:	Middle East , North Africa, Europe
Launch vehicle:	Proton
Operational life:	15 years
Manufacturer:	EADS Astrium
Polarisation:	Ku-band: linear; Ka-band: circular
Total transponders:	Ku-band: 42 (Europe); 12 (Middle East). Ka-band: 4 (250MHz, 500MHz and 600MHz)



SES ASTRA 2F: 28.2°E/28.5°E

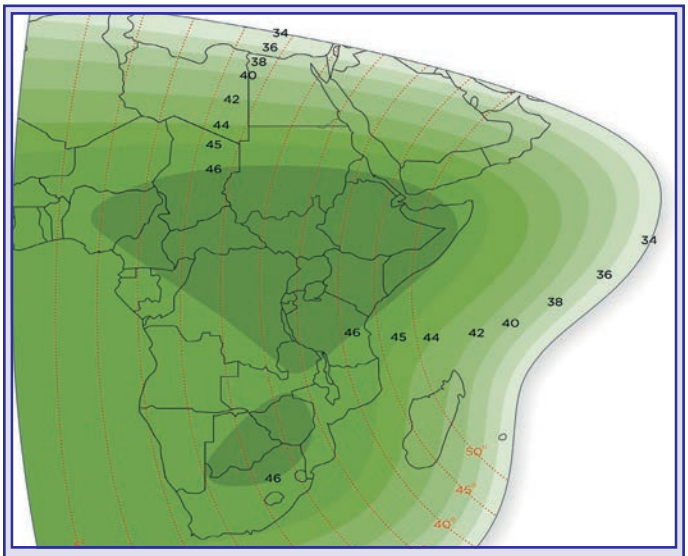
Serves to deliver next-generation broadcast, VSAT and broadband services in Europe, Middle East and West Africa, and carries Ku- and Ka-band payloads.

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

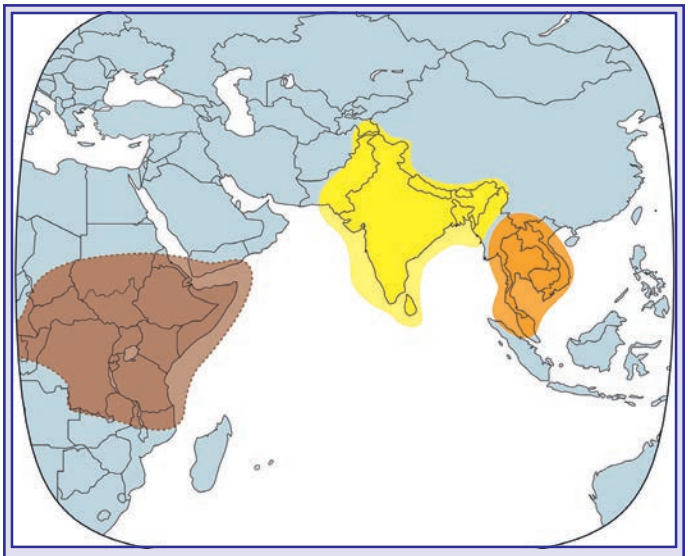
Launch date:	February 2014
C-band Payload:	13
Frequencies:	Uplink: 5.950 to 6.385GHz Downlink: 3.680 to 4.200GHz
Transponder bandwidth (MHz):	36 & 72
Polarisation:	Dual linear
Cross-polarisation separation (dB):	Better than 27
EIRP (peak value) (dBW):	45
TWTA size:	62W
TWTA redundancy:	34 for 26 primary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



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

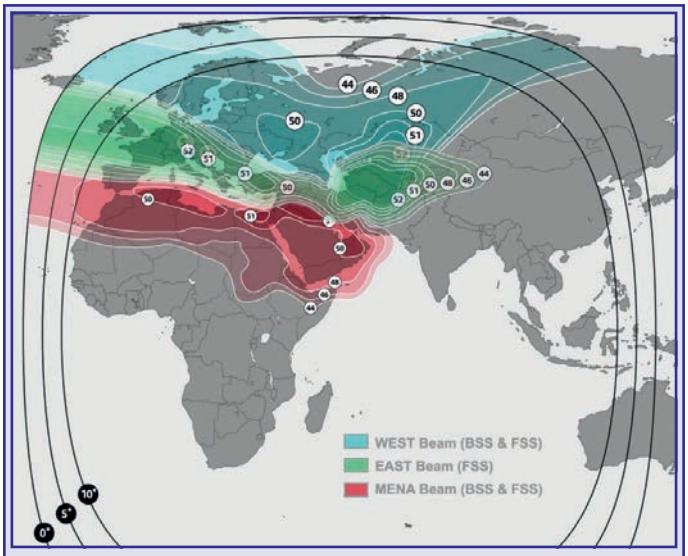
Thaicom 6 has 18 active C-band and 8 active Ku-band transponders. The satellite's African capacity, 6 C-band transponders each with 72MHz bandwidth, is being marketed under the AfriCom 1 designation.

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

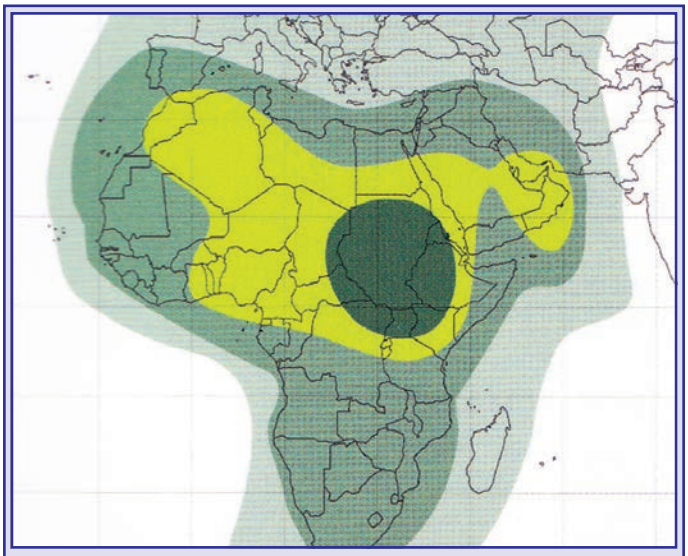
Launch date:	May 2016
Operational life:	≥ 15 years
Altitude control:	3-axis stabilised
Launch mass:	<3,200 kg
Solar arrays:	Two 4-Panel Solar Wings with UTJ cells
Stabilisation:	3-axis stabilised, using thrusters and reaction wheels; zero momentum biased
Propulsion:	Liquid bi-propellant transfer orbit 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



TürkmenÄlem 52E/MonacoSat: 52°E

38 active Ku-band transponders shared over 3 beams. Turkmenistan Minister of Communications owns 26 TPs and the rest 12 TPs with Middle East/North Africa coverage are fully leased to SES.

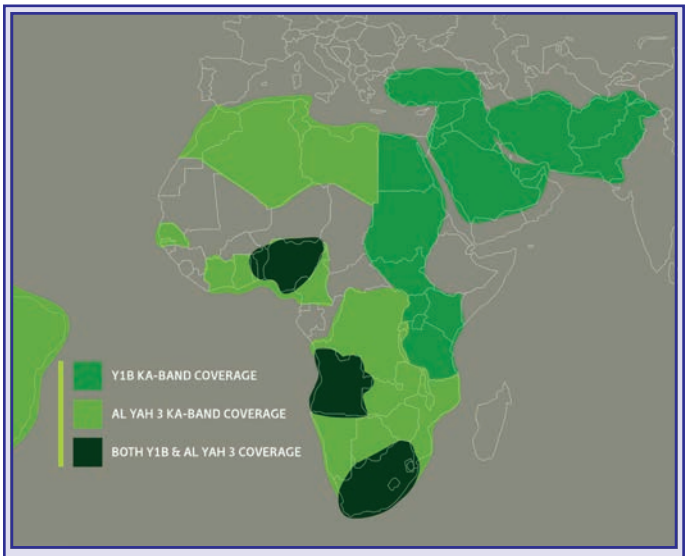
Launch date: April 2015
Manufacturer: Thales Alenia Space
Operational life: 16+ years
Launch cehicle: Falcon 9 v1.1
Number of Ku-band transponders: 38
Beacons: 11201, 11449



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