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LEO SATELLITE CONSTELLATIONS

Broadband Satellite Communications Now Also Available With Constellations

Low Earth Orbit – A New Communications Paradigm

INTERVIEW
Andrew Jordan, President & CEO, AsiaSat

FOCUS ASIA
Non-GEO Communications Constellations: A Win or a Wash for Asia?

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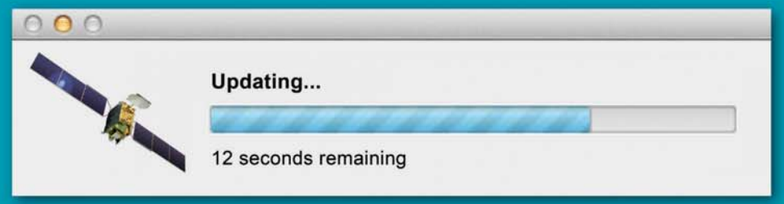

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MESSAGE FROM THE PRESIDENT

This month our magazine is devoted to LEO Satellite Constellations. While many of us have spent our careers working with GEO satellite systems and we are all familiar with the NGSO systems introduced in the 1990s – Iridium, GlobalStar and Orbcomm – these were narrow-band constellations that largely operated on the fringes of our industry and did not pose a threat to the incumbent GEO operators. This neat arrangement began to really be challenged with the advent of O3b, which commenced operations only 3 years ago and has already begun to transform the data markets it serves.

The next generation of LEO constellations is likely to radically rebalance the communications satellite industry in ways that we have never seen before.

This issue of our magazine explores the history of this evolution, the coming revolution, and maps out where it is headed. It assesses the values that non-geostationary orbits open up and evaluates the pros and cons of GEO vs LEO systems for a range of applications. It also examines the evolving relationship between GEO and NGSO operators and makes a case for the cooperation we have already witnessed with SES and O3b and, more recently, Intelsat and OneWeb.

We also delve into the growing list of LEO proposals, the likely market opportunities for LEO constellations in Asia and how they are likely to complement next generation terrestrial infrastructure. Our writers' focus on how low latency may change everything for our industry and the promises of enormous new satellite capacity.

The improvement of operational efficiency, low latency and the introduction of "spatial networking' will be key to the leap forward being introduced by the new LEO constellations. And as you will see explained, this is not just new networks with more capacity but rather new routing and switching capabilities leading to new applications that were never possible with traditional GEO systems.

If you want to understand the breakthroughs that LEOs portend then look no further. It is laid out and explained in detail so that we can all better understand the transformative power that LEOs will generate for our industry and the communities we serve.

Gregg Daffner
President, APSCC

Broadband Satellite Communications Now Also Available With Constellations

Rachel Villain, Principal Advisor, Euroconsult

Comsat constellations, already a market reality

Non-geostationary orbits (i.e. LEO and MEO) were long ignored by commercial communication operators who sought the broader coverage, longer lifetime and simpler ground network of GEO satellites. Up to the advent of Iridium, Globalstar and Orbcomm in the late 1990s and of O3b more recently, these orbits were exclusively used by government satellites, principally for military and scientific missions.

Pursuant to the launch of O3b, the first constellation for broadband communications, 125 satellites are now in orbit for four comsat constellations. This compares to about 300 satellites in operation in geostationary orbit for commercial communications services. The investment to manufacture and launch these four constellations totals $7 billion, with a wide range in capex between Orbcomm (less than $300m) and Iridium Next (around $3 billion) that reflects different system capacities for different business models.

The four comsat constellations in operation

	O3b	Iridium	Globalstar	Orbcomm
Satcom service	broadband (HTS)	narrowband (GMPCS)	narrowband (GMPCS)	narrowband (low rate data)
Satellite fleet in orbit	12	70	24	18
Start of operations	2014	2001	2001	2001
2016 revenues (rounded)	*$100m*	$434m (+5%)	$97m (+7%)	$187m (+5%)
# users YE 2016 (rounded)	*40*	850K (+9%)	*700K*	1.7 million (+10%)

Source: Euroconsult (italics denotes estimates)

As of early 2017, 19 constellations have filed for spectrum to the U.S. FCC, of which OneWeb was the first one to do it for almost 1,000 small satellites. These constellation projects want to use C, Ku, Ka and V-band frequencies from satellite systems in LEO and/or MEO orbits. At least two of them (i.e. SpaceX and Boeing) have

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designed mega-constellations requiring several thousands of satellites in orbit. OneWeb is the most advanced in terms of funding with $1.7 billion of equity raised to finance capex totaling about $3 billion. In 2015, SpaceX estimated its capex at up to $15 billion for 4,425 satellites in Ka-band. Boeing has not communicated on the investment for a V-band constellation of up to 3,000 satellites.

These constellations are mega not only in satellite count but also in terms of the bandwidth capacity they will bring to the market. When OneWeb is due to be in operation in 2020, it could provide as much Tbps as those due to be available on all commercial geostationary communications satellites (or GEO comsat) at that date.

Still, Euroconsult estimates that GEO comsat should remain the largest market for the space industry in the next ten years. Indeed, the manufacturing and launch of the 170 commercial GEO comsat we expect over the decade should represent a market of around $45 billion for the space industry. Assuming O3b extension plus two to three new constellations, the non-GEO comsat market could range from $8 billion to over $20 billion, depending of the architecture of the constellations.

Market elasticity to be proved with comsat constellations

The paradigmatic change introduced in the space industry by the mega-constellations has started to revolutionize satellite design, testing and production. It remains to be seen how they will incentivize the demand for broadband satellite communications because of their lower cost of ownership for ultimate users. The constellations will definitively be game changers for satcom services provided that their value proposition of huge capacity at low latency and low cost materialize.

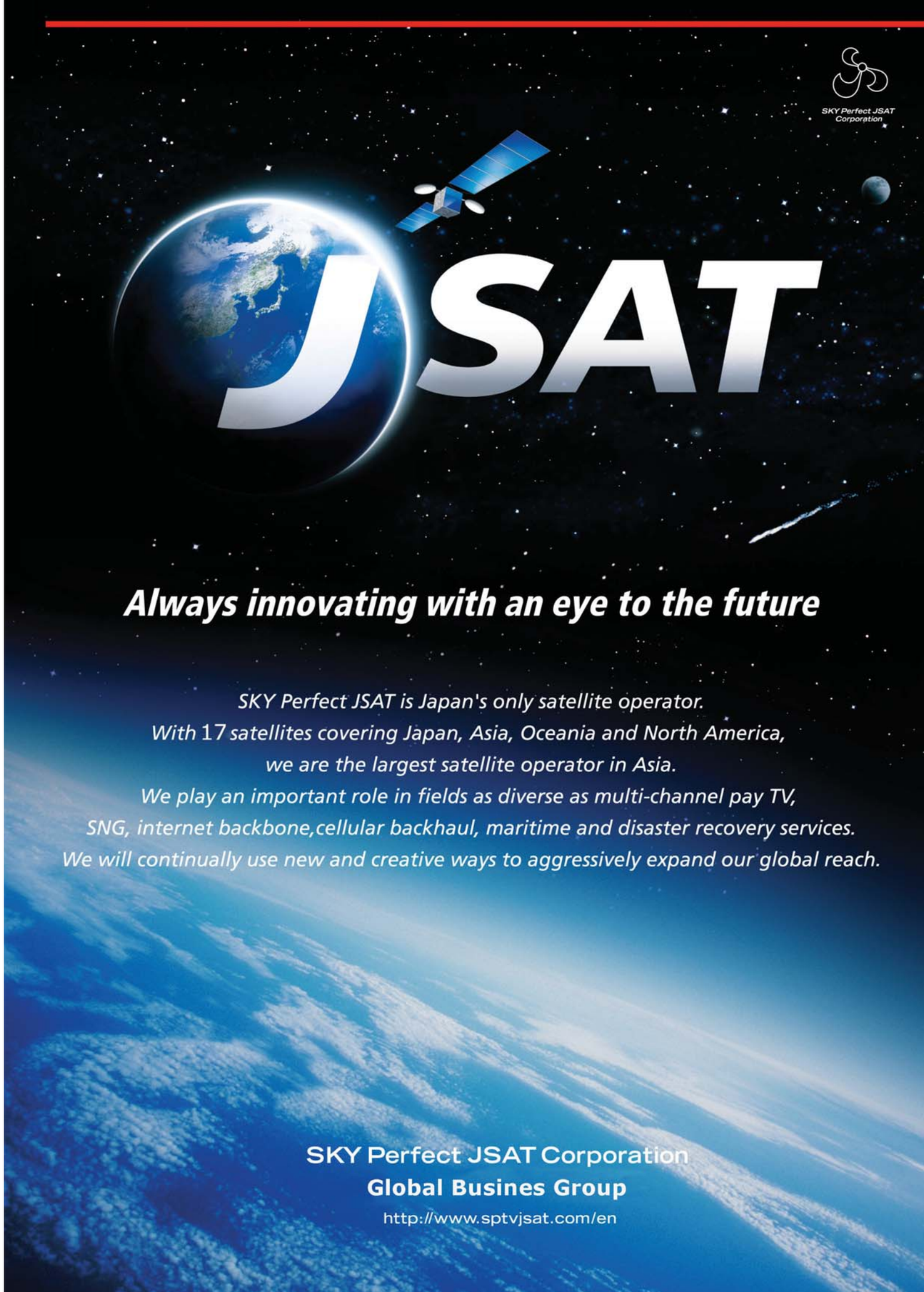
Market uncertainty in the satcom domain of space is maximal because of the intensification in competition between communications infrastructures everywhere on Earth (i.e. inter-satellite competition on one hand and between satellite and terrestrial networks on the other):

- GEO satellites: Two constants remain, i.e. the large capital cost to launch a new satellite system and the market inertia in endorsing new standards (e.g. Ka-band or S-band terminals, Q/V bands) and new technologies (e.g. flexible payloads, optical intersatellite links)
- LEO/MEO constellations: These projects are funded not only on the promise of creating new markets but also on the fact that they will complement the GEO comsat (e.g., business and capital relations between SES and O3b, and Intelsat and OneWeb).

Complementarity of GEO and non-GEO comsat systems

Relative to GEO satellite systems, LEO systems and, to a lesser extent MEO systems, have specific technical features (e.g., capacity lost over oceans and complex terminals) that make their technical design challenging, increase maintenance costs, and generally raise the bar to profitability because of a lower capex efficiency relative to GEO systems when the lifetime of the bandwidth is discounted. Considering their high upfront investment costs and the necessity to recoup that investment as quickly as possible but not before the whole constellation has been launched, issues of service distribution and pricing are highly sensitive in the business plans for such systems.

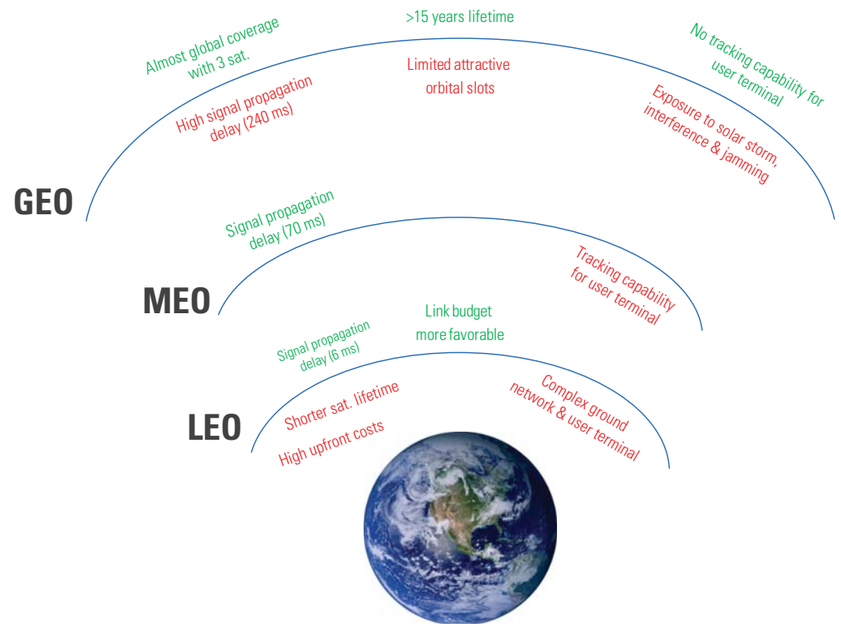
Their commercial success is driven by the capability of the numerous local satcom service providers to address multiple vertical markets in very different geographic markets with the right terminal cost. The “reselling”



capability of the local service providers is itself driven by the ROI expectation they have considering the specific investments required on the ground that have to be amortized (multiple gateways, double user antenna, development cost of flat panel electronically-steered antenna).

GEO satellites offer more flexibility to scale the investment according to the geography of demand, provided that 1) the right spectrum is available to the commercial operators to expand their activity and 2) the ground equipment for high spectrum efficiency is not cost-prohibitive. In the past ten years, the productivity gains of GEO comsat have been tremendous with the introduction of higher throughput and more flexible payloads. Satellites with high throughput payloads permitted by multiple spot beams with high frequency reuse are a major innovation of the Western satellite industry now endorsed by commercial operators. Indeed, about two-thirds of the total of 1.3 Tbps now available commercially on GEO comsat has been deployed on HTS systems.

Relative PROS & CONS for Satellite Systems by Orbit



Capitalistic movements in the satellite sector driven by win-win strategy

Considering the benefits of complementary satellite architectures, the world's two largest commercial satellite operators have progressively embarked into non-GEO systems with a strategic acceleration recently:

- In mid-2016, SES took full ownership of O3b pursuant to an investment of $730 million (excluding debt). To SES, it appears that the higher throughput and lower latency of O3b over GEO satellites allows it to better serve specific segments of its customer base (principally maritime and military);
- In 2015, Intelsat invested $25 million in the first $500 million round of equity of OneWeb. The interopera-

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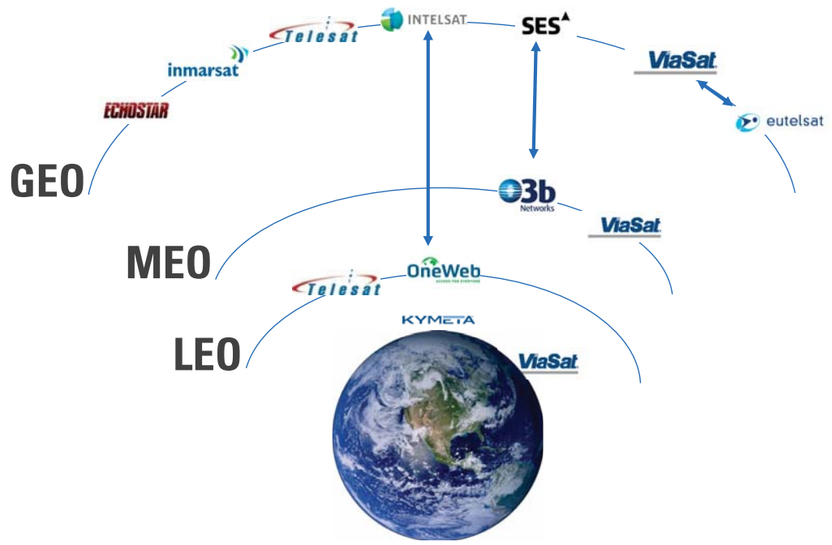
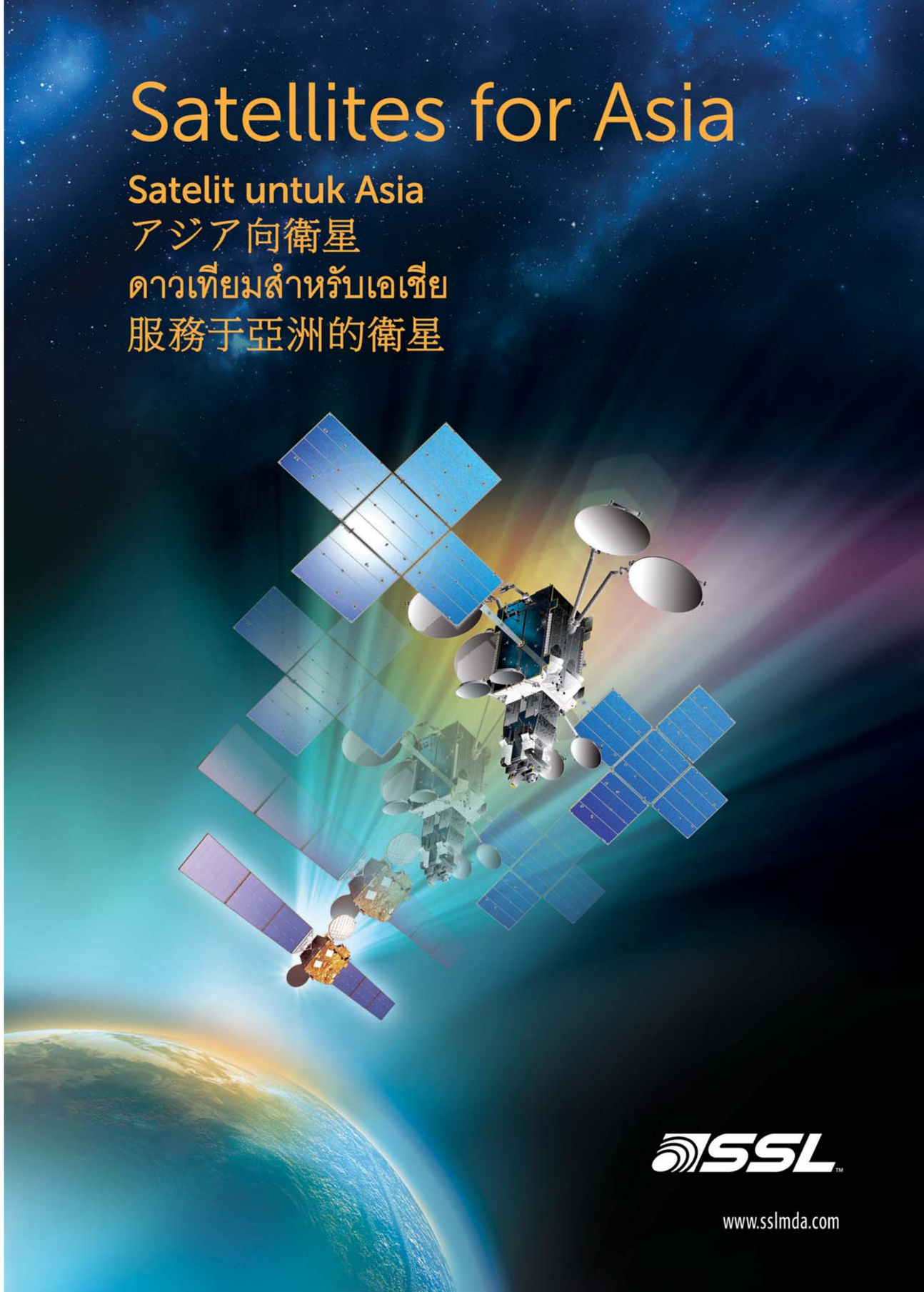
bility of the two systems will allow customers to seamlessly switch from one system to the other. Intelsat will have access to polar regions, while OneWeb will hand-off traffic to Intelsat over the equatorial zones where GEO spectrum has priority.

The operational synergies between Intelsat and OneWeb was a strong rationale behind Softbank's decision to merge the two companies. The merger and Softbank's investment of $1.7 billion in new shares of the combined company still have to be approved by a large proportion of Intelsat's bondholders.

Together with SES and Intelsat, five other GEO operators do most of the wholesale and retail broadband satellite business. They all have either commit to non-GEO investment or look to do so in the short term in their own way, including constellation filings (Ka- and V-bands), partnerships with constellation investors and new technology development (e.g. Inmarsat BGAN terminals on board LEO satellites).



Rachel Villain is Principal Advisor in Euroconsult's Paris office with 30-year experience in advising a wide range of public and private stakeholders in their space strategy and investment. She supervises industrial consulting missions and contributes to the development of methodology and resources to address new topics of interest for the global satellite sector. Rachel has been the editor of *Satellites to be Built & Launched over the Next Ten Years* since the creation of Euroconsult 35 years ago.



Low Earth Orbit – A New Communications Paradigm

Mark Rigolle, CEO, LeoSat Enterprises

One of the most talked about recent developments in the satellite sector is the emergence of low earth orbit (LEO) constellations. Why are we now seeing a resurgence? And what are the opportunities for the Asia Pacific region?

LeoSat Enterprises is a company that is launching a constellation of up to 108 low-earth-orbit communications satellites which will provide the fastest, most secure and widest coverage data network in the world. Mark Rigolle, CEO of LeoSat, outlines in this article the case for LEO and LeoSat's game-changing system with all its advantages for data communications.

Big Data. Big Opportunities.

Today the world is increasingly data-driven, cloud-based and trans-national, creating an ever-growing demand to move large quantities of data quickly and securely around the globe. In the last 10 years data usage has exploded, with more data created in the past two years than in the entire previous history of the human race*. And by the year 2020, about 1.7 megabytes of new information will be created every second for every human being on the planet*.

Thales Satellite-Constellation Composition

The availability of data, a new generation of technologies such as IoT and M2M, and a cultural shift toward data-driven decision making and automation are continuing to drive our dependency on Big Data, and fast and resilient communications networks. And bandwidth requirements are also rising with the demand for always-on connectivity and businesses are increasingly looking at how technology and connectivity can improve operational efficiency.

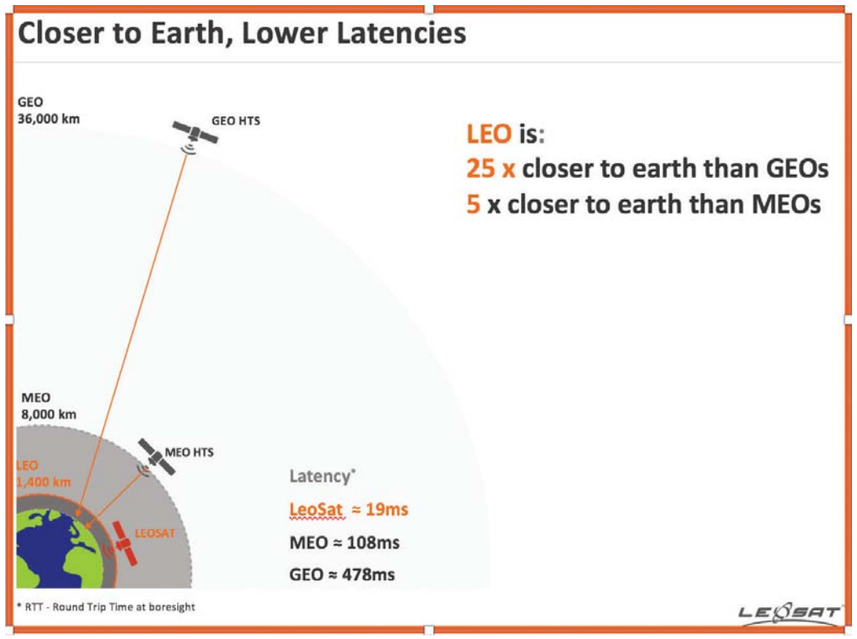
With this increased dependency on Big Data and cyber security – how can satellite networks become truly relevant?

Traditional Satellite Networks Sub-Optimal for Data

It is true to say that satellite has up until now been viewed as a last resort or gap filler for data transport as traditional satellite networks operating in geostationary orbit (GEO) suffer from high latency and typically provide little throughput. While only annoying for voice and video applications, for data communication it is truly a limiting factor in reaching the desired performance or simply a showstopper for certain applications to work. So, whilst GEO remains strong in video, true data-driven applications such as 4G and 5G backhaul, remote management and enterprise connectivity require a fundamentally different satellite architecture that can solve the issues of latency, throughput, reach, mobility and security.

Latency Changes Everything

Let's look at latency and why is it so important in data transport. Network latency is defined as how much time it takes for a packet of data to get from one designated point to another. Ideally in the world of data, latency needs to be as close to zero as possible in order to create a smooth user experience. For satellite networks, the closer you get to earth, the less latency there is. With LEO satellites orbiting the earth at around 1,500 kms that's 25 times closer than GEO satellites (36,000 kms) and five times closer than MEO satellites (8,000 kms),



LEO Diagram

Russian Satellite Communications Company
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1857
1957
1967
2017
50 YEARS
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the case for using LEO for data networking becomes compelling. These Low Earth Orbit (LEO) satellites bring latencies down from 500+ms to only 20ms or so and importantly they can now measure up to the latencies typical for terrestrial infrastructure.

A New Satellite Architecture for Data

In addition to the issue of latency, as we move to a more data centric world, the traditional satellite architecture of 'bent pipe' is very much showing its limitations. Bent pipe means that whatever is transmitted to a satellite needs to come down straight away. While this has worked well to connect our continents back in the 60s and 70s, and still works well for DTH video applications, it does not work well for data. Using that type of technology for data requires the use of many earth stations with antennas that are connected to terrestrial infrastructure to carry traffic to its final destination and/or beyond the reach of the satellite. This is suboptimal to say the least and comes with a great amount of expense and operational requirements.

So, while LEO as such will solve latency issues typically associated with satellite, the real game-changer for data will be achieved by stepping away from traditional "bent pipe" and taking satellites to the next level, to "spatial networking". One such system in development is *LeoSat*.

LeoSat Enterprises was established by Cliff Anders and Phil Marlar, two former Schlumberger executives with direct experience of the challenges of data transportation in the Oil & Gas exploration and cruise-line business. Realizing that the enterprise data solution they were developing would also be perfectly suited to a number of vertical markets (Enterprise, Finance, Government and Media), LeoSat was formed to leverage proven satellite communications technology to build a new low-earth orbit (LEO) satellite constellation that will provide a truly global, enterprise-grade, high-speed and ultra-secure data network.

LeoSat's unique network consists of a constellation of 78 satellites which form a fully-redundant mesh network interconnected through laser links. This creates an optical backbone in space which is about 1.5 times faster than fiber. Data can be transferred from satellite to satellite without having to come down to earth as is

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required in a bent pipe system. This way, traffic can be sent from where it originates all the way across the globe to where it needs to terminate without touching anything on the ground until it reaches its destination. As obvious as this architecture may sound from a networking perspective, up until now it has not been available for high speed data in the satellite industry.

In addition, traditional satellite design only allows for modulation of data in RF, posing limitations for integration with terrestrial networks. In order for satellites to be seamlessly interoperable with terrestrial networks, either MPLS or IP, the satellites need to support full duplex and they also need to have routing and switching capabilities, similar to their terrestrial counterparts. With On-board processing (OBP) and MPLS networking as integrated features of the new LEO systems, they will be able to operate as a full-duplex, spatial extension to terrestrial networks that can carry traffic to any place on earth, from pole to pole and from land to sea. With LEO bringing all of the above advantages to the satellite market, allowing satellites to go beyond their traditional role of 'gap-filler' - LEO systems will actually start to become a technology of choice for data communications.

New Opportunities for the Asia Pacific

What can a new LEO data network offer? In sectors such as telecommunications, multi-national enterprise, government services, maritime and energy, LEO systems can solve essential communications and connectivity issues and meet the ever-growing demand to move large quantities of data quickly and securely around the world. For a typical Fortune 1000 company, just a 10% increase in data accessibility will result in more than $65 million additional net income*. The key attributes of a system in low earth orbit can be used for a number of applications, for example, to provide 4G and 5G satellite backhaul to the cellular industry, give banks secured networks with their foreign offices, provide enormous uploading bandwidth required for oil & gas exploration or allow Internet access to passengers on cruise ships. LEO will not only provide a competitive advantage in the existing satellite services market, it will help to expand these markets by enabling new opportunities through previously unavailable levels of performance with true worldwide reach.

**Source: See http://master-it.com/big-data-explained-plus-20-mind-boggling-facts/*

Increased Capacity for Cellular Backhaul

As cellular protocols become more and more sophisticated and cellular use accelerates, there is an ever-increasing need to transport cellular signals for long distances, at high speeds, in high volumes and in its native form. These growing backhaul needs are not being met by current terrestrial networks and existing and planned satellite networks are too slow and the bandwidth too limited. For existing and emerging market telecom operators, LEO offers significant advantages as its latency, timing and transport are in compliance with the network standards of the newer 4G, 5G and LTE cellular systems. And with the continued growth in Internet use, streaming media, smart phone use, mobile apps and the "Internet of Things", the low latency of the LEO systems will become increasingly an attractive alternative to the high latency of GEO systems.

Secure, High Throughput, Global Network for Government Communications

Governments are increasingly looking to the commercial satellite sector and in particular next-generation satellite constellations to provide the innovative and resilient communications infrastructure they need. The Military and Government sector relies on a number of key attributes when it comes to communications networks. Critical operations require bandwidth intensive applications, near real time command and control and advanced sensor capabilities. The proximity LEO satellites have to the earth translates into lower latencies and better data rates. Security and resilience are also key attributes and with LeoSat's unique touchless architecture - taking traffic in its native form and carrying it from any point on earth to any point on earth without touching the earth's surface in between and therefore completely isolated from any terrestrial infrastructure – this is an enormous advantage to the Military. And for Embassy communications, rooftop-to-rooftop without any terrestrial touchpoint in between, means an ultra-secure, resilient communications network.

High Speed and Ultra Low Latency for The Finance Sector

In the finance industry and in particular the trading sector, banks, hedge funds, trading firms and financial services companies are always looking for the latest technologies and innovations to stay ahead of the competition. With exchange technology and big data at the forefront as key differentiators for success, companies are looking to address the challenges of latency management and network connectivity. Low earth orbit communications satellites with inter-satellite links can achieve lower latency and stronger end-to-end security compared to traditional terrestrial solutions used today.

Constellation LEOSAT

Seamless, Global Data Coverage for Maritime Communications

Maritime operators face significant problems getting adequate broadband networks to interlink ships to each other and to a main office and to serve the ever-increasing data and Internet needs of passengers and crew. On cruise lines, passengers are demanding more and more bandwidth to power consumer devices and for Internet access. Existing satellite systems, most of which can only illuminate limited portions of the earth from GEO or MEO orbits, cannot satisfy these needs. A LEO system with interconnected satellites can bring ships "on-net", regardless of their global position, just as if they were a local network node enabling operators to leverage the new "Smart Ships" digital infrastructure where cloud-based operations will improve efficiency, operational effectiveness and safety as well as providing new business opportunities.

LeoSat Aims to Revolutionize Satellite Data Transport

There are a number of new LEO systems in development which will have a positive impact for data communications. Each of these forthcoming systems, be it Oneweb, SpaceX, Boeing, Telesat, bring different capabilities and opportunities for broadband communications. Our system, LeoSat, is focused solely on the business market and is being developed by Thales Alenia Space, a company with unmatched expertise in designing and manufacturing low and medium earth orbit constellations such as Iridium Next and O3B. LeoSat's data network solution is truly unique with the ability to deliver fiber-like services via a single, high-performance, inter-connected, MPLS-based LEO constellation. Consisting of 78 satellites, effectively an MPLS network of "routers in space", LeoSat provides customers with very high throughput, low-latency and highly-secure communications between any two or more locations on earth, independent of existing terrestrial networks. This is achieved through deploying optical inter-satellite links (ISLs) between satellites, who in turn support symmetric connectivity to a ground antenna with speeds of up to 1.6 Gbps and even 5.2 Gbps where needed. Contrary to bent-pipe HTS solutions, gateways are not a pre-requisite for LeoSat to operate its network. For customers, this unique use of technology allows for premise-to-premise connections with no terrestrial touch-point in-between and sets a new bar for high-speed networks. In addition, data security is assured as data stays on LeoSat's physically separated satellite network for the entire route, making it much less susceptible to monitoring, hacking or even disruption. Start of the launch of the constellation is expected in 2020.

LEO and GEO – A Perfect Partnership

It is clear that there are a lot of opportunities for growth in the data and mobility markets throughout the Asia Pacific region. From Government Applications to Corporate Networks and from Cellular Data Solutions to the Maritime sector: all markets are strong in the region. Combining the speed of fiber with the ubiquity of satellite means that LeoSat is creating a new communications paradigm, shifting the perception of satellites from a last resort option to a first choice for data transportation. With this in mind, we have seen FSS operators, looking to complement and expand their capabilities, partnering with LEO satellite operators to provide combined GEO/LEO data services that cannot be supported by GEO alone. This trend is set to continue as FSS operators see the value in partnering with LeoSat to offer the market enterprise grade, low latency, extremely high speed and secure data services worldwide.

Mark Rigolle, CEO of LeoSat Enterprises has over 22 years of experience in the telecom and satellite sectors. He was previously Chief Financial Officer of SES and then CEO of O3b Networks. He has also acted as advisor to satellite operators and private equity funds, as well as being a co-founder of Kacific, a promising satellite-broadband-to-the-home start-up.

Interview with **Andrew Jordan,** President & CEO, AsiaSat

Andrew Jordan rejoined AsiaSat as President and Chief Executive Officer in November 2016 after 23 years when he was General Manager of the Company during 1991-1993. We have talked to Andrew to understand his vision, and how he will keep the company moving forward under his new leadership.

What changes have you made at AsiaSat over the past few months?

I was very excited to come back to AsiaSat as CEO because the company is the jewel in the crown of Asian satellite operators, with deep Asian roots, a blue chip customer base and a modern fleet of well-designed satellites. We also have great people who are highly qualified, passionate and dedicated to the company's success. AsiaSat's back office teams, Engineering, Legal, Finance etc., are best in class, but the sales and marketing structure I inherited was over complicated and not fully effective with 3 separate teams all reporting directly to the CEO. So an immediate priority was to streamline this structure, and I was delighted to hire Barrie Woolston to join us as Chief Commercial Officer in February. Barrie has spent over a decade and a half in sales leadership roles with content aggregators primarily Arqiva and latterly Encompass. With this solid background, and as a former customer of satellite operators, Barrie gives us a unique and invaluable perspective into what customers want and how to provide maximum value to them. We have streamlined the sales structure into 1 team in 2 different geographic locations, all reporting to Barrie and with renewed focus on our customers. Additionally, I created a new role of VP Strategy and Business Development, and was delighted that Sabrina Cubbon accepted this role. Sabrina has been with the company for 25 years, and has both an engineering and a sales background so she is uniquely placed to apply her institutional and industry knowledge to broaden our strategic initiatives to drive the company forward.

While you say you have a new focus on customers, in what ways do you intend to serve customers differently?

As I said earlier, AsiaSat has a very impressive line-up of blue chip customers, many of them in relationships that span over 2 decades. However, the company was a little slow to adapt to the new satellite environment where we face headwinds due to oversupply and the arrival of HTS satellites which reduce the cost per bit to data customers in particular. In this new environment, companies' commercial approach must be agile, creative and very customer focused, transforming relationships from purely transactional to a more partnership based approach. By this I mean recognising the issues customers face, and adapting our approach to help them achieve their KPIs, in a mutually beneficial win-win scenario. In my first 100 days, I set out to meet all of our customers, to introduce myself as the new CEO and Barrie as the new CCO, and we delivered the message that AsiaSat is open for business, flexible and creative and this message was very well received.

With these changes, how do you forecast AsiaSat's performance for the coming year?

I referred earlier to the headwinds we face as an industry, but with such challenges, there are opportunities, it is just a question of knowing where to create and find them. As I also mentioned, in my meetings with key customers, I found a mood of growing optimism for business prospects in direct contrast to the general pessimism in the market over the last 18 months. So my view is that with a combination of hard work, innovation, flexibility and creativity, we are cautiously optimistic for a return to modest growth in 2017, and to build on that for the following years.

Are there any developments being made that are sources of this optimism?

AsiaSat is in a very good position to capitalise on its leadership as Asia's premier satellite operator. To point to tangible developments, AsiaSat 5 and AsiaSat 7 continue to be industry leaders for broadcast and content delivery services in Asia, and AsiaSat 4 which has been performing well for our data customers, will soon be replaced with the more powerful AsiaSat 9 later this year. This new satellite will bring enhanced C-band capacity for improved services across Asia, particularly the Pacific Rim region. It will also significantly increase our Ku-band capacity with customised coverage for some of Asian emerging markets. For example, the world's first dedicated beam tailored for Myanmar and designated high-powered Ku-band beams for Mongolia and Indonesia, where satellite has a role to play in connecting the remote and rural areas. This next generation satellite is also expected to support the future growth of UHD broadcasting pioneered by Asia's first true UHD channel '4K-SAT' on AsiaSat 4. We are also accelerating our activities in China, building on our strong presence in both the broadcast and data markets there.

What is driving the demand, and what applications and services are being requested?

Contrary to some press reports and previous market sentiment, linear TV is alive and well, and DTH platforms will continue to be the most cost effective and efficient delivery mechanism for television

AsiaSat 9 will offer higher power and wider coverage at 122°E

AsiaSat 9 in CATR, ready for system level antenna scans

From its Tai Po Earth Station in Hong Kong, AsiaSat offers high-quality and high-reliability broadcast, turnaround and occasional use (OU) services to customers

content in most of Asia. It is true of course that viewership of linear TV is declining slightly over time, but OTT represents an opportunity rather than a threat, and AsiaSat is in the process of launching an OTT platform for its customers, for applications such as "content anytime, anywhere and on any device".

Where we see big growth is in mobility and consumer broadband. With the increase and maturity in capability of HTS satellites, we will be able to offer very cost effective solutions for aeronautical, maritime and consumer broadband to bridge the digital divide today, and in the near future connected cars and IoT solutions. Of course AsiaSat is already offering aeronautical, maritime and broadband today with our FSS satellites, and HTS technology will enable us to grow these businesses significantly.

What do you see as the major challenges to the satellite industry? How is AsiaSat positioned for these challenges?

One clear challenge facing our industry and that we are all working hard at is spectrum availability. The IMT industry has not given up on trying to get satellite spectrum, so it is critical that the satellite community continues to work together in a very concerted and constructive effort to make sure their billions on investment in space, and the vital role we play in providing communications services across Asia are not jeopardised by relinquishing the spectrum to other mobile telecommunications services. Despite the success we had at the WRC-15 in preserving much of the C-band frequency in use today for existing and future satellite use, we have to continue to fight for protecting our C-band as the mobile industry has not stopped eyeing on it for IMT. As a part of this effort, we have continuously encouraged our customers and shared with them information on how to register their C-band earth stations with the ITU. Efforts on looking into the use of other spectrum resources such as the Ka, Q and V bands will also be our focus at the WRC-19.

Regulatory obstacles have also been viewed as constant challenge in our industry. There are markets that have tightened the access to the landing rights for foreign operators, however, we are confident that AsiaSat will continue to benefit from a strong presence in the more than 50 countries we cover with high quality and high powered satellite capacity.

Andrew Jordan was appointed as Executive Director, President and CEO of AsiaSat on 1 November 2016. He has over 25 years of experience in the satellite industry.
Mr. Jordan was the General Manager in the Marketing Department of AsiaSat from 1991 to 1993. Prior to re-joining AsiaSat, he held executive positions with several satellite operators. He has also led complex deal negotiations in China, Hong Kong SAR, Australia, Italy and the United Kingdom.
He holds a Bachelor's Degree in Chinese from School of Oriental and African Studies, the University of London.

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Non-GEO Communications Constellations: A Win or a Wash for Asia?

Carolyn Belle, Senior Analyst, NSR

Since WorldVu Satellites (now OneWeb) burst onto the global stage in 2014, the industry has been abuzz with talk of non-GEO constellations and a connected world. Non-GEO constellation projects aim to offer a range of connectivity solutions, from enabling a telco to extend their network, supporting village Wi-Fi models, delivering highly secure and low latency point-to-point data connections, or providing direct broadband access to consumers. Yet despite the announcement of more than a dozen additional non-GEO constellation projects in the last three years, global connectivity from LEO or MEO remains mostly a promise. What is the real potential for these systems to reach orbit, and if they do, what value can they offer to Asia?

The Path to Deployment

Many companies have stated intentions to begin launching their constellations this year, with others targeting an initial deployment no later than the mid-2020s in line with regulatory requirements. Active engagement in satellite design and manufacturing partnerships mean the space segment is unlikely to be the constellation showstopper. Even though CAPEX limits and a planned pace of deployment require new manufacturing approaches and facilities, especially for the >1,000 satellite constellations, manufacturing and launch capacity will stretch to meet demand.

Yet financial, regulatory, and technological challenges combine to make non-GEO constellation deployment a risky proposition – one the failed players of the 1990s know all too well.

CAPEX estimates for non-GEO constellations run upwards of $10 billion, with all but the smallest constellations requiring at a minimum $2.5 billion. OneWeb/Intelsat has notably attracted equity investment that can be combined with debt financing to meet anticipated requirements, and several players can rely on corporate coffers to bankroll R&D and system deployment, but others will be challenged to bring together the right partners to finance activities. Overruns are likely for all.

Spectrum coordination with the ITU, GEO operators, and other LEO/MEO players in addition to country-level licenses present a series of challenges that have not yet been fully resolved. Despite strategic partners that

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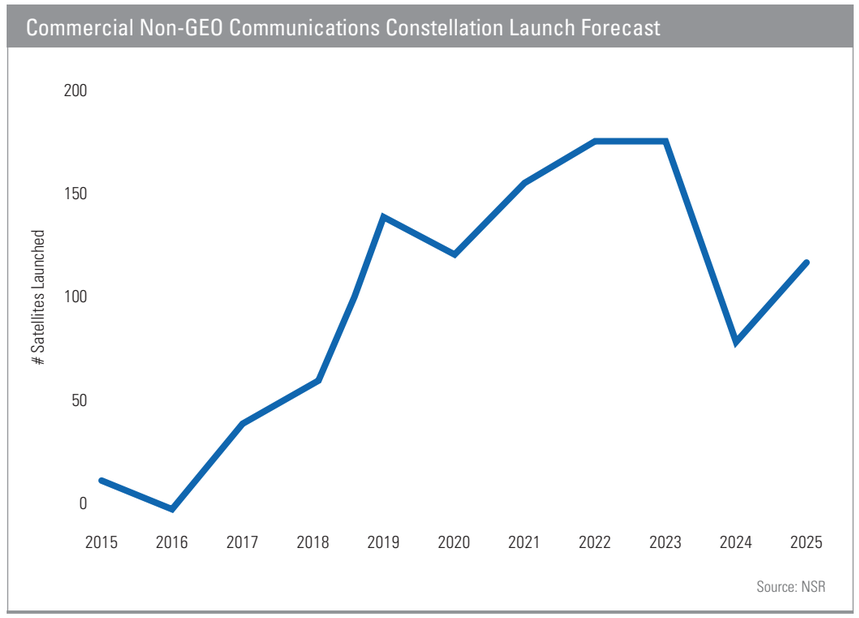
will assist some players with country-by-country licensing regimes, for many target countries approval depends on access to local decision makers and concerns remain that operators will be able to secure comprehensive landing rights on the allotted deployment schedule which would impact negatively projected revenues. Developing a low footprint and low cost terminal capable of tracking and signal handoff between many satellites is the cornerstone of proposed business models. The technology does not yet exist to meet these three requirements and development status is unclear.

Planned Non-GEO Communications Constellations

Company	Orbit	Frequency	# of Satellites	Start of Deployment*
OneWeb/Intelsat	LEO/MEO	Ku, V	720 - 2,720	2018
SpaceX	LEO	Ku, V	1,600-11,943	by 2022
Boeing	LEO	V	147 - 3,103	by 2022
LeoSat	LEO	Ka	84 - 108	2018
Telesat	LEO	Ka, V	117 - 234	2017
Xinwei	LEO	-	32	2014 (test)
Yaliny	LEO	-	140	2017
Samsung	LEO	mm wave	4,600	-
Astrome Technologies	LEO	mm wave	150	2019
KasKilo (M2M)	LEO	Ka	288	by 2019
CAST	LEO	-	60	by 2020
Helios Wire (M2M)	LEO	S	30	2018
Sky & Space Global	LEO	S, L	200	2017
Astrocast (M2M)	LEO	-	64	2017
Kepler (M2M)	LEO	Ku	140	2017
Lucky Star	LEO	-	156	-
Viasat	MEO	Ka	24	by 2022
Laser Light	MEO	Optical	8-12	2019
O3b Networks	MEO	Ka, V	+48	2018

**per company announcements*

Source: NSR



NSR finds 1-2 new, fully commercial constellations likely to launch in the coming years, in addition to expansion launches from players like O3b Networks and system deployments from government entities. As is common in the satellite industry, both delays and extended deployment timelines are anticipated.

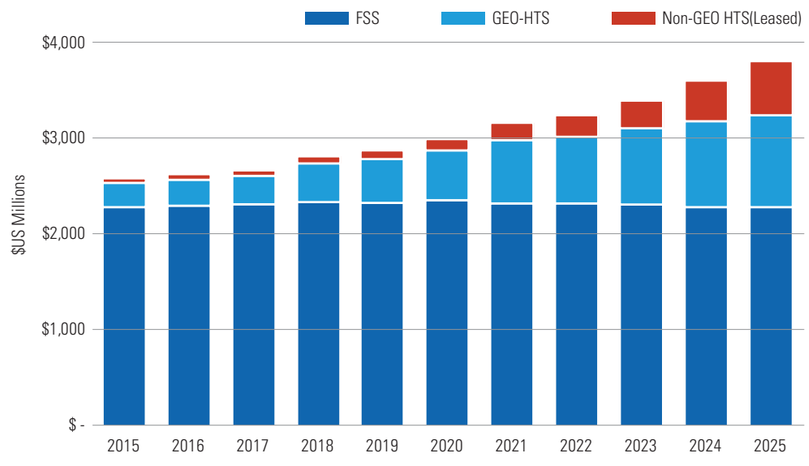
Value for Asia

The ITU has estimated that 3.9 billion people worldwide – just over 50% of the global population – are without internet services as of end of 2016. Nearly half of this segment lives in India, China, and Indonesia alone, with additional unconnected populations throughout Asia. This lack of coverage, coupled to ever increasing reliance on data connectivity and consequent increasing demand for throughput, presents a clear opportunity for growth of telecom infrastructure in the region. Satellites have unique potential to address this unserved and underserved market, while also offering highly secure networks, seamless IoT connectivity, and other enterprise requirements. Yet, does a satellite based solution offer the right value for Asia, in the face of developing terrestrial infrastructure?

When looking at individual growth drivers and restraints, NSR concludes that terrestrial networks demonstrate more potential across more Asian markets than their non-GEO satcom counterparts. While only 16.5% of the population within Asia Pacific is estimated to live within a 10 km range of a fiber connection today, rollout of new infrastructure like fiber and terrestrial microwave is ongoing and can provide a low-cost solution that, unlike satellite, does not require consistent asset replenishment. Fiber offers a technologically mature, high capacity service that is immune to the atmospheric interference that impacts satellite communications. Government support for terrestrial national broadband initiatives is a significant driver, with fiber projects in Asia seen as a means of job creation and economic stimulus that maintains domestic control over communications infrastructure. Indonesia's current Palapa Ring initiative is one example of this trend.

Buildout of terrestrial networks can address many of the same vertical markets non-GEO constellations are targeting: consumer broadband, enterprise data, backhaul, and government and military. Yet installation is slow and costly, and will never address 100% of Asian consumers. Satellites can provide a more near-term solution with fewer up-front costs to the country/consumer, as well as the coverage needed to close the digital divide, and provide high quality services to remote enterprise users across Asia's archipelagic and mountainous regions. Nevertheless, the threat of national satellite capacity deployment or regulatory protectionism will challenge non-GEO constellation operators in establishing market share.

Asia Satellite Capacity Revenue Forecast



Source: NSR

NSR estimates the satellite market opportunity across Asia exceeds $28 billion in the 2017 through 2025 period. While much of this remains in the domain of GEO satellites, 7%, nearly $2 billion, is accessible to non-GEO systems with growth potential after 2025. LEO constellations will compete on the promise of lower latency than their GEO counterparts as well as a lower cost per bit. Broadband, enterprise data, and mobile backhaul present the best opportunities, particularly given trends of shifting data traffic to mobile networks. Mobility, while a clear market for satellite capabilities, will be constrained in Asia by a low willingness to pay for services.

The key to securing customer traction will be competitive service rates and ground terminal prices. Players like OneWeb have promised a user terminal in the low hundreds of dollars, but it remains to be seen whether this target can be attained. First to market advantages will be a significant motivator for this market. For those seeking to address global broadband needs, the low ARPUs obligate a critical mass of users to be sustainable, and we have already seen shifts towards a B2B focus as systems deploy to kick-start revenue generation.

The Bottom Line

The Asian telecommunications market is large with myriad niche markets, offering enough demand for the coexistence and growth of both non-GEO satcom and fiber businesses. While terrestrial solutions like fiber will win the greater portion of growth demand, if non-GEO satcom systems focus on delivering the low-cost services envisioned and mitigating the impact of government preference for domestic fiber or GEO satcom solutions, they will find an eager market in the region. With at least one aspiring operator expected to overcome challenges and deploy a non-GEO constellation by the mid-2020s, non-GEO satcom offers a compelling value proposition for users across Asia from enterprise to consumer broadband.

**Information for this article was extracted from NSR's Satellite Manufacturing and Launch Services, 7th Edition and Global Satellite Capacity Supply & Demand, 13th Edition reports.*

Carolyn Belle joined NSR as an analyst in 2014. She focuses on satellite manufacturing and launch activity, and in particular the trends surrounding creation of diversified space architectures. She is the lead author for NSR's Satellite Manufacturing and Launch Services and Small Satellite Markets reports, and participates in research in government and military communications markets. Ms. Belle regularly contributes to the diverse tailored consulting projects undertaken at NSR, lending expertise to feasibility studies, satellite procurement assessments, analysis of competitive dynamics, and addressable market sizing for both start-ups and industry leaders.

AxelGlobe – The Microsatellite Constellation in the New Space Era

Yuya Nakamura, President & CEO, Axelspace Corporation

Axelspace is a Tokyo-based startup company with about 30 members. The company was founded in 2008, by the graduates of University of Tokyo and Tokyo Institute of Technology who had engaged in microsatellite development during their school days. Before describing the company details, let me quickly share the unique experience of mine at university. Back in 2003, University of Tokyo launched a tiny satellite. The satellite is called "CubeSat", which weighs only 1kg and is small enough to fit into your palm (Fig. 1). Tokyo Institute of Technology also made its own CubeSats. These two CubeSats were successfully put into orbit and operated perfectly to become the world's first successful student-made satellites. The University of Tokyo's CubeSat had an onboard camera, and took hundreds of beautiful Earth photos to entertain people (Fig. 2).

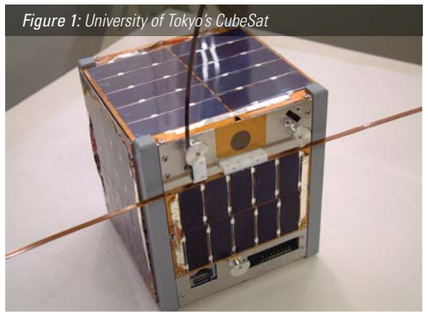


Figure 1: University of Tokyo's CubeSat

Engineering Model of CubeSat

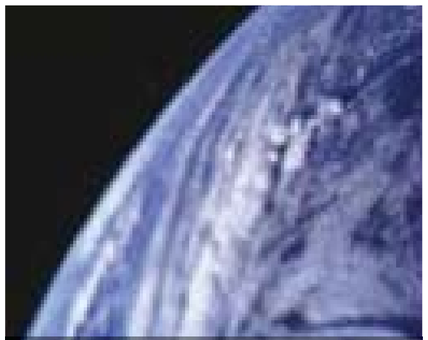


Figure 2: Earth photos taken by University of Tokyo's CubeSat

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We experienced seven microsatellite projects in total at two universities, and gained knowledge and skills to develop low-cost microsatellites. After graduation, I founded Axelspace in 2008 with two of my colleagues to contribute to the society making use of our microsatellite technology. I wanted to change the situation of the space industry in which the government was almost the only user and companies were struggled hard to develop the world's most advanced technology. It seemed to me that the industry was looking not at the customer needs, but at the country's space budget. That is why we employed our company slogan "Space within your reach" so that we can create the customer-first culture in the company. Fortunately, our first customer was Weathernews, which is the world's largest weather information company. The important point here is that the company did not belong to the space industry. We learned a lot from them about how "normal" private companies think, judge and act. We could see the space industry objectively.

Let's get the topic back on track. Why did they need their own satellite? Weathernews wanted to monitor the Arctic Ocean frequently. For what? Due to the global warming, ice in that region was melting rapidly, and new shipping routes were emerging during summer. Shipping companies were paying full attention to the situation, because such new routes could drastically shorten the voyage distance. Thinking about the voyage from East Asia to Europe, the distance is just two-thirds of the traditional route and they can considerably save fuel cost. In addition, they can avoid paying high toll to the Suez Canal. The route is known as the "Northern Sea Route". Weathernews needed to know the sea ice condition frequently to provide navigation service to shipping companies using the Northern Sea Route. The easiest way to do so is of course using satellite imagery. At first, they thought about purchasing images from existing satellites. However, they found that those images were too expensive to make it their new business. Then, we met them at the best timing. The cost of microsatellites is just 1% of the conventional big satellites, and they thought it would pay for itself within several years. We agreed to develop their own commercial satellite "WNISAT-1". The satellite was successfully launched in 2013. Its successor "WNISAT-1R" will follow soon to provide more precise information.

Besides Weathernews satellites, we developed a business demonstration satellite "Hodoyoshi-1" (Fig. 3). It was part of the government-funded project led by University of Tokyo. The mission of Hodoyoshi-1 is Earth observation, and the satellite can capture images with 6.7m ground resolution. Since its launch in 2014, the satellite has taken over 2500 photos. Fig. 4 is Japan's Mt. Fuji, taken on December 29, 2015. Other photos can be found at AxelGlobe website (https://www.axelglobe.com).

Figure 3: Hodoyoshi-1

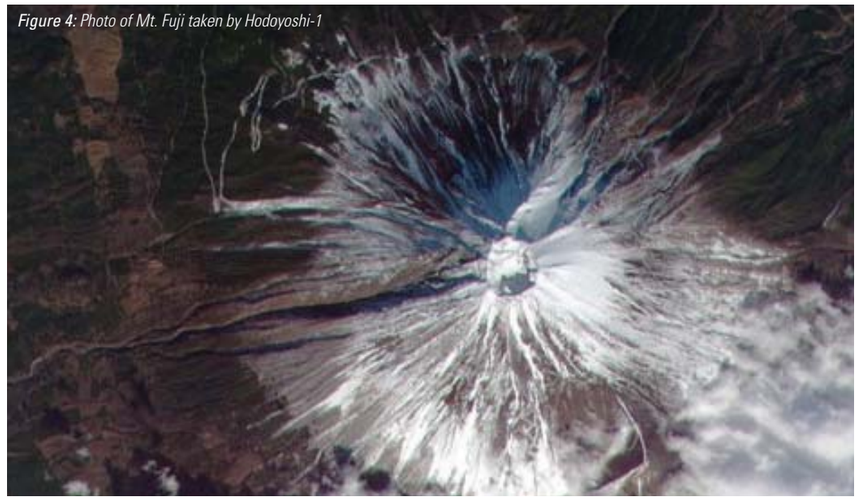

***Figure 4:** Photo of Mt. Fuji taken by Hodoyoshi-1*

We also made a contract with Japan Aerospace Exploration Agency (JAXA) to develop their microsatellite to be launched in 2018 using Japan's Epsilon launch vehicle. It is a technology demonstration satellite, accommodating many new components, sensors and actuators full of innovative and challenging attempts developed by universities, research institutes and private companies in Japan. We became the first startup company which undertook the whole satellite project from JAXA.

As we have seen, Axelspace has been engaging in dedicated satellite projects since establishment. However, if we stick to it, we would have only one or two customers per year. We wanted to involve many more people in space utilization. In December 2015, we announced the inauguration of "AxelGlobe" project. In this project, we will launch 50 microsatellites in total, and monitor the whole world every day. You can find how we can achieve this here: https://youtu.be/8zRrLNnNuTQ. We ourselves possess satellites. Only data from those satellites are to be delivered to end users. In fact, users' ultimate needs do not reside in the possession of satellite hardware. However, needless to say, we need big money to construct such a constellation. We raised 16.7M USD (1.9B JPY) in 2015 from Mitsui & Co., Sky Perfect JSAT and seven venture capital firms in Japan. With this fund, we started to develop a 100kg-class microsatellite named "GRUS", which constitutes AxelGlobe constellation. We will launch 3 GRUS satellites at the end of 2017. Each GRUS satellite has two telescopes onboard, which enables a wide swath of about 60km. At the same time we aimed for far better ground resolution than Hodoyoshi-1, and achieved 2.5m, with which we can even count the number of cars on roads. Readers may point out that there are many other microsatellite players in the world pursuing even better ground resolutions like 1m. It may seem that they have higher level of technology than Axelspace. Not necessarily. In fact, the ground resolution of 2.5m is not our technological limit. We set this figure on purpose. Let me show you four reasons of this. (1) If we pursue 1m or better ground resolution, we cannot avoid competing against drones except for B2G businesses, which could cause a very tough situation. (2) We have to abide by strict regulations because such high-resolution images are inevitably classified as sensitive information in terms of national security, and it could become difficult to expand our business globally. (3) We cannot pursue better resolution and wider swath at the same time if we fix the size of the telescope. It is a trade-off. We prioritized wider swath over better resolution, because we would like to cover the whole globe every day with only 50 microsatellites, which is the ultimate goal of AxelGlobe project. The typical swath of most 1m resolution microsatellites is 10km or less. (4) Last but not least, 1m resolution world is a red ocean!

"Daily" monitoring frequency is crucial for our business. Changes on our planet are getting faster and more dynamic these days. Nevertheless, most of macro trends are unnoticeable. The AxelGlobe constellation will be able to detect day-to-day subtle changes and then trends around the world, which contain rich business intelligence important to a wide range of industries such as agriculture, forestry, fishery, urban planning, area marketing and GIS. Let me share some examples.

Agriculture: In fact, satellite imagery has traditionally been used to get the yield estimate. The clients are insurance firms and futures brokers. Such business will continue to grow as more and more satellites are starting to provide the same type of data at a lower price. In addition, the microsatellite constellation will increase the monitoring frequency, which will enable us to create new services for farmers. They need to know crop growth at short intervals like every three days. If uneven growth is detected in the farm, they can adjust the way they fertilize. It is known as "variable rate fertilizer application". We can also suggest when to harvest, which drastically affects the time and cost to dry crop after harvest.

Forestry: Satellite imagery will help us realize efficient forest management, saving time and effort to find illegal logging activities and fallen trees due to natural disasters. Brazilian government constantly purchases sat-

ellite images of the Amazon rainforest to keep track of deforestation. We may be able to suggest when to thin forests to keep them in good shape.

Fishery: Red tide can be seen from space. Early detection of it will avoid the damage to cultured fish. On another front, chlorophyll existence will indicate a good fishing place.

Urban planning: Imagine you want to build a department store in some new city in a remote country. By tracking dynamics of the city for months using daily satellite images, we can narrow down the location candidates without sending people to that city.

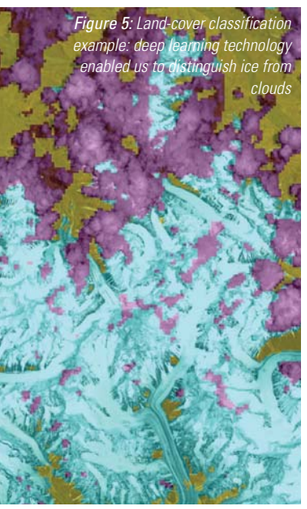

Figure 5: Land-cover classification example: deep learning technology enabled us to distinguish ice from clouds

Economic trends: How many cars are being exported from the port today? How much crude oil is stored today in this oil storage station? Tracking such economic factors in real time will help you choose the next action before other people get statistics reported by the government, which often takes months.

How can we deliver such values to end users? In order to realize above-mentioned applications, it is necessary to analyze images and extract information from them. Of course we can provide raw images if customer request, but what they really want is usually some insights obtained from those images. There are traditional methodologies for satellite imagery analysis, but we have to develop a new one. It is because the data amount would get far larger than before. The data amount from 50 satellites in AxelGlobe will increase by 8 petabytes a year. Not only storage issue. How can we analyze such big image data? Can we do that by hand? No way! We have to rely on state-of-the-art AI technology. Deep learning enables us to automatically detect, classify and count objects in an image. We are currently making a variety of experiments, and getting interesting results. Land-cover classification (Fig. 5), building and road detection (Fig. 6), vessel detection (Fig. 7) and so on.

There is one thing we have to keep in mind when we do automatic analysis using deep learning. Image quality is critical. As we saw in the movie, we place all 50 satellites into one orbital plane. This is because we want to ensure the quality uniformity across the images. We believe this point differentiates us from other microsatellite constellation players. If we use multiple orbits with different local time, it would become difficult to compare images. The direction of the shadow of an object cast on the ground is different when the shooting time is different. Such difference is essentially meaningless and we humans understand that instinctively. Machines don't. When we think of making the most of AI technology, we should accumulate machine-friendly

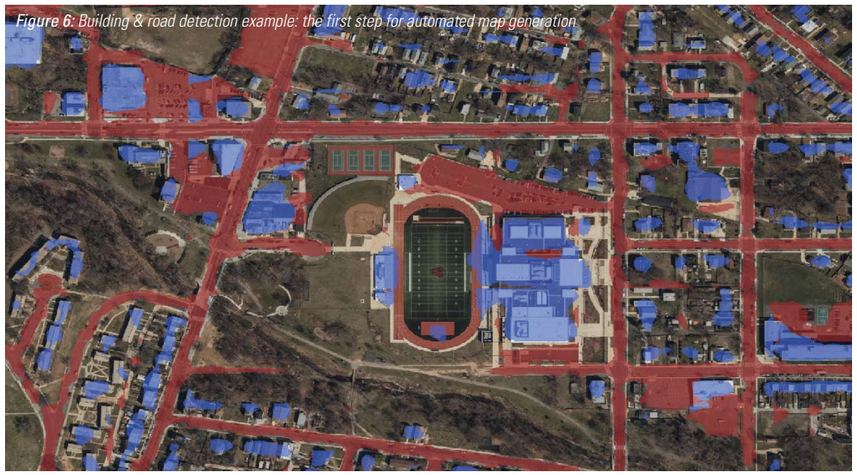

Figure 6: Building & road detection example: the first step for automated map generation

Figure 7: Vessel detection example: one of the important information sources for maritime domain awareness

data to enable efficient and effective learning. Then, the more data we get, the bigger advantage we have.

We do everything from satellite hardware design to data analysis and delivery. This vertical integration is one of the reasons we can effectively provide practical services to answer user needs. However, I am not saying that we need no partners. We ultimately regard AxelGlobe as B2B2B business. We have to admit that space data by itself cannot resolve all issues. We often need industry-specific data or knowledge as well as space data when providing a certain solution to end users. Should we become a professional of every industry? Of course not. We should be devoted to being a data provider in principle and involve players or partners who apply space data to their own industries. We would like to construct such "space data ecosystem".

We plan to complete the constellation with 50 microsatellites by 2022. We still need big money to accomplish it, but we consider every possible option. Honestly speaking, we don't think that we need to possess all 50 satellites by ourselves. The idea about sharing satellites and data with our potential business partners such as governments and blue-chip companies is worth consideration. I believe that we can build a win-win relationship with them.

Our project concept will evolve as time goes on. Another 50 microsatellites may join the AxelGlobe network to realize twice-a-day monitoring of the whole globe. Radar sensors may appear in addition to optical sensors. M2M communication functionality may be added out of the recent IoT boom.

Honestly, it is difficult even for us to expect how pervasive the microsatellite utilization would become. However, one thing is for sure. The microsatellite constellation will get established as an indispensable infrastructure in several years. I hope you dive into the microsatellite world to explore a wonderful future with us.

Yuya Nakamura is the president and CEO of Axelspace Corporation. He earned Ph.D. in aerospace engineering from University of Tokyo in March 2007. After serving as a researcher at the university for one year and a half, he founded Axelspace with two of his colleagues. He is also a member of the Committee on National Space Policy since 2015.

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The ABU's Digital Broadcasting Symposium 2017 Focused on Going Digital

Opening Session (Photo: ABU)

DBS Session chaired by MEASAT (From left to right, Ajeet Khare, Canara Lighting; Jun Tsumochi, NHK; Prashant Butani, MEASAT; Prashant Chothani, Travelxp & Media Worldwide; Dawoon Chung, KBS) (Photo: ABU)

Dato' Jailani Johari, Malaysian Deputy Minister of Communications and Multimedia visiting the exhibition (Photo: ABU)

The 13th ABU Digital Broadcasting Symposium (DBS) event comprising of an international conference, industry exhibition and focused workshops was held from 6-9 March at The Royale Chulan Hotel Kuala Lumpur, Malaysia. The event attracted 1,148 participants from 56 countries representing 379 organisations. The DBS provides an opportunity for the broadcast and media industry stakeholders to network, share and experience wide-ranging technologies, advanced solutions and innovative ideas.

With the theme "Digitise, Digitalise and Dominate", the event provided a holistic approach towards implementing digital technologies throughout the broadcast infrastructure. Through its 12 conference sessions, 14 focused workshops and a 63-booth industry exhibition, the event showcased and discussed on the benefits of going digital and steps necessary for implementing these solutions.

The 3-day conference provided a platform for the industry experts and media enthusiasts to share and discuss topics on advanced digital technologies, digital solutions, business challenges, and effective and innovative solutions that are changing the broadcast industry. The 12 conference sessions comprised of wide-ranging topics relevant to the current media space including; Enhancements in Workflow and Media Management; From HD to UHD; Innovating the Audio Experience; Immersive Media; Future of TV Experience; the IP Ready Broadcast Chain; Cloud Technologies; Online Media and Cyber Security; The Changing Media Business; OTT, IBB and the Interactive Audience and Digital Transition. Delegates enjoyed the chance to interact with top-level professionals from the industry who are actively involved in harnessing the advanced technologies and digital solutions the industry has on offer.

Fourteen focused workshops presented advanced solutions on content and technology for radio and television broadcasters. The workshops provide an opportunity for manufacturers as well as technology solution providers to present/showcase and demonstrate their own products, including sharing of experiences and results from use-case scenarios. Topics related to Content Development Ideas, Technology Introduction, Application and Implementation, Media Delivery and Archiving and Media Management were among those discussed and presented by leading industry players. In addition to these a series of workshops presented 'Next Generation Audio and Video Technologies' through live demonstrations and advanced techniques for an enhanced audio-visual experience attracting full-house sessions all throughout the show.

The exhibition was joined by 47 organisations. They included leading equipment manufacturers, system integrators, transmission network integrators, frequency planners, Internet and broadcast service providers, digital system proponents, regulatory agencies and other media players showcased their latest technologies and services at the event. This provided a unique opportunity for the exhibitors to interact, understand and network with representatives from broadcasters, creative content developers and channel operators across the region and around the world.

The 2017 DB Symposium was officially opened by the Malaysian Deputy Minister of Communications and Multimedia, YB Dato' Jailani Johari in the presence of the Deputy Director-General of RTM, Mr Magli Alias.

The event was supported by over 55 sponsors and partners from around the world. The symposium's Principal Sponsor was WorldDAB for the fourth consecutive year with six other major sponsors in MCMC, Rohde & Schwarz, Dell EMC, MediaGeniX, Aspera and Dolby. The event was also supported by Radio Television Malaysia.

The next ABU Digital Broadcasting Symposium 2018 will take place from 5-8 March 2018 in Kuala Lumpur. Further details on the event are available at www.abu.org.my/dbsymposium.

AsiaSat and Globecast to Deliver TRT World in HD

March 24, 2017 - Asia Satellite Telecommunications Company Limited (AsiaSat) and global media solutions provider Globecast have reached an agreement to deliver international Turkish news platform TRT World in HD to viewers across the Asia-Pacific region via AsiaSat 7. The deal expands TRT's reach and strengthens its position in the Asian market. TRT World is owned by Turkish national public broadcaster TRT and is Turkey's first English language international news platform, providing news coverage in English 24/7 from Istanbul. Globecast and TRT World chose AsiaSat 7 because of its extensive Asian coverage, international channel neighbourhood and excellent audience access. AsiaSat 7 has a region-wide C-band footprint covering Asia, the Middle East, Australasia and Central Asia, as well as high-power Ku beams dedicated to serving East and South Asia. Globecast is providing TRT World with a global packaged service for the DTH distribution of the news platform including worldwide connectivity and uplink distribution services using its unique reach to access 10 satellites.

ViaSat Selects eXtremeDB to Optimize Metrics Data from its Satellite Ground Network

March 28, 2017 - McObject, developer of the eXtremeDB® Financial Edition database management system, announced that ViaSat, Inc., a global broadband services and technology company, has chosen eXtremeDB in order to implement a new physical layer satellite debugging application known as the Data Metric Aggregation System (DMAS) project. DMAS ingests metrics feeds from satellite ground-system elements at a very high rate and conducts analysis of the data to identify trends and abnormalities to help enhance network speed, quality and reliability. Today approximately 1 million metric entries per second are captured from the ViaSat ground system using eXtremeDB. It is expected that DMAS, using eXtremeDB's capabilities, will significantly improve the flow rate, performance and quality of the metrics data. Analytics performed on the DMAS data can then be leveraged across market segments and geographic regions of the ViaSat network.

SES Achieves Major Performance and Efficiency Gains Over VT iDirect's DVB-S2X Technology

March 29, 2017 - iDirect announced another successful over-the-air (OTA) test of its next-generation DVB-S2X technology. The test was conducted with the world-leading satellite operator, SES, over C-Band and achieved 5.7 bps/Hz. The DVB-S2X forward channel and Adaptive TDMA return channel OTA testing was conducted on the SES-4 satellite and leveraged iDirect's next-generation iQ Desktop Remote, Universal Line Cards and Intelligent Gateway appliance. VT iDirect recently announced its next-generation DVB-S2X technology, which is based on a powerful, customized ASIC (Application-Specific Integrated Circuit) chipset and powers the new iQ Series family of remotes. iDirect's iQ Series, which will operate in both DVB-S2X and DVB-S2 mode, is targeted for broadband, enterprise, and mobility applications and packaged in desktop, rack-mount, board level and embedded compute form factors that will become available over the course of this year. The family of new remotes are software upgradeable to license added network capabilities and higher throughput levels, thereby reducing the cost of ownership, as well as improving flexibility across a broad array of markets.

GMV Provides Critical Support to METEOSAT-7 End-of-Life Operations with Optical Telescopes

March 31, 2017 - Meteosat-7 was launched in September 1997 and is operated by EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites. It is the last satellite of the first generation of Meteosat. First over Europe and next from its current orbital location over the Indian Ocean region at 36000 Km above our heads, Meteosat I has been providing a fruitful service for almost two decades, a period that is now coming to an end. To avoid the proliferation of space debris in the crowded geostationary ring, EUMETSAT will conduct a safe re-orbiting into a so-called "graveyard" orbit, located at least 250 km above the current location. These end-of-life operations will be carried out in compliance with the latest recommendations included in the 24113 standard of the International Organization for Standardization (ISO) concerning space debris mitigation. In order to support these critical operations, GMV will task observations from 9 different telescopes worldwide to follow the spacecraft trajectory evolution every night. These telescopes, operated by GMV's partner ISON (International Scientific Optical Network), are placed in distant locations in 6 different countries to ensure the highest redundancy in case of bad weather conditions or contingencies. As part of this activity, and in parallel with these operations at EUMETSAT, GMV will make use of its internal state-of-the-art flight dynamics tools to perform an independent checking

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and monitoring of the maneuvers and orbital evolution of the spacecraft. GMV solutions, making use of all telescopes and ranging stations involved, will verify the correctness of EUMETSAT operational data.

AsiaSat 9 in Myanmar

April 5, 2017 - In late 2017, AsiaSat will launch the world's first dedicated Myanmar beam, bringing more power and enhanced coverage to the country and a commitment to deliver the best service to all customers. With AsiaSat 9 boasting most powerful EIRP in C and Ku-Band so far and an excellent 'look angle', to not only meet the demands of industrial and business connectivity for the likes of Mining, Oil and Gas, and Banking, but also to offer entertainment in television and live sports events in the highest quality the country has seen, AsiaSat is connecting Myanmar. AsiaSat 4 at 122°E is serving areas of Myanmar right now, with companies such as KBZ Gateway Company Limited utilizing our VSAT capabilities. The company is also currently using capacity on AsiaSat 7's Ku-band, alongside other Myanmar customers including Seanet, and King Royal Technologies Co Ltd. With the increased C-band power and a customized Ku-band on AsiaSat 9, AsiaSat will be positioned to serve Myanmar better, and to an expanding portfolio of customers and end users.

Inmarsat Crosses Milestone of 1,000 Aircraft in Backlog for Next-Generation Inflight Broadband

April 5, 2017 - Inmarsat has more than 1,000 expected aircraft under signed contracts, both installed and as a backlog, for its next-generation GX Aviation and European Aviation Network (EAN) inflight broadband services. The milestone was celebrated during an evening reception with airline customers, partners and the media at the Aircraft Interiors Expo (AIX) in Hamburg, Germany last night. The fast-growing backlog, which includes aircraft that have either been installed or are awaiting installation, is a major endorsement of Inmarsat's strategy to make the connected aircraft a reality. It follows a succession of leading airline customers that have selected to equip their fleet with Inmarsat's GX Aviation and EAN services, including Lufthansa Group, International Airlines Group (IAG), Air New Zealand, Singapore Airlines, Norwegian Air and Air Asia.

Mitsubishi Electric to Build New Satellite Production Facility

April 7, 2017 - Mitsubishi Electric Corporation announced that it will invest approximately 11 billion yen to construct a new facility for the production of satellites at company's Kamakura Works in Kamakura, Japan. Together with existing facilities, Mitsubishi Electric's production capacity will increase to 18 satellites in parallel, up from 10 in parallel at present, which will enable the company to satisfy growing demand for governmental satellites in Japan and commercial communication satellites worldwide. Mitsubishi Electric is targeting space-related revenue of 150 billion yen by 2021. The new facility will increase production efficiency, shorten production time, reduce costs and elevate product quality for enhanced competitiveness. It will incorporate information technology based on Mitsubishi Electric's e-F@ctory solutions, which extract hidden benefits from existing resources through integrated automation to improve efficiencies, reduce costs and increasing overall productivity. Mitsubishi Electric's long involvement with satellites includes the Himawari-7, -8 and -9 weather satellites, the Superbird-C2, Japan's first commercial communications satellite, QZS high-accuracy positioning satellite systems and the TURKSAT-4A and -4B satellites for Turksat A.S of Turkey.

Long March 3B Launches Experimental ChinaSat-16 Satellite

April 12, 2017 - China's first high throughput satellite SJ-13/ Chinasat-16 was launched by LM-3B launch vehicle from the Xichang Satellite Launch Center. The satellite, with the capacity over 20 Gbps which exceeds the total capacity of all Chinese communications satellites before, was sent to orbit at 19:04 p.m. (Beijing time) by a LM-3B launch vehicle. The satellite is developed by China Academy of Space Technology (CAST), based on its DFH-4 platform using hydric propulsion technology. For the first time among all the DFH-4 based satellite, it will use electric propulsion for its on station keeping. ChinaSat 16 satellite, located at 110.5E, is aiming to provide Ka-band satellite broadband and multimedia services. China Satcom is responsible for the construction and operation of the satellite. The satellite is able to provide 26 user beams covering China and offshore areas and will service for distance learning, medicine, internet access, airborne and maritime communications and emergency communications. The new satellite will test a new electric propulsion system to be used for orbit raising and station keeping at a geosynchronous altitude. It also carries the first high-throughput satellite payload (HTS) developed by China. The satellite will also conduct space-to-ground laser communications experiments.

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22	**CASBAA Satellite Industry Forum** • Singapore • http://casbaaevent.com/events/casbaa-satellite-industry-forum/
23-25	**CommunicAsia2017** • Singapore • www.communicasia.com
23	**SatComm2017 @ CommuicAsia2017** • Singapore • www.communicasia.com

JUNE

6-8	**Global Space Exploration Conference (GLEX)** • Beijing, China • http://glex2017.org/
7-9	**VIETNAM ICT COMM 2017** • Ho Chi Minh City, Vietnam • www.ictcomm.vn

SEPTEMBER

11-15	**World Satellite Business Week** • Paris, France • www.satellite-business.com/en
14-19	**IBC 2017** • Amsterdam, the Netherlands • www.ibc.org
25-28	**ITU Telecom World 2017** • Busan, Korea • http://telecomworld.itu.int/

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APSCC aims to exchange views and ideas on technologies, systems, policies and outer space activities in general along with satellite communications including broadcasting for the betterment of the Asia-Pacific region. Conferences, forums, workshops, summits, symposiums, and exhibitions are organized through regional coordination in order to discuss issues that affect the industries and to promote and accelerate the efficient introduction of outer space activities, new services and businesses via satellites.

In order to disseminate industry related information, APSCC publishes a quarterly satellite magazine as well as a monthly e-newsletter, which are distributed worldwide to members and others. The quarterly magazine and other publications are available on the Web at www.apscc.or.kr.

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