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GVF Directory **& Satellite Resource Guide** **2019**

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David Meltzer
Secretary General
Global VSAT Forum
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As I write this opening piece for the 2019 GVF Directory, I think back on my career and the perspective it affords me. I have worked for sixteen years at one of the largest satellite operators in the world, served on the board of an established yet challenged regional operator, and served on the board of a new satellite company seeking to deliver a first-of-its-kind telecommunications service. In between, I worked at an organization focused on helping those in need that often relied on communications and earth observation satellites to deliver life-saving services. While I never entirely left the satellite industry, when I joined GVF as its new Secretary General in August 2018 I found myself fully immersed in the industry for the first time in 13 years. These experiences, and the last six months as GVF's Secretary General, lead me to several observations:

- The satellite industry has evolved to meet business and regulatory challenges by introducing services delivered by powerful and efficient satellites;
- Yesterday's promise of Ka-band delivered broadband services has been delivered and new services delivered by promised LEO systems have attracted billions of dollars of investments;
- Some of the most renowned businessmen in the world such as Jeff Bezos, Elon Musk and Richard Branson are investing billions in further commercializing space; and
- Technological advances have lowered the cost of satellites, launch services, ground-based equipment and other related products and services which brings communications services to more and more underserved communities which, in turn, drives economic and social development.

These observations, and others, leave me excited for the satellite industry and the role GVF can play as the sole global trade association for the industry. By advocating on behalf of the industry and our members (which represent virtually the entire satellite ecosystem), GVF can raise the profile for the industry and promote its regulatory and commercial goals. Working with our partners, GVF can provide training opportunities that will result in increased and better use of satellites. Similarly, GVF can organize and promote conferences which our members can lead and attend and thereby meet customers, learn of developments affecting their business, and collaborate with other industry stakeholders. Finally, GVF can lead industry efforts to address regulatory developments, sustainable space operations, cybersecurity and other critical issues facing the industry.

My goals for 2019 include delivering more services for our members and improving GVF's value proposition. Necessarily, this requires greater efforts to learn what services and benefits are valued by GVF's members and what they do not value and then finding ways to efficiently deliver those services. I look forward to the challenge.



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Chairman

Arunas Sleky, Vice President, Corporate Marketing, Hughes Network Systems. Arunas Sleky is responsible for managing all of Hughes marketing communications and advocacy initiatives worldwide.

He holds a B.App.Sc. degree in electrical engineering from the University of Toronto, a M.Sc. from the University of Illinois, and a PhD in computer and communications engineering from UCLA. He is the co-author of a founding patent for wireless data systems (CDPD), and is a frequently published author on satellite and wireless communications. Dr. Sleky has served as the elected Chairman of the GVF Board since 2006.

Dr. Arunas Sleky
Vice President Corporate Marketing
Hughes Network Systems, LLC



Director

Yasir Hassan, Director of Transmission Operations, Arabsat. Yasir Hassan has almost 20 years of experience in the telecommunication field starting with King Fahad City for Satellite Communication in Saudi Arabia. He joined Arabsat in July 1998, held the position of Engineering Services Head in 2008 and was selected to be the Director of Transmission operation in 2010.

Mr. Hassan holds a Bachelor of Science with honour degree in Electrical & Electronic Engineering from Eastern Mediterranean University, Northern Cyprus, and obtained his MBA from University of Leicester, UK in 2005. He also serves as a Director on the Satellite Interference Reduction Group.

Yasir Hassan
Director of Transmission Operations
ARABSAT



Director

Nick Dowsett, Director, IntelsatOne Enterprise Solutions, Intelsat. Mr. Dowsett is responsible for developing and managing Intelsat's IntelsatONE Enterprise Solutions portfolio of managed solutions. Since the launch of the IntelsatOne portfolio in 2002, he has overseen its significant growth of enterprise customers and traffic.

Mr. Dowsett has been employed in the global telecommunications industry for over 30 years. Prior to joining Intelsat in 2002, he worked for six years at Concert Communications Inc., a British Telecommunications and AT&T joint venture company. Employed as a Senior Manager, his responsibilities included managing all commercial aspects of a global circuit-switched voice product and the development & launch of a global IP-based enterprise voice product offering.

Nick Dowsett
Director, IntelsatOne Enterprise Solutions
Intelsat



Director

Paul Deedman, Director, Spectrum Regulation, Inmarsat. Mr. Deedman's role in Inmarsat is to ensure that the necessary international spectrum regulations are in place for the continuing operation of the current Inmarsat satellites, network, and future systems. He is involved in CEPT spectrum activities and the ITU-R working parties, most recently on issues such as new regulations for Ka-band mobile terminals (ESIMs) and protection of the L-band MSS spectrum for proposed terrestrial LTE systems. He has participated in all of the ITU World Radiocommunication Conferences since 1997, and has been closely engaged in the regional preparations for WRC.

Mr. Deedman joined Inmarsat in 2000, having previously worked for the Radiocommunications Agency, and has an honours degree in telecommunications from the University of London (Queen Mary College).

Paul Deedman
Director, Spectrum Regulation
Inmarsat





Director

Simon Gray, Senior Vice President of Humanitarian Affairs, Eutelsat. Mr. Gray is also a member of the ITU Advisory board for developing disaster comms strategy worldwide. He has been elected by the other eight satellite fleet operators to coordinate the satellite charter with the UN for the satellite industry. Mr. Gray has worked in the satellite industry for over 20 years and while at Eutelsat has been responsible for the largest training program ever undertaken by a satellite operator. His role in Eutelsat has also encompassed developing a new class of satellite terminal, equipment approval, mobile apps, training courses & training tools. His team has also been responsible for overseeing over 350,000 terminal installations across four continents and he is the point of reference for the Eutelsat fleet for remote terminal technology.

Simon Gray
Senior Vice President of Humanitarian Affairs
Eutelsat



Director

Keith Johnson, COO & EVP Energy, Speedcast. Mr. Johnson has 30 years of experience in the satellite telecommunication and energy industries. In his role at Speedcast, he oversees all of Speedcast's business activities for the energy and oil & gas sector, including strategic planning, programme management, business development and global sales. He is a member of the Executive Staff, and participates directly in supporting the various strategic acquisitions made over the last few years.

Mr. Johnson is an author of many published papers on telecommunications, satellite, wireless and IT. He attended Texas A&M University, and graduated from Houston Baptist University with a double major in Marketing and Management.

Keith Johnson
COO & EVP of Energy
Speedcast



Director

Nancy Eskenazi, Vice President, Legal & Regulatory Affairs, SES. Mrs. Eskenazi has more than 20 years of experience in the satellite sector, Ms. Eskenazi brings a unique regulatory and policy perspective to GVF. In this role she leads development and execution of regulatory and policy strategy for the Americas, Europe, Russia and Turkey. She also manages global export control, sanctions compliance and antitrust matters. Nancy is closely involved in regulatory, policy and spectrum matters on national, international and at the ITU levels.

Ms. Eskenazi holds an LLM in International & Comparative Law from Georgetown University and a Juris Doctor and MS in Television, Radio & Film from Syracuse University. She received a Bachelor of Arts degree from the University of Massachusetts at Amherst.

Nancy Eskenazi
Vice President, Legal & Regulatory Affairs
SES



General Assembly & Members' Meetings

A General Assembly will be convened at least once each year in the 4th calendar quarter (Oct.-Dec.) and at other times as deemed necessary by the Board of Directors. The purpose of the General Assembly will be to present to the Membership: Election of the Board; Proposed Constitutional Amendments; Financial Reports; the Secretary General's Report; and other business as appropriate (strategy, policy, etc.). Non-Members of the GVF may be invited by the Secretary General to attend the open portion of these General Assemblies. The agenda and ballots for all formal votes will be delivered to the authorized voting representatives 30 days in advance of the General Assembly. Ballots may be returned in person at the meeting or by post. All votes made by post must be received at the designated location 7 days in advance of the meeting. A quorum will be deemed to be established for any General Assembly Meeting in which a minimum of 30 percent of the Full Members or 50 percent of the Full Founder Members are in attendance.

Members' Meetings will be convened periodically throughout each year, at times and in locations confirmed by the Board of Directors. The purpose of these meetings will be to provide to the Membership: Reports on global and local trends; Program Updates; Open Forum Discussions Related to Strategy, etc.; and other business as appropriate. Non-Members of the GVF may attend some portion of these Meetings.



GVF Secretariat

David Meltzer Secretary General

Mr. Meltzer brings over twenty five years of experience in the satellite industry, including serving as a board member for both a regional satellite operator and for a mobile satellite operator. Previously, he served for 16 years in various business and legal roles at Intelsat, culminating in serving as Intelsat's General Counsel and Executive Vice President for Regulatory Affairs. Most recently, Mr. Meltzer served as the General Counsel and Chief International Officer of the American Red Cross where he led its legal, international disaster relief and development activities.

Martin Jarrold Chief of International Programme Development

Martin Jarrold has worked for GVF for more than 10 years, having been appointed GVF Chief of International Programme Development in June 2001. His particular responsibilities include outreach to the member organisations of the GVF and for the further development of the profile of the Forum within the satellite communications industry, and across the global telecommunications policy and regulatory community. This extends to the development and delivery of programmes focused on extending the understanding of, and promoting the use of, satellite-based communications in various key end-user vertical markets.

Irina Petrov Vice President for Marketing and Membership

Ms. Petrov has over twenty years of experience in the satellite industry serving the last eleven years with Onlime Group that provides premium business communications to customers across the globe, with the last five years as its Vice President for Marketing. Ms. Petrov has also worked for several satellite operators in marketing and project management positions. In addition to possessing significant experience planning and organizing conference events and writing articles for satellite industry media, Ms. Petrov brings an extensive set of skills, knowledge, and a network of relationships that enables GVF to significantly increase the services offered to its membership and grow it to an even stronger satellite community.



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GVF Code of Conduct Policy

Members must conduct themselves in their capacity and activities as a Member of the Global VSAT Forum in keeping with the aims and objectives of the association as outlined in the GVF mission statement, the GVF Opportunity and Rationalization document, and the GVF Constitution. Observing this code is a condition of membership in the association. If a Member is in breach of this code, or appears on reasonable grounds to be so, they may be reported to the Board by another member or a member of the Board.

The Board shall request, and the member concerned shall supply, all such information as is reasonable and relevant concerning the breach or apparent breach and may make such representations to the Board concerning the same as they may wish. The Board shall consider the evidence and the representations carefully and objectively, and shall record in writing their reasoning for any determination, and submit it to the Member concerned for comment, before the determination is actioned. Any determination by the Board must be proportionate to the breach or alleged breach and may consist of a verbal warning, a written warning, a suspension of membership or an expulsion from membership. In the case of an expulsion, no refund of membership fees shall be made. A determination made by the Board may be relaxed, suspended, withdrawn or reversed as the Board may further determine from time to time, on reasonable grounds.

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Education and training initiative

With more than 30 learning courses, 15 certifications, and over 15,000 students, the GVF Training and Certification Program has been the standard for the satellite communications community since 2005. Interactive, simulator-based online training makes GVF training globally available, highly effective, efficient, and low cost.

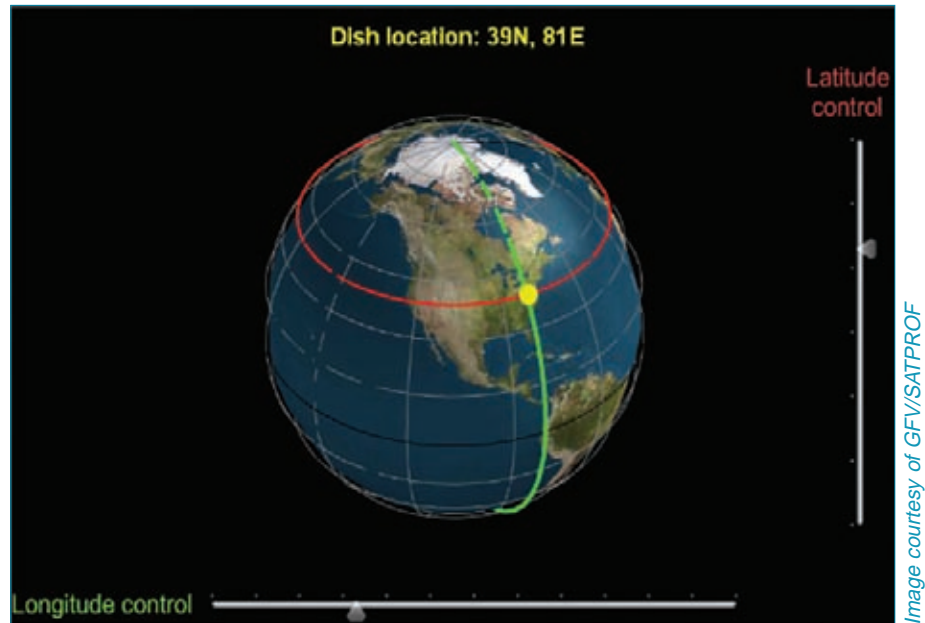
GVF training is ideal for:

- VSAT field technicians and installers;
- Network Operations Center and Access Center technical staff;
- Teleport and broadcast uplink technicians;
- Ground equipment and link engineers;
- Marine satcom field technicians and engineers;
- Marine VSAT equipment operators (seafarers and crew);
- SNG truck/van operators;
- Mobile/autopoint terminal operators, including military and broadcast;
- Quick-deploy terminal operators, including military users; and
- Managers, commercial/sales staff, and support staff in satcom organizations.

The training programme is strongly supported by all sectors of the industry, including a formal resolution of endorsement by WBU-IMCG (formerly ISOG).

Many major satellite operators, service providers, and manufacturers have integrated GVF training into their own staff development programmes.

Students or training organisations begin at www.gvf.org/training to explore the curriculum and certification paths. Upon registration, students receive individual login accounts to



"Many major satellite operators, service providers, and manufacturers have integrated GVF training into their own staff development programmes."

the dedicated learning system and work through their online courses at their own pace. Each course contains knowledge tutorials (many with animation and interactive simulations), followed by a quiz, and where applicable, a simulator-based skills test. Satcom Professional Certification students may register for a required hands-on skills test, offered by any of more than 100 GVF Examiners worldwide, who are either on-staff at participating organizations or offer testing sessions to the public.

New courses, including specific training on using HTS, LEO, and MEO networks and on

specialized equipment, are being continually developed in collaboration with satellite operators and equipment manufacturers.

Knowledge Center Subscription plan

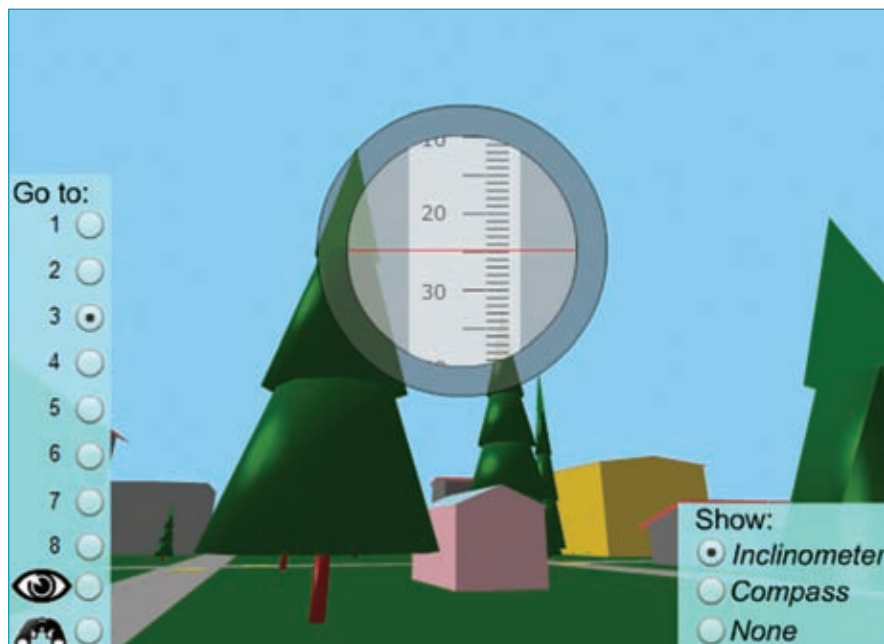
Under the Knowledge Center Subscription plan, GVF now makes the entire suite of standard learning courses and certifications available for an affordable fixed annual subscription rate.

Students may freely choose their courses, revisit them for refresher training and resources access, and renew their certification, at zero additional cost. Further, organizations may now enter into a Site License agreement, under which their entire staff is subscribed to the GVF curriculum for a heavily-discounted, single annual fee.

When certification requirements are met, the student may elect to be listed in the public directory of certified professionals, which serves as an excellent resource for organisations seeking expertise in their regions.

Separately, any organization or company which commits to its staff maintaining appropriate GVF certifications is now eligible to be recognized as an Accredited Organization for Training.

GVF training delivery is highly flexible and adaptable through a suite of Enhanced Training Services, which include branded, custom-designed portals, enabling organizations to integrate the GVF standard curriculum with their own specific training materials for delivery to staff and customers. In fact, most of the corporate and organization training programs in the satellite communications industry are built on the GVF curriculum and learning delivery system.



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Pacific Endeavor 2019 and communications capacity building @Satcom Endeavor

Each year militaries from throughout the Indo-Asia-Pacific region collectively strengthen their disaster preparedness capabilities through expanded collaboration with the GVF and its member companies in supporting delivery of capacity building to enable more effective application of satellite-based broadband solutions to humanitarian assistance and disaster response (HADR).

Pacific Endeavor 2019 Multinational Communications Interoperability Programme (MCIP) of US Pacific Command (PACOM)

The MCIP Programme for HADR *Communications Capacity Building Exercise & Information Sharing Module* is aimed at 22-plus militaries of the Indo-Asia-Pacific region – known as ‘Satcom Endeavor’ – will again be run by GVF, and its Members’ support for the ‘Satcom Endeavor’ programme is invited.

‘Satcom Endeavor 2019’ will be the fifth in this series of events dedicated to extending the understanding of, and to the experience of directly using, the latest satellite communications systems and solutions amongst military first responders. This element of the Pacific Endeavor programme is a unique opportunity for officials from participating nations to experience the latest

technological solutions along with enhancing knowledge, building capacities, and inter-military personnel relationships.

The target audience at this event are key decision-making officials from the communication and signals divisions of the participating militaries from the various Indo-Asia-Pacific nations, who will assemble in a single location – in 2019, in Port Moresby, Papua New Guinea – to set-up and familiarize themselves with systems, products, services and solutions offered by the satellite industry.

The expanded collaboration that has occurred during previous year’s Pacific Endeavor programmes exemplifies the increasing extent to which military leadership and the satellite industry are continuing to work together to strengthen disaster preparedness through the use of space-based broadband solutions.

Riaz Lamak, President, Mahdi Bagh Computers (MBC) and the GVF’s Lead and Point of Contact for Pacific Endeavor for a further year observed, “Our collaboration is for capacity building and information sharing, exemplifying the latest technology from our industry as a vital HADR resource.

It is highly commendable that with completion of the four previous ‘Satcom

Endeavor’ programmes, there is now a rich resource of GVF-certified officials in each of the countries. With this, MCIP has created a registry of skilled and GVF-certified human resources available in each country. This database is available to each of the nations for augmenting their available resources and facilitating quick deployment of disaster relief initiatives.”

This is an important opportunity for those GVF Member organizations which bring their solutions and/or can present examples of case studies and best practices.

GVF has proposed running a combination of activities for ‘Satcom Endeavor 2019’, which include:

- (1) Classroom-based training;
- (2) Mentored online training;
- (3) Hands-on practical sessions & presentation of new technology along with selected unique solutions which are key to HADR preparedness; and
- (4) A field-training exercise.

For additional information please contact Riaz Lamak, GVF Lead assigned by PACOM to coordinate ‘Satcom Endeavor 2019’ (riaz.lamak@gvf.org).



Pacific Endeavor 2018. Photo courtesy of GVF

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NewSpace revolution: Small satellites and all that...

The lexicon of space has acquired a new listing... **NewSpace**

NewSpace is an umbrella label that, broadly, describes ever-more apparent and high-profile moves towards an emerging, private, spaceflight and space commerce market segment. The term may mean many varied things to a varied range of people. It can be said to encompass such elements as the colonization of our Moon and of Mars, the emergence of space tourism, and, generally, easier and more affordable access to space. The range and limits to the list depend on personal perspectives and might even be construed as being as unending as space itself.

The domination of the satellite and space sectors by government entities – though with the private sector always having had a technology and services supplier role/relationship with these entities – began to change with the advent of what has grown into a vigorous satellite communications market over the last several decades, involving the launch of hundreds of satellites to an increasingly congested geostationary orbital arc above the equator. But, even though satcoms was (and, of course, very definitely still is) commercial space, new generations of space entrepreneurs now think of it as “Old Space”. Not old in the negative or pejorative sense of being of declining relevance and significance, but in the sense that it has been, and continues to be, the foundation to the evolution and emergence of a new generation of space-based commercial activity.

Old Space

For these space entrepreneurs there are certain facets of “Old Space” that are anachronistic, i.e., barriers to space in terms of cost and time as exemplified in new satellites taking years to go from the design to launch, and at a cost of many tens of millions of dollars.

A vast number and range of new commercial entities are looking to harness space in an entirely new way, developing faster, better, and improved access to space and spaceflight technologies, and the entrepreneurs backing and building these entities are redefining the boundaries of what is possible. However, we must not make the mistake of thinking that this elevated commercial orientation to space has necessarily left the government entities behind because, after all, the NewSpace revolution has, in actuality, prompted more and more governments to establish their own space agencies.

NewSpace is clearly making the headlines. Aside from the technology, if the financial forecasts for the scale of the emerging NewSpace market prove true, it is destined to continue as frontpage news. For example, Bank of America Merrill Lynch has estimated the value of the space market — manufacture

and use of infrastructure, space-enabled applications, etc., a pan-industry figure not limited to just the NewSpace/small satellites arena — at US\$339 billion, predicting that by 2045 this figure will grow – with expansion across the satellite deployment, ancillary services and launch capability segments – by a factor of eight, to US\$2.7 trillion.

Figures like this are indicative of a market of myriad private companies, new start-ups, and spin-offs from academia, that are driven by commercial competition for customers. This is the very fabric of NewSpace. It is important to underscore the fact that the investment isn't only coming from the pockets of well-known billionaires such as from the performance car manufacturing, or commercial airline, or Internet environments, nor only from the makers of one of the better-known carbonated drinks.

Investors, of all flavours and sizes, channelled a total of US\$2.8 billion into NewSpace start-ups in 2016, and this evolving and expanding commercialisation of space, facilitated by and reflected in these investments, is originating from companies located in a widening range of countries. These include not only more traditional government space, and commercial space (satcoms), nations such as the USA, Russia, China, Japan, India, France, Italy, Canada, Spain, the UK, and many European countries not previously considered space-active nations (with the possible exception of having crew members on the ISS) through to smaller developing nations.

It is beyond the remit of this chapter to explore such facets of NewSpace as space colonization, planetary and asteroid mining, space-based manufacturing, and space tourism, and instead the focus will be directed

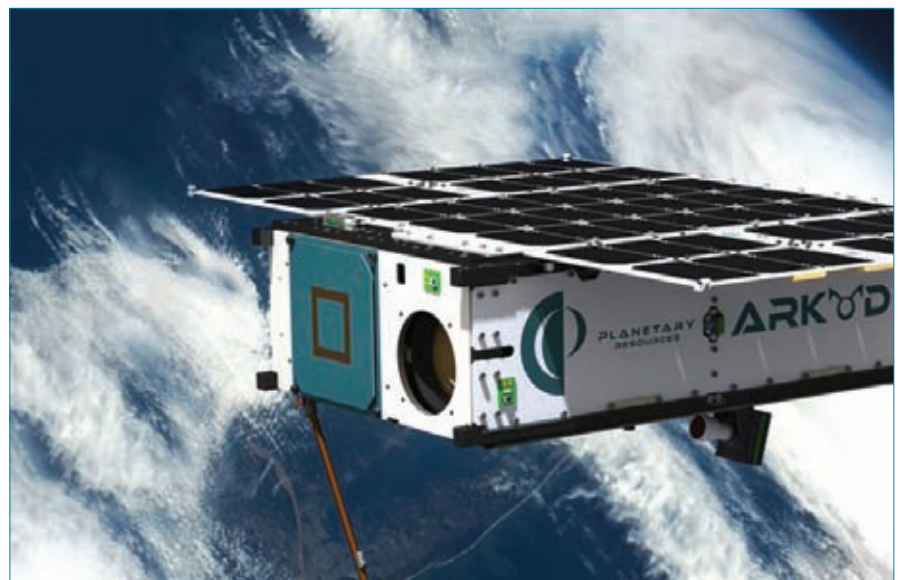
towards what is generally referred to as the small satellite, or ‘smallsats’, market and which encompasses: launch services; satellite manufacturing, in-orbit servicing, and constellations; Earth observation; sustainable space operations/orbital debris; and, of course, the satellite communications ecosystem – which itself faces profound evolutionary change as (a) ‘high throughput’ gets closer to Earth than GEO orbit, and (b) as integration with next generation terrestrial mobile communications into a unified “network of networks” contributes to the realization of 5G.

Launch vehicles

Launch is getting cheaper and more accessible: Commercial spacecraft launch entities working on next-generation technologies are in good company. SpaceX, of course, has spearheaded the reusable rocket launch campaign with the Falcon 9, alongside Blue Origin with New Shepard. Both are also developing additional reusable launch vehicles. The huge number of small satellites expected for launch in the coming years has created a massive market opportunity for dedicated small satellite launch vehicles; NanoRacks is launching cubesat missions from onboard the ISS, Rocket Lab has completed the world's first private orbital launch complex, Virgin Galactic is developing in-air launches of small satellites with its LauncherOne and SpaceShipTwo vehicles from aircraft, and start-up Orbex is developing a dedicated small satellite launch vehicle in the UK.

What are ‘smallsats’? There is a profusion of terminology in the ‘smallsats’ ecosystem: “Small”, “nano”, “micro”, “mini”, and yet more. This is potential for a lot of confusion so, before continuing, it would be useful to achieve clarity by defining some terms. The following is the widely recognised, though not officially sanctioned, terminological convention:

- Small satellites (the catch-all term for spacecraft with mass under-500kg);
- Mini-satellites (mass range 100kg-500kg);
- Micro-satellites ^[1] (mass range 10kg-100kg);



Arkyd-6 CubeSat, a technology demonstrator. Photo courtesy of Planetary Resources

- Nano-satellites ^[2] (mass range 1.0kg-10kg);
- Pico-satellites ^[3] (mass range 0.1kg-1.0kg); and
- Femto-satellites ^[4] (mass range 0.01kg - 0.1-kg).

A new manufacturing paradigm: Given the boom in small satellite demand, manufacturers with the appropriate specializations will thrive. Clyde Space, Boeing, Surrey Satellite Technology Ltd (now fully owned by Airbus Defence and Space), Lockheed Martin, Mitsubishi Electric Corporation, Northrop Grumman Innovation Systems, SSL and Thales Alenia Space are all heavily invested in small satellite manufacturing. Additionally, Airbus Defence and Space has inaugurated several serial production lines in France and the USA for the assembly, integration and testing of OneWeb's small satellites.

Satellite servicing: The biggest lifespan limitation for satellites is fuel capacity. A typical geostationary telecommunications satellite is retired after 15-20 years, not because any of the components cease to operate, but because they no longer have enough fuel to maintain orbital station-keeping and attitude control. The space sector has been debating satellite servicing for decades, but it's only now that pioneers Northrop Grumman Innovation Systems and Effective Space Solutions Ltd have taken the first steps towards in-orbit satellite servicing. Both are working with the 'space tug' model, wherein a spacecraft docks to the 'target' satellite and utilizes its own fuel to maintain the satellite and its own station and attitude. In an example of the type of public-private partnership that is expected to become increasingly ubiquitous in the NewSpace era, the US Government's Defense Advanced Research Projects Agency (DARPA) has selected SSL as its commercial partner for its own Robotic Servicing of Geosynchronous Satellites (RSGS) programme, which will develop technologies for cooperative inspection and servicing in GEO orbit.

Constellations and mega-constellations

Discussion of the future of small satellite constellations has had a high profile in recent years and O3b Networks (now part of SES) has well demonstrated their capabilities. Medium Earth orbit (MEO) – as with O3b – and low Earth orbit (LEO) have been under-exploited in the commercial satellite communications sector until now, with the majority of satellites using those orbits being dedicated to scientific research applications and government programmes. All that is about to change. Iridium NEXT, OneWeb, LeoSat, Telesat, Boeing, Fleet, Samsung, Kepler Communications and SpaceX all have constellations somewhere between the planning and operational stages. Most of the planned future constellations will target the global connectivity market, delivering low-cost high-speed Internet services, and are expected to help bridge the digital divide.

Commercial Earth observation: In recent years, however, it has been next-generation commercial Earth observation that has dominated the 'smallsats' market. Of the 328 small satellites launched in 2017, then the

largest annual total ever, fully two-thirds of these spacecraft were orbited to deliver Earth imaging/observation applications. Pre-NewSpace, Earth observation was firmly confined to governments and their various specialized agencies, that is, those with budgets big enough to sustain such – then – expensive programmes. Earth imaging/observation is no longer such an expensive and exclusive club, because of the reducing cost of launch and the reducing cost of manufacture.

Utilized for anything from weather forecasting, biodiversity tracking, atmospheric chemistry monitoring, disaster recovery operations, ocean management, environmental observations, and observing poaching and illegal fishing activities, the Earth observation segment is a major field of enterprise. DigitalGlobe, capable of delivering true 30cm resolution imagery, collects more

than one billion square kilometres of imagery annually, while Spire Global, which monitors the Earth via a network of small satellites, has won the world's first Commercial Weather Data Pilot contract with the National Oceanic and Atmospheric Administration (NOAA). ImageSat International (ISI), Planet Labs (which now includes Terra Bella, formerly Skybox Imaging), Earth-I, Hera Systems, Satellogic, and BlackSky are all transforming the Earth observation sector with exciting new steps forward in capabilities.

It is not necessary to recount here the details of the widely-known phenomenon of "space junk" and the widely-held concerns about the already existing problem of orbital debris becoming exacerbated by even greater potential volumes of NewSpace launch vehicle and end-of-life satellite remains. Government, and inter-government, agency concerns – from NASA and ESA, through to

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NOTES: Additionally, given the scale of some of these descriptive names/terms (and their associated diminutive mass), it would be useful to provide some contextualisation, as follows:

- Micro-satellites: Designs of this type sometimes have the micro-satellites working together or in a formation.^[1]
- Nano-satellites: Designs of this type may be launched individually, or they may have multiple nano-satellites working together or in formation, when sometimes the term 'satellite swarm' or 'fractionated spacecraft' is used. Some designs require a larger 'mother' satellite for communication with the ground or for launching and docking with the nano-satellites. With advanced miniaturisation and capability in electronics and the use of satellite constellations, nano-satellites are increasingly capable of performing commercial missions previously requiring micro-satellites. In Earth imaging/observation, for the same mission cost, significantly increased revisits (high-frequency change detection) are achievable with nano-satellite constellations.^[2]
- Pico-satellites: Designs usually have multiple pico-satellites working together or in formation ('swarm'). Some designs require a larger 'mother' satellite for communication with the ground or for launching and docking with picosatellites. The CubeSat design, with approximately 1.0 kg mass, is an example of a large pico-satellite (or small nano-satellite).^[3]
- Femto-satellites: Like pico-satellites, some designs require a larger 'mother' satellite for communication with the ground. In March 2014, the nano-satellite KickSat was launched on a Space X Falcon 9 to release 104 femto-satellite-sized 'chipsats', called 'Sprites'.^[4]

other emerging national agencies – are now being augmented by the evolution of private sector protocols and practices and the development of proof of concept technologies to tackle part of the problem. For example, the RemoveDebris mission, a spacecraft carrying camera technology and a laser ranging Lidar – to track, characterize and target orbital debris – and a harpoon plus a net – to capture debris – and a 'dragsail' membrane which will unfurl from the spacecraft to hasten its atmospheric re-entry and destruction, along with the piece of captured "space junk".

Starlink constellation

In early 2018 two experimental SpaceX satellites – Tintin A & B – were launched as demonstration platforms to lay the foundation for the forthcoming Starlink constellation that will provide Internet access from low-Earth orbit (LEO)/non-Geostationary orbit (NGSO). Tintin A & B were launched with a mass of approximately 400kg each, reinforcing the general expectation that the 4425 satellites of the, now expanded, Starlink constellation will "weigh-in" in the mini-satellites class. What is significant about the number of satellites in the planned SpaceX mega-constellation and about the planned mega-constellations of others – including, for example, OneWeb and Telesat – is not only the fact that so many are needed to deliver on the respective business and service models for providing Internet access from LEO, but that the only way to make the projects financially feasible is to have smaller spacecraft built in a new way – not the lengthy bespoke process of building a multi-tonne spacecraft destined for geostationary orbit, but using a combination of off-the-shelf components, new satellite system miniaturization technologies, and mass-production techniques, at low-cost per-unit of functional capability.

The near-future full realisation of that part of the NewSpace revolution that is the technology of small satellites (to use the catch-all term for all spacecraft under 500kg

mass), and of the full advantages of their scalability to constellation configuration, will be across three principal segments: Communications (including connectivity for the Internet of Things – IoT, and machine-to-machine – M2M, applications), Earth Imaging/Observation, and Scientific/Technological. Scientific and technological applications lay beyond the current remit, so here we continue to focus on communications and on Earth imaging/observation applications.

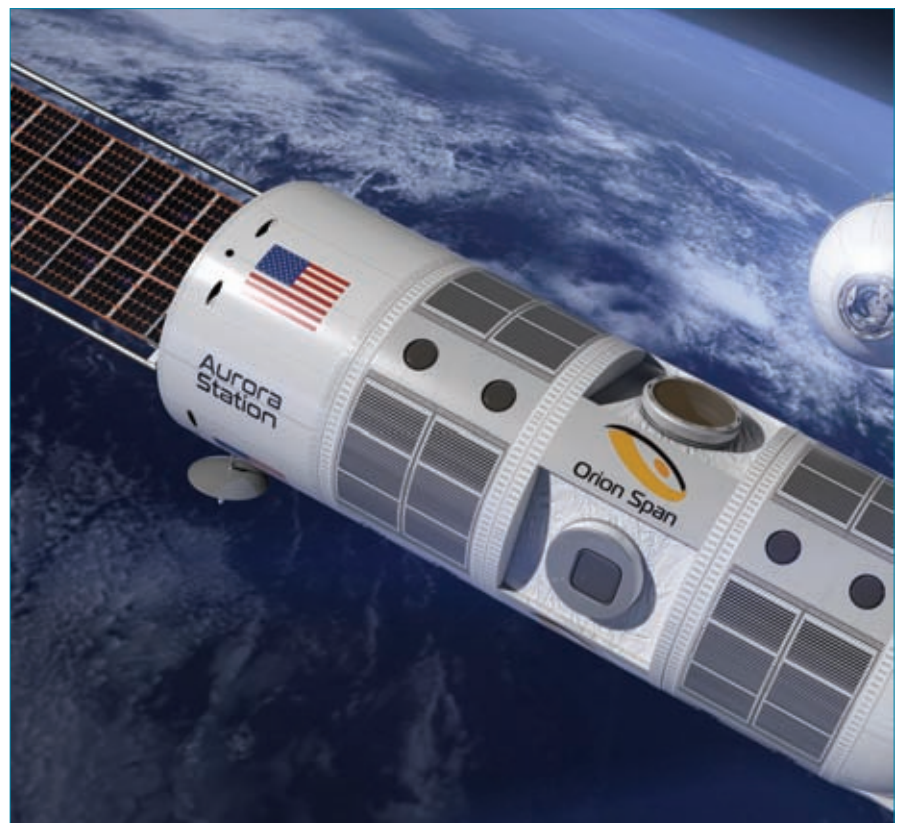
Of course, small satellites in constellations

operate in non-geostationary orbits (NGSO), that is, low-Earth orbit (LEO) for communications and Sun-synchronous orbit (SSO), which is a LEO variant, for Earth imaging/observation. For telecommunications applications (including IoT/M2M) this means being able to take advantage of higher performing link budgets and reduced transmission latency while having the coverage of higher altitude orbits. For Earth imaging/observation this reduces revisit times/increases revisit frequencies (high-frequency change detection) for the same surface territory.

IoT world

Small satellite constellations will be a vital element in the success of the emerging IoT world that is one facet of the 5G mobile broadband communications future. Satellite connectivity has provided the communications foundation for the requirements of several verticals – including M2M applications – for some several decades, but now it is trending to centre stage for applications and users across the economic and social spectrum. It is no longer regarded by the wider sphere of communications solution provisioning as being stage left, no longer regarded as a niche market-only technology, no longer a solution of last or remote resort.

At no earlier point in the history of mobile communications is the success of the next generation of networking technologies so dependent upon the take-up of network services by industry vertical markets. This is clearly reflected in the qualitative nature of 5G, a quantum leap beyond the person-to-person communications focus of earlier generations of mobile and towards a device-to-device ecosystem characterized,



Aurora station. Photo courtesy of Orion Span

according to the International Telecommunication Union (ITU), as:

- Enhanced Mobile Broadband – eMBB – aimed at meeting demand for increasingly digital lifestyles, focusing on services with high bandwidth requirements, e.g., high definition (HD) videos, virtual reality (VR), augmented reality (AR);
- Ultra-reliable and Low-latency Communications – (uRLLC) – aimed at meeting expectations from digital industry, focusing on latency-sensitive services, e.g., assisted and automated driving, remote management; and,
- Massive Machine Type Communications – (mMTC) – aimed at meeting demand for a further developed digital society, focusing on services that include high requirements for connection density, e.g., IoT for smart cities, smart agriculture, resources management, infrastructure and utilities monitoring, location-based services (LBS), etc.

The nature of 5G is, therefore, about a world of devices, that is, with the IoT, or rather – in time and with growth and evolution in the market – an Internet of Everything Everywhere (IoEE). Also a quantum leap – a leap, that is, beyond the realms of the maturing, and still expanding, M2M connectivity environment which has an already long-standing dependency on, and synergy with, satellite communications links – the world of IoT will be built on a connectivity foundation which will comprise a highly integrated functionality of, and between, terrestrial broadband wireless platforms and broadband satellite platforms.

The 5G networked world of IoT, and related applications, will require that every device is connected wherever it happens to be and whilst Wi-Fi, Bluetooth and today's terrestrial wireless network connections are able to support many IoT applications, these technologies are not, and will never be, ubiquitous and seamless. Thus, they are not readily able to service the many areas of low population density within

which economic activities – such as in the agriculture, civil engineering, mining, oil & gas and utilities sectors as well as in transport (human and logistical) between urban hubs – and the provision of social programmes – such as education and health services – will benefit from IoT.

IoT coverage, to be truly global in scope, in terms of both urban device density and remote device deployment – will require wholesale integration of the terrestrial with the ubiquity and seamlessness that only satellite networks – increasingly planned to include future small satellite constellations – can provide.

The future

Looking to the future, the Euroconsult *Prospects for the Small Satellite Market* report forecasts that the small satellite market will experience sustained expansion through to 2026 (the forecast period addressed in the report), with the total value (manufacture and launch) of the market reaching as much as US\$30.1 billion. Expansion will be driven by the roll-out of multiple constellations mainly for commercial operators.

The report further forecasts that this period will see the launch of over 6,200 small satellites with the Earth imaging/observation segment accounting for over 1,100 of this number and broadband communication expected to exhibit the strongest growth in units launched – with the advent of the constellations from OneWeb, SpaceX, Telesat, and several other operators – comprising 50 percent of the overall number of small satellite orbited.

Small satellite constellations will develop as a core element of NewSpace and of the wider revolution in device-to-device communications that will be 5G. As referenced by the 3GPP, the 5GPPP, and other stakeholder actors, satellite will no longer feature as merely an “interfacing” technology and service, with a secondary role in the “network”, but an “integrated” technology and service, fully part of an evolving and complex “network of networks”.



New Shepard on the launch pad the morning of Mission 8, April 29, 2018

The evolving regulatory environment and WRC-19

While the telecommunications industry focuses on the quadrennial gathering of regulators from around the world at the World Radiocommunication Conference which will be held late this year in Egypt, regulatory developments affecting satellite communications are occurring on an almost daily basis. Many of these developments concern the allocation of radio spectrum.

It is, perhaps, hyperbole to describe radio spectrum as the oxygen which enables satellite and other forms of communications to exist. Increase the amount of spectrum allocated to satellite communications, and the industry will grow at an even faster rate as it is able to introduce new services. Decrease the amount of spectrum allocated to satellite communications, and the industry will be challenged to introduce new services while maintaining existing services.

Introduction of 5G

Today's spectrum issues often focus on the introduction of 5G. In these early days of 5G, it is impossible to accurately predict the rate at which 5G infrastructure will be deployed, impossible to accurately predict the rate at which 5G services will be adopted, and impossible to accurately predict which 5G-enabled services will take-off and which will be slow to be adopted. What is certain is that the provision of 5G services will require scarce spectrum resources and it is the effort to secure expanded spectrum for 5G services that has engaged the focus of the telecommunications regulators and industry.

For the satellite industry, 5G services will be a significant additional driver of growth as satellites are extremely well positioned to provide expanded and enhanced broadband services to businesses and consumers. High Throughput Satellites (HTS) in geosynchronous orbit and new constellations of Low Earth Orbit (LEO) satellites will provide large amounts of data throughput at very high speeds with low latency to businesses, consumers, and machines. Billions of dollars have been, and will continue to be, invested in the space and ground based technologies that make these services possible.

Like beachfront property, spectrum is a finite natural resource. While technological advances have enabled more efficient utilization of spectrum, the fact remains that the satellite industry and the international mobile telecommunications (IMT) industry are each eager for spectrum assets to enable 5G and an extensive array of other services. As a result, there is competition for spectrum. For GVF, our focus in 2019 necessarily has to be to advocate on behalf of the satellite industry on spectrum issues. Protection of existing investments in the C, Ku, and Ka-bands in response to the acquisitive strategies of the IMT industry is critically important. Similarly, obtaining rights to utilize

other portions of the radio spectrum — such as the Q and V-bands — is a major area of focus for GVF and much of the satellite industry.

Safeguarding existing rights

While satellite operators are often at the forefront of advocating on spectrum issues, the entire satellite ecosystem will be impacted by the decisions made by national, regional and international regulators. Safeguarding and growing existing spectrum rights for the satellite industry will drive growth for operators, ground segment providers, manufacturers, launch service providers, broadcasters,



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ISPs, and many other elements of the satellite ecosystem. As GVF focuses on advocating for the entire satellite industry and the retention, protection and growth of its spectrum rights, standing on the other side of the issue will be the global trade association for the IMT industry — GSMA with its over 600 employees and revenues 250 times greater than those of GVF. Alongside GSMA are other IMT trade associations and some of the largest telecommunications companies in the world. For the satellite industry to succeed on the regulatory front at WRC-19, the entire ecosystem must join GVF in bringing forceful advocacy of the satellite industry's interests.



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Figure 1 - left to right: Jorge Ciccorossi, ITU; Alexandre Vallet, ITU; Martin Jarrold, GVF; and, Fehmida Lamak, MBC

Satellite value-add symposium in Geneva

As one of the likely first readers of this 2019 edition of the GVF Directory & Satellite Resource Guide you are in a position to appreciate the origins of the particular example covered here of GVF's creative innovation in evolving and promoting mission-critical partnerships which facilitate debate on development and growth of the global satellite industry.

Of course, during CABSAT 2019, GVF again presents the well-established Satellite Hub Summit @ CABSAT programme, and parts of this programme will be addressing a number of the capacity building issues that GVF had previously most-recently addressed in late-2018 through its collaboration with the International Telecommunication Union (ITU) in introducing a value-added capacity building facet to the ITU's latest World Radiocommunication Seminar (WRS).

Following initial discussions in January 2018 between the ITU Radiocommunication Bureau Space Services Department and GVF, and further planning and preparation between the GVF Secretariat, GVF member Mahdi Bagh Computers Private Limited (MBC), and Geneva, GVF partnered with the ITU in delivering a November 2018 symposium focused on capacity building for national regulators.

The Satellite Symposium, delivered at ITU headquarters, was supported by Hughes, SES, Eutelsat and QuadSAT – with content development and extensive training support resources delivery provided by MBC staff – and took place just before the ITU World Radiocommunication Seminar 2018 (WRS2018).

The objective of the Satellite Symposium programme was to build capacities with WRS2018 delegates, informing national regulatory authorities about the latest technology innovations in satellite communications, creating a greater level of understanding of the nature of the rapid mobilization of satellite-based communication links, and providing an understanding of methodologies and approaches to reducing and mitigating the causes of satellite interference. The symposium was well attended by large numbers and was simultaneously web-cast.

Following opening remarks made by Alexandre Vallet, Chief, Space Services

Department, Radiocommunication Bureau, and Jorge Ciccorossi, Senior Engineer, Space Services Department, Radiocommunication Bureau, GVF chaired the Symposium for the sessions of the first two-and-a-half-days. (See Figure 1.)

During the Symposium, WRS2018 delegates from all continents had the opportunity to advance their understanding of the latest satellite communications systems and service trends, as well as of regulatory, policy and spectrum coordination issues. The addition of the Symposium to the continuation of the WRS series – previously held in the Americas, European and Asian regions – facilitated the inclusion of a hands-on outdoor workshop where participants had the opportunity to gain experience in the installation and use of satellite terminal equipment and to perform antenna pointing accuracy measurements. Simon Gray of Eutelsat, supported by Riaz & Fehmida Lamak and Shafeeq Hamza, also of MBC, demonstrated the use of an installation application for the Eutelsat *Tooway* system, and delegates practiced the use of the correct



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cable-stripping and crimping tools to correctly prepare terminal connections, also accessing the Internet over the established satellite link. (See Figure 2.)

The final sessions of day three addressed the coexistence of small satellite constellations with other systems, related regulatory issues and new solutions on space monitoring.

The presenters/panellists and themes included (* Presentation slides available at www.itu.int/en/ITU-R/space/workshops/2018-SmallSat/Pages/Presentations.aspx):

- **Christine Leurquin** (VP, Institutional Relations & Communications, EMEA, SES)
"Emerging Technologies & Innovations"
- **Simon Gray** (SVP, Humanitarian Affairs, Eutelsat; member of the GVF Board of Directors)
"United Nations Crisis Connectivity Charter"
The "Eutelsat Quantum" high throughput satellite
- **Brennan Price** (Senior Principal Engineer, Regulatory Affairs, Hughes/EchoStar)
"Evolution & Future of Broadband Satellite Services"
- **Joakim Espeland** (CEO, QuadSAT)
Drone technology in satellite terminal testing & installations
- **Riaz Lamak** (GVF Liaison on International Training, Benchmarking, Validation & Product Quality)
GVF-MBC classroom-based training
- **Dr. E.P. Balasubramanian** (Former Deputy Director Indian Space Research Organization)
"Introduction to Satellite Communications"
"New Systems Technologies"
"Launch Vehicle Technology"
"Satellite Interference Reduction"

As well as the link to access speaker/panellists' presentations (as above), a video summarizing the event, and photographs of the proceedings, may be accessed as follows:

- YouTube video <https://www.youtube.com/watch?v=F19AX0-nAYQ>
- Photographs www.flickr.com/photos/itupictures/albums/72157704046110604

The ITU Satellite Symposium 2018 has been lauded a significant innovation and a great first-time success, thanks to the invaluable material and personnel resources

contributed by the members of GVF – Mahdi Bagh Computers Private Limited, Hughes, SES, Eutelsat and QuadSAT – and the collaborative facilitation and leadership of the ITU's Space Services Department.

Christine Leurquin's presentation gave a comprehensive overview of solutions addressing multiple government, mobility & fixed data markets; empowering the digital economy & digital equality; bridging the digital divide; digital mobility, security & safety; crisis connectivity; O3b mPOWER; space innovation; and, examined satellite "Sweet Spots" in the 5G ecosystem.

In his presentations Simon Gray explored the Crisis Connectivity Charter, its objectives, implementation, and signatories; continuing with an examination of satellite technology advances, the growth in high throughput satellite (HTS) capabilities and the quantum shift in HTS complexity, reliability, greater speed, and reduced costs; and, concluding that satellite is a wholly complementary facet of ICT networks.

Brennan Price covered satellite broadband networks and services; evolution of satellite broadband; and profiled Hughes' services in action in the fields of Always-On Connectivity for Public Protection & Disaster Relief, and Always-On Connectivity for Telehealth, together with an examination of spectrum issues related to satellite and the delivery of 5G.

Drone technology

From QuadSAT, Joakim Espeland provided an overview of the uses of drone technology in satellite terminal testing & installations. Approaches to the validation of this innovative technology are being developed with the assistance of GVF, applying the earlier work of the GVF Mutual Recognition Arrangement Working Group in having developed the protocols [GVF 101] 'Mutual Recognition of Performance Measurement Guidelines & Procedures for Satellite System Operator Type Approvals; and, [GVF 105] 'Performance & Test Guidelines for Type Approval of Comms-on-the-Move Mobile Satellite'.

Riaz Lamak profiled the work of Mahdi Bagh Computers Private Limited with particular reference to mentored training & advanced satellite system engineering classroom-based training associated with the GVF Training & Certification portfolio, network validation & benchmarking for GVF, and GVF humanitarian assistance & disaster recovery (HADR) programmes. Also profiled in detail

was the GVF training programme content and structure.

In his presentations Dr. E.P. Balasubramanian's took the audience through a highly detailed introduction to satellite communication and continued with a comprehensive analysis of the evolving architecture & applications market, new system technologies, technology trends in satellite systems, satellite & launch vehicles, the satcom value chain, regulatory considerations & interference reduction, and visions for satcom growth.

In 2019 CABSAT had its traditional March calendar slot, and once again the Dubai exhibition was complemented with an important GVF programme of key satellite industry themes which afforded a high-profile to participating speakers and supporting sponsor organizations.

The GVF Satellite Hub Summit @ CABSAT 2019 – the 5th event in the successful series and one of the most important regional platforms delivered by GVF for MENA & South Asia – was held over 12th to 14th March at Dubai International Convention & Exhibition Centre/Dubai World Trade Centre.

The previous four years of the event have been widely recognized as an essential value-added feature of the exhibition. The 2019 programme comprised two full days (12th & 13th March) of free-to-attend, presentation-based, and panel discussion-focused content, presented within a physical "Hub", an open-access theatre-style structure situated within the satellite exhibition halls. The format was augmented with an additional half-day Workshop session on the final day of CABSAT, 14th March.

Key Knowledge Partners for the Satellite Hub Summit included Euroconsult, Northern Sky Research (NSR), and SpaceWatch Global. Stéphane Chenard of Euroconsult, Torsten Kriening of SpaceWatch Global, Riaz Lamak of GVF, and Virgil Labrador of Satellite Markets & Research, will comprise the moderating team. Media Partners were *Satellite Markets & Research*, *Satellite Evolution EMEA*, *talk Satellite*, and *SatellitePro ME*.

The GVF Satellite Hub Summit is an established major focus for the discussion of satellite communication industry themes applicable to the Middle East, North Africa and South Asia regions, and serves to create a prominent platform for addressing and analysing evolutionary and revolutionary transitions in satellite technologies, services,

applications, and markets. The programme for the Dubai Hub Summit featured the following themes for discussion:

- **Global Satellite Focus... Big Ticket Issues on the Industry Forward**
Agenda: Regulation, Spectrum & WRC-19; The Interference Agenda – A Problem Gone Away?; Satellite & the Cloud/Network Virtualization, M2M, IoT, 5G; Cyber Security Developments & Initiatives; Disaster Response – Satcoms Innovations & Strategies; Sustainable Space Initiatives & Best Practices; Satellites & Space – Expanding Access, Emerging Technologies, Globalizing Aspirations.
- **Global Satellite Business is Big Business. New Space Making It Bigger:** UHTS/VHTS/HTS 2.0; HTS Evolving: The LEO & MEO Mega-Constellation Terrabit Factor; Smallsat Markets – Applications in Revolution; Accelerating Ground Segment Dynamics Antenna Evolution: Parabolas to FPA's; Satcoms & Earth Observation-Application & Market Interfaces; Resources from Orbit – Exploiting 'Bigger' Data, Data Analytics, Applications Innovation.
- **Mobility: 'Maritime Morning' – 'To the Wider Market and Service Horizon':** Maritime Mobility – Growth Steaming Ahead?; Maritime Market Plurality–Addressing Segment Differences; Key Facets of the User Experience; Bandwidth Inshore & on the High Seas; Satellite & Vessel Autonomy – Where? How? Why?; Satellite Cyber Security @ Sea; Radomes & Superstructure Footprints.
- **Mobility: 'Aero Afternoon' – It's Not Just About the IFEC!:** Understanding New Segment Evolving Demand Dynamics; Aero – Frequency Dedicated or Frequency Agnostic?; Never Mind the Orbit – It's all about the Price!; Hacking Aircraft Satcoms – Myth or Reality?; Always Online! Take-Up Rates by Captive Passengers or Demanding Customers?; How's the Hardware Doing?; Antennas – Conformal, or What?

The capacity building theme continued into the morning of the third day of CABSAT with a Workshop which explored Satcoms Insights & Capacity Building: Engineering, Applications & Training.



Figure 2 – ITU staff, GVF trainers & Symposium/Workshop delegates with Tooway satellite terminals



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Founded in 1976 by the 21 member-states of the Arab League, Arabsat has been serving the growing needs of the Arab world for over 40 years, operating from its headquarters in Riyadh-KSA and two satellite control stations in Riyadh and Tunis. Now one of the world's top satellite operators and by far the leading satellite services provider in the Arab world, it carries over 500 TV channels, 200 radio stations, pay-TV networks and wide variety of HD channels reaching tens of millions of homes in more than 80 countries across the Middle East, Africa and Europe—including an audience of over 170 million viewers in the Middle East and North Africa (MENA) region alone tuned into Arabsat's video "hotspot" at 26°E.

Operating a growing fleet of owned satellites at the 20°E, 26°E, 30.5°E, 39°E and 44.5°E, Arabsat is the only satellite operator in the MENA region offering the full spectrum of broadcast, telecommunications and broadband services. This capacity will continue to expand with the launching of new satellites, making Arabsat satellites' fleet the youngest in the region. Arabsat also maintains strategic partnerships with most of the world's leading satellite companies and VAS integrators. With the acquisition of Hellas Sat, one of the leading telecom groups in southeastern Europe, these partnerships and acquisitions continue to expand Arabsat's reach with new orbital slots and frequency rights. This allows customers to reach farther than ever and deliver content and state-of-the-art solutions to any end-viewers audience or business partner around the world.



Mobile Journalism - Credit: EHF Media



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Founded in 1977, Eutelsat Communications is one of the world's leading satellite operators. With a global fleet of satellites and associated ground infrastructure, Eutelsat enables clients across Video, Data, Government, Fixed and Mobile Broadband markets to communicate effectively to their customers, irrespective of their location. 7,000 television channels operated by leading media groups are broadcast by Eutelsat to one billion viewers equipped for DTH reception or connected to terrestrial networks. Headquartered in Paris, with offices and teleports around the globe, Eutelsat assembles 1,000 men and women from 46 countries who are dedicated to delivering the highest quality of service.

GENERAL DYNAMICS SATCOM Technologies

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General Dynamics SATCOM Technologies is a leading supplier of satellite communications products and services for video, voice and data worldwide. The company's wide range of products includes fixed, mobile, flyaway, VSAT and SATCOM-on-the-Move antennas and antenna systems; RF electronics including SSPAs and modular block converters; control systems and rack-mount transit cases. Additional products and capabilities include RF microwave components, such as filters and diplexers, and optical and radio telescopes. Many of the company's standard products are classified as "Ready-to-Go" ("RTG") and can ship to customers within thirty days of order acceptance to meet time-critical requirements.



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Hughes Network Systems, LLC (HUGHES) is the global leader in broadband satellite technology and services for home and office. Its flagship high-speed satellite Internet service is HughesNet®, the world's largest satellite network with over 1.3 million residential and business customers across the Americas. For large enterprises and governments, the company's HughesON® managed network services provide complete connectivity solutions employing an optimized mix of satellite and terrestrial technologies.

The JUPITER™ System is the world's most widely deployed High-Throughput Satellite (HTS) platform, operating on more than 20 satellites by leading service providers, delivering a wide range of broadband enterprise, mobility and cellular backhaul applications. To date, Hughes has shipped more than seven million terminals of all types to customers in over 100 countries, representing approximately 50 percent market share, and its technology is powering broadband services to aircraft around the world.

Headquartered outside Washington, D.C., in Germantown, Maryland, USA, Hughes operates sales and support offices worldwide, and is a wholly owned subsidiary of EchoStar Corporation (NASDAQ: SATS), a premier global provider of satellite operations.



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Inmarsat is the world leader in global, mobile satellite communications. It owns and operates the world's best global portfolio of satellite networks, specifically designed for customer mobility, and holds a multi-layered, global spectrum portfolio, covering L-band, Ka-band and S-band, enabling unparalleled breadth and diversity in the solutions it provides. Inmarsat's long established global distribution network includes not only the world's leading channel partners but also its own strong direct retail capabilities, enabling end-to-end customer service assurance. The company has an unrivalled track record of operating the world's most reliable global mobile satellite networks, sustaining business and mission critical safety & operational applications for almost 40 years. It is also a major driving force behind technological innovation in mobile satellite communications, sustaining its leadership through a substantial investment and a powerful network of technology and manufacturing partners. Inmarsat operates across a diversified portfolio of sectors with the financial resources to fund its business strategy and holds leading positions in the Maritime, Government and Aviation satcoms markets.



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Intelsat operates the world's first Globalized Network, powered by its leading satellite backbone, delivering high-quality, cost-effective video and broadband services anywhere in the world. Intelsat's Globalized Network combines the world's largest satellite backbone with terrestrial infrastructure, managed services and an open, interoperable architecture to enable customers to drive revenue and reach through a new generation of network services. Thousands of organizations serving billions of people worldwide rely on Intelsat to provide ubiquitous broadband connectivity, multi-format video broadcasting, secure satellite communications and seamless mobility services.



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Kacific is a next-generation broadband satellite operator. Working through local partners, its satellites deliver fast internet bandwidth empowering public services, businesses and consumers in urban areas, rural villages and remote communities in territories with highly dispersed pockets of population. Its first satellite, Kacific-1 brings affordable broadband in the archipelago countries of the Pacific and South East Asia.



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Contact: George Knizewski
Job Title: President

Knight Sky was founded in 2003 as a satellite services and wireless consultancy supporting DoD and Federal civilian agencies with subject matter expertise in the ever-evolving area of IP networking via satellite. Knight Sky has established a successful track record of serving high-value, critical mission customers such as the US Army (PEO EIS), Defense Information Systems Agency (DISA), the National Guard Bureau (NGB), the Federal Bureau of Investigation (FBI), the Federal Emergency Management Agency (FEMA) and the Department of Homeland Security (DHS).

Newtec

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Internet: www.newtec.eu
Contact: Thomas Van den Driessche
Job Title: Chief Executive Officer

Newtec specializes in designing, developing and manufacturing equipment and technologies for satellite communications. As a pioneer in the industry, Newtec is dedicated to creating new possibilities for the broadcast, consumer and enterprise VSAT, government and defence, cellular backhaul and trunking and mobility, offshore and maritime markets. Its products and technologies can be applied in a wide range of single and multiservice applications from DTH broadcasting, video contribution and distribution and disaster recovery and backbones for cellular backhauling, to small and medium enterprises, SCADA and oil and gas networks, aircrafts and vessels.

OneWeb

Name: ONEWEB
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Internet: www.oneweb.world
Contact: Adrian Steckel
Job Title: Chief Executive Officer

OneWeb's mission is to enable affordable Internet access for everyone, connect every school on Earth, and bridge the digital divide by 2027. OneWeb is building a communications network with a constellation of Low Earth Orbit satellites that will provide connectivity to billions of people around the world. With more than eight terabits per second of new capacity in its first constellation, it will transparently extend the networks of mobile operators and ISPs to serve new coverage areas, bringing voice and data access to consumers, businesses, schools, healthcare institutions and other end users.



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SES

your satellite company

Name: SES
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Email: Contact Form
Internet: www.ses.com
Contact: Steve Collar
Job Title: President and Chief Executive Officer

SES is a world-leading satellite operator and the first to deliver a differentiated and scalable GEO-MEO offering worldwide, with over 50 satellites in Geostationary Earth Orbit (GEO) and 16 in Medium Earth Orbit (MEO). SES focuses on value-added, end-to-end solutions in two key business units: SES Video and SES Networks. At SES, the company connects and enables broadcast, telecom, corporate and government customers, and enrich the lives of billions of people worldwide.

speedcast

Name: SPEEDCAST
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Contact: Pierre-Jean Baylier
Job Title: Chief Executive Officer

Speedcast is one of the world's most trusted providers of highly reliable, fully managed, end-to-end remote communication and IT solutions. The company utilizes an extensive worldwide footprint of local support, infrastructure and coverage to design, integrate, secure and optimize networks tailored to customer needs.

With differentiated technology, an intense customer focus and a strong safety culture, Speedcast serves more than 2,000 customers in over 140 countries via 39 teleports, including offshore rigs and cruise ships, 10,000+ maritime vessels and 4,500+ terrestrial sites. Speedcast supports mission-critical applications in industries such as maritime, oil and gas, enterprise, media, cruise and government. Learn more at www.speedcast.com.





Name: TELESAT
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Contact: Tom Eaton
Job Title: Vice President International Sales

Telesat is a leading global satellite operator, providing reliable and secure satellite-delivered communications solutions worldwide to broadcast, telecom, corporate and government customers. Headquartered in Ottawa, Canada, with offices and facilities around the world, the company's state-of-the-art fleet consists of 17 GEO satellites, the Canadian payload on ViaSat-1 and one Phase 1 LEO satellite which is the start of Telesat's planned global LEO satellite constellation that will offer low latency, high throughput broadband services. Telesat is also a leading technical consultant providing high value expertise and support to satellite operators, insurers and other industry participants on a global basis. Privately held, Telesat's principal shareholders are Canada's Public Sector Pension Investment Board and Loral Space & Communications Inc.



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Contact: Andreas Chrysostomou
Job Title: Chief Strategy Officer

Today, the Tototheo Group specializes in innovative, efficient and functional solutions in the fields of satellite and radio communication, automation, navigation systems and Ship repairs. Headquarters are in Cyprus with branch offices in Greece and Singapore.

The company supplies, services, integrates and installs high-quality sophisticated on-board electronic equipment. Its customers include merchant fleets, the offshore industry, the fishing industry and coastal as well as government. It also caters for the land communication users with mobile and fixed solutions via satellite and radio. Furthermore, learning from its customers and the market, it has invested in software and online applications development. It provides online tracking solutions and management tools, thus adding value to its services.

The Tototheo Group also provides consultancy services. A complete range of quality products from well-established manufacturers allows it to offer its customers tailor-made solutions, varying from supply and installation to engineering, project management, shore-based maintenance, traffic accounting



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Contact: Richard Baldrige
Job Title: Director, President and Chief Operating Officer

Viasat is the global communications company that believes everyone and everything in the world can be connected. For more than 30 years, Viasat has helped shape how consumers, businesses, governments and militaries around the world communicate.

Today, they are a global team of fearless innovators finding better ways to deliver connections with the capacity to change the world. The company is developing the ultimate global communications network to power high-quality, secure, affordable, fast connections to impact people's lives anywhere they are—on the ground, in the air or at sea.

Viasat is a growing, global company — more than 4,500 strong across 26 offices — all with a focus to bring really great service to all. It has a history of delivering results built on bold promises — to its customers, partners, and shareholders.



SES 15 launch



Name: VT iDIRECT
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Email: Contact Form
Internet: www.idirect.net
Contact: Kevin Steen
Job Title: President & Chief Executive Officer

VT iDirect® is a global leader in IP-based satellite communications. The company provides technology and solutions to enable service providers and satellite operator partners to optimize their networks, differentiate their services and profitably expand their business.

For more than 20 years, the VT iDirect organization has focused on meeting the economic and technology challenges across the satellite industry. Today, the product portfolio, branded under the name iDirect, sets new standards in performance and efficiency, making it possible to deliver voice, video and data connectivity anywhere in the world.

VT iDirect's parent company, Vision Technologies Systems, Inc. (VT Systems) and its subsidiaries are providers of engineering solutions, products and integrated systems and services.

VT Systems is a wholly-owned subsidiary of Singapore Technologies Engineering Ltd (ST Engineering). As part of the larger ST Engineering family, the combined synergies enable expansive technology capabilities, leadership across multiple vertical industries, and broad access to global resources for VT iDirect's network of more than 350 partners.

iDirect Government™ is a wholly owned subsidiary of VT iDirect, formed in 2007 to better serve the US Government and defence communities.

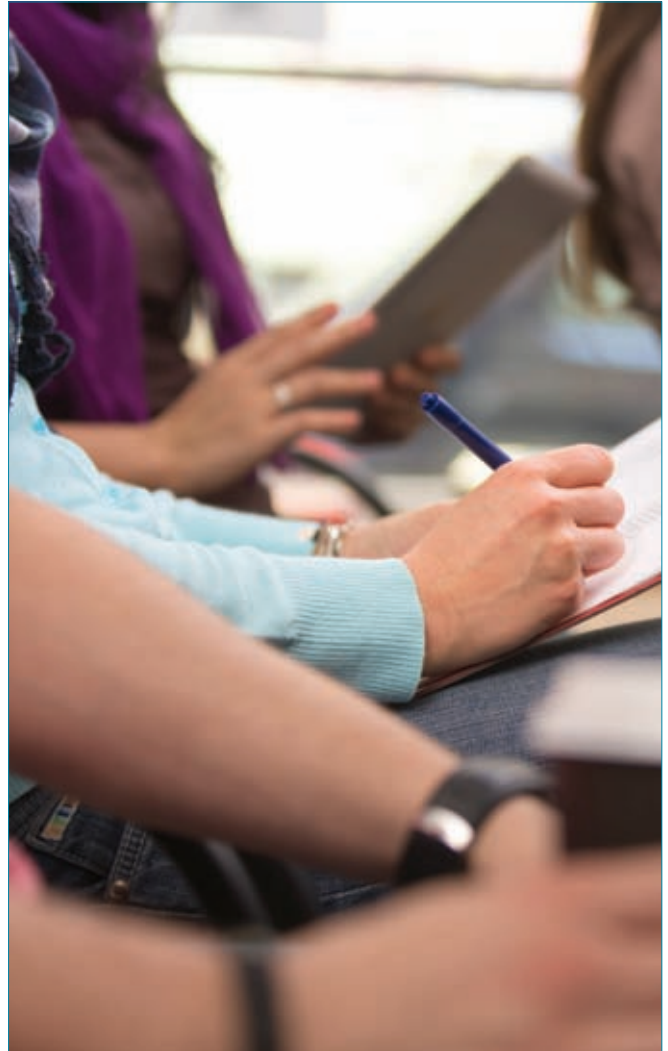


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Name: WILEY REIN LLP
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Contact: Jennifer D. Hindin
Job Title: Partner

Wiley Rein is a dominant presence in Washington, DC, with more than 240 attorneys and public policy advisors. Its firm has earned international prominence by representing clients in complex, high-stakes regulatory, litigation, and transactional matters. Many of the firm's attorneys have held high-level positions in the White House, on Capitol Hill, and in federal agencies including the US Department of Defense, the US Patent and Trademark Office, the Federal Communications Commission, the US Department of State, the US Department of Commerce, the Federal Election Commission, and the US Department of Justice. Many of its attorneys also have active high-level security clearances that allow them to quickly "read in" to matters when there is a need to access classified materials. The Legal Times has noted that the firm "represents as perfect a merging of public policy and corporate America as exists in Washington."

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Name: ABS
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Contact: Jim Frownfelter
Job Title: Chief Executive Officer

ABS delivers cutting-edge satellite services across the Americas, Africa, Asia-Pacific, Europe, the Middle East, Russia and CIS countries. Operating a fleet of six satellites, it serves 93 percent of the world.

ABS operates a fleet of satellites: ABS-2, ABS-2A, ABS-3A, ABS-4/Mobisat-1, ABS-6, and ABS-7.

Headquartered in Bermuda, ABS has offices in the United States, United Arab Emirates, South Africa and Asia. ABS is majority owned by funds managed by the European Private Equity firm Permira.

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Contact: Jenn Heinold
Job Title: Senior Vice President, Events

Access Intelligence is a leading worldwide information and marketing company that provides unparalleled business intelligence and integrated marketing solutions in nearly a dozen global market sectors, including aerospace and satellite. Access Intelligence publishes *Via Satellite* magazine and produces the annual SATELLITE Conference and Exhibition in Washington, DC.

With a customer-centric culture dedicated to editorial excellence and marketing integrity, Access Intelligence serves business professionals worldwide with a portfolio of products, including events, e-letters, data and digital products, e-learning magazines and e-media solutions.

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Contact: Gregory Francis
Job Title: Managing Director

Since 1999, Access Partnership has helped some of the world's leading ICT organisations gain access to new markets, drive sales, meet regulatory goals, shape policy outcomes and introduce new services into previously underserved markets. The company's expertise in the areas of government relations and regulatory affairs means it is able to provide clients with a range of solutions that create the commercial environment they need to flourish.



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Contact: Peter Milne
Job Title: Principal Consultant

Satellite communications, design and technology specialist, Aetheric Engineering is an independent telecommunications consultancy, established in 1989. Aetheric Engineering offers and is renowned for its flexibility and tailoring of support to the actual needs of each of its clients.

The company offers advice and support throughout all project phases from feasibility and design studies, through procurement and project management, to installation, commissioning and operation of telecommunications networks, especially satellite communication systems. Support is available for both civilian and military systems.

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Contact: Dr. Onur H. Karabey
Job Title: Chief Executive Officer

ALCAN Systems is developing a new class of innovative smart antennas—ultra thin flat panel technology, very low power usage, and able to adjust its beam electronically without any moving parts—at an extremely affordable price. The result is a high-performance, future-proof data connectivity solution for any location. With the groundbreaking method of using liquid crystal display assembly line for production, the ALCAN Systems flat panel antenna represents a technology breakthrough in satellite and cellular communications.

ALCAN smart antennas are designed to meet the needs of a range of markets including maritime, aero, land mobility, consumer broadband, and enterprise. ALCAN's systems are compatible with satellites in any orbital altitude (LEO, MEO and GEO) and can support Ka and Ku-band frequencies. The low profile, low power, low cost nature of the ALCAN antennas also makes them ideally suited for cellular backhaul, easily placed on top of cell towers for expanded 3G and 4G coverage, and ultimately 5G services as well.

Furthermore, ALCAN's antennas will provide critical Customer Premises Equipment (CPE) for 5G, as the mmWave signal from the cell-towers need to be transferred into buildings.



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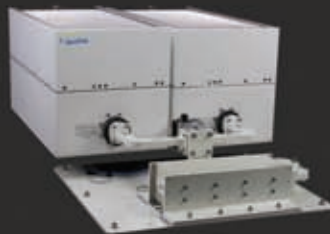
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Email: Contact Form
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Contact: Erwin Greilinger
Job Title: Product Line and Sales Manager for Satellite Monitoring Solutions

ATOS helps your satellites to perform at full capacity during their entire mission to ensure that your investment is always safe. No matter if you are a satellite manufacturer who needs to check all electrical systems to be sure they are fully functional before the satellite is launched, or if you are a satellite operator who has to avoid signal interferences at all costs – ATOS provides proven and reliable satellite testing and monitoring solutions that give you the peace of mind that you will be able to fulfill all your contractual obligations.

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Contact: Krystal Dredge
Job Title: Marketing Manager

AvL Technologies, Inc. is a privately held US company specializing in the design, development and production of mobile satellite antennas and positioner systems. With corporate headquarters based in Asheville, North Carolina, and a regional office located in the UK, AvL is able to offer superior service and support to customers around the world. AvL provides systems integrators with positioner and complete antenna system products, product development and services that maximize the technical and commercial benefits for their customers with cost, performance, quality and reliability requirements.

AvL provides solutions and support for satellite ground terminals for SNG, mobile broadband Internet access, Disaster Relief, Oil & Gas Data Backhaul, and Defense & Homeland Security customers throughout the world. AvL offers the world's largest range of satellite antennas for vehicle-mount, flyaway and fixed Earth station applications with sizes ranging from 60cm to 5.0 metres. Thanks to state-of-the-art manufacturing capabilities, cutting edge designs and development, AvL antennas are extraordinarily sturdy, efficient, and reliable. In addition, AvL is well known for providing adept customization to meet specific needs and requirements.



CPI TWTAs come with advanced graphical user interface

Name: BOEING
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Email: Contact Form
Internet: www.boeing.com

Boeing is the world's largest aerospace company and leading manufacturer of commercial jetliners and defense, space and security systems. A top US exporter, the company supports airlines, US and allied government customers in 150 countries. Boeing products and tailored services include commercial and military aircraft, satellites, weapons, electronic and defense systems, launch systems, advanced information and communication systems, and performance-based logistics and training.

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Internet: www.camporicogroup.com
Contact: Jose Luis Rodriguez
Job Title: Chief Executive Officer

Campo Rico Group (CRG) Communications is a satellite internet service provider with the capacity to provide timely cost-effective solutions for sustained communications before and after natural disasters in Puerto Rico and the US Virgin Islands. As a member of the Global VSAT Forum and the UN Global Emergency Telecommunications Cluster, CRG proposes the creation of a Caribbean Preparedness and Response Center or CPR, which aims to organize and manage local, customized, scalable consortiums of organizations with common interests and a strong willingness to collaborate in an emergency. Together, the members of these groups will take part in a coordinated satellite communications network as an innovative solution to efficiently prepare for, and recover from, natural and other disasters.

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Contact: Susan Bull
Job Title: Senior Consultant

As well as consultancy, Comsys offers multi-client reports which have earned a reputation as reliable, realistic and accurate. This is because Comsys undertakes its own primary research, visiting countries and companies in all regions of the world. It has also built market databases which have been compiled from this direct research over the past 19 years and these form the basis of the insight into events, trends and developments which the company is able to give to all of its clients.



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Name: CPI SATCOM & MEDICAL PRODUCTS DIVISION

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Contact: Doug Slaton

Job Title: Marketing Product Manager

The Satcom Products Group of CPI's Satcom & Medical Products Division (CPI SMP) is a worldwide leader in uplink amplifier products and systems for satellite communications. CPI has played a pivotal role in the satcom industry since its inception: the first satellite projects, including INTELSAT and CONUS, were supported by CPI, which was then part of Varian Associates, Inc. Today, CPI's scope and global reach is unmatched, having shipped over 50,000 high power amplifiers to uplink stations in over 150 countries. CPI satcom products for satellite uplink and troposcatter applications are available in all standard frequencies from S-band to V-band.

CPI SMP's Satcom Products Group is uniquely equipped to be your one-stop HPA sub-system supplier for standard and emerging satcom applications, whether for GaN-based solid state BUCs and SSPAs, traveling wave tube amplifiers (TWTAs) or klystron power amplifiers.

CPI's Satcom Products Group is also a global leader in the design and manufacture of uplink klystrons and advanced millimeter wave klystron technology, with frequency ranges up to 700GHz.



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CPI Antenna Systems Division (CPI ASD) is a manufacturer of high-performance antenna systems for SATCOM, telemetry, radar, electronic warfare and high-frequency (HF) applications. CPI ASD represents a merger of CPI ASC Signal Division, with a 50-year heritage of engineering creativity; CPI Malibu Division, a leader in antenna design and development since 1975; and Orbital Systems, a world leader in positioners and feeds used for Earth Observation, Direct Broadcast reception, and TT&C ground stations. As a result of a recent purchase of the limited-motion GEO antenna family from Viasat, CPI ASD now offers SATCOM antennas from 1.0m to 18m in diameter.

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Contact: Thoralf Dietz

Job Title: Head of Corporate Communications

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Under its roof, 72 institutes and research institutes work at locations throughout Germany. 25,000 employees generate the annual research volume of more than 2.3 billion euros.

The Fraunhofer Institute for Integrated Circuits IIS in Erlangen is a leading global application-oriented research institution for microelectronic and information technology system solutions and services. It is today the largest institute of the Fraunhofer-Gesellschaft.

Name: GILAT SATELLITE NETWORKS

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Contact: Doreet Oren

Job Title: Director Product Marketing

Gilat Satellite Networks Ltd is a leading global provider of satellite-based broadband communications. With over 30 years of experience, it designs and manufactures cutting-edge ground segment equipment, and provides comprehensive solutions and end-to-end services, powered by its innovative technology. Delivering high value competitive solutions, the company's portfolio comprises a cloud based VSAT network platform, high-speed modems, high performance on-the-move antennas and high efficiency, high power Solid State Amplifiers (SSPA) and Block Upconverters (BUC).

Gilat's comprehensive solutions support multiple applications with a full portfolio of products to address key applications including broadband access, cellular backhaul, enterprise, in-flight connectivity, maritime, trains, defence and public safety, all while meeting the most stringent service level requirements.

Name: GLOBAL IP

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Internet: www.goglobalip.com

Contact: Nagib Chahine

Job Title: CTO and Acting SVP Sales and Marketing

Global IP was established with the aim of building a state-of-the-art IP network, based on its first high capacity satellite, GiSAT-1, dedicated to the Sub-Saharan region.

Enabling affordable broadband access – a key driver to economic growth – to over 800 million people in 39 countries in the region, its network is built around the 150 Gbps Ka satellite, which is larger than all other Ka satellites located over Africa, combined.

It believes in being agile and flexible, and is committed to always being a step ahead of changes in the market, able to invent services, solutions and business models that best meet customers' needs. In order to fulfill this commitment, it has undertaken the ambitious task of building its own satellite, which is being constructed by Boeing, in accordance with its specifications and the needs of the market. GiSAT-1 which is scheduled for launch early 2019 has a new digital payload, and offers twice the capacity as previous digital payload designs.

Made up of a team of highly-regarded satellite industry executives, Global IP professionals share vast experience, a



love of Africa and an intrinsic understanding that the region is on the verge of a paradigm shift.

Together with a multinational team of executives and experts, the company want to drive transformation, growth and advancement, and bridge the digital divide providing superior connectivity and greater internet capacity, across broader geographical areas, at affordable prices.

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Job Title: SVP, Sales Engineering and Marketing

Globecomm is a leading engineering-driven, global connectivity provider serving media, maritime, enterprise and government markets in over 100 countries.

It develops smart connectivity solutions to address customer issues across a broad spectrum of areas, including system design and integration, managed communication services including mobile and IoT, media services and mission critical networks. Globecomm is known for its unique ability to provide robust connectivity to the most remote locations under the most treacherous conditions. Globecomm is dedicated to improving communications and leverages its world class, global network to offer end-to-end, managed service communication's solutions worldwide.

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Contact: Chris DeMay
Job Title: Chief Technology Officer & Founder

HawkEye 360 is developing a constellation of formation-flying micro-satellites in Low Earth Orbit (LEO) to execute a unique radio frequency (RF) spectrum monitoring and geolocation capability. The company's analytics engine generates reports on signals that can be used to track and monitor global transportation networks, detect distress alerts, assist with emergencies and much more.

By implementing this exciting new concept, HawkEye 360 will provide highly accurate maritime domain awareness, establish a spectrum inventory, and develop insight into how signals are being used globally. HawkEye 360 will be uniquely postured to provide space-based geolocation data that can help prevent and mitigate SATCOM interference.

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Contact: Carlos Espinos Gomez
Job Title: Chief Executive Officer

HISPASAT is the Spanish satellite communications operator, a leader in the distribution of content in Spanish and Portuguese. With more than 25 years of experience, the HISPASAT Group maintains an important presence on the Iberian Peninsula and in Latin America, where it is now the fourth satellite operator. HISPASAT has solidly positioned itself in high growth markets and has a stable strategic client base. HISPASAT distributes more than 1,250 television and radio channels through its powerful fleet of satellites and is a key driver for the Spanish aerospace industry.

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Job Title: Commercial Director

INSTER was created in 1985. It is a company with 100 percent Spanish capital. INSTER develops its activity in the sectors of Telecommunications (Critical Mission Systems), Satellite Communications, Defense (Control, Communications and Systems Integrations), Maritime and Port, Security, Civil Protection and Engineering & R&D.



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Contact: Carlos Alvarez
Job Title: Marketing Manager

Integrasys is a privately owned company specializing in engineering and manufacturing Satellite Spectrum Monitoring Systems in the telecommunication and broadcasting markets. Integrasys was founded in 1990 by a group of Hewlett-Packard engineers - experts on Automated RF & Microwaves Test Systems and Software. Since then Integrasys has evolved towards today's company, offering a wide range of signal monitoring products for different telecom services.

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Contact: Rachel Lee
Job Title: Global Marketing Manager

Intellian is the world's leading provider of satellite communications and smart systems for the maritime, industrial, and military sectors. Founded in 2004, Intellian is leading the way in driving innovation in the satellite communications market. Governments and global players choose Intellian's stabilized satellite antenna systems to deliver connectivity when it matters most. Intellian operates in 10 offices worldwide, including global logistics centers in Asia, the Americas, and Europe, and is supported by a network of more than 450 partners across the globe. Intellian Technologies Inc. is listed on the Korean Stock Exchange, KOSDAQ (189300:KS).

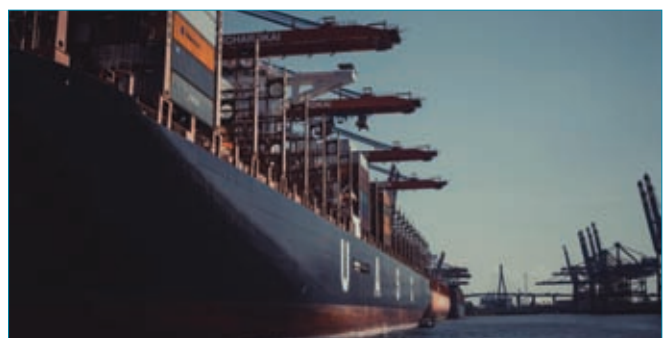
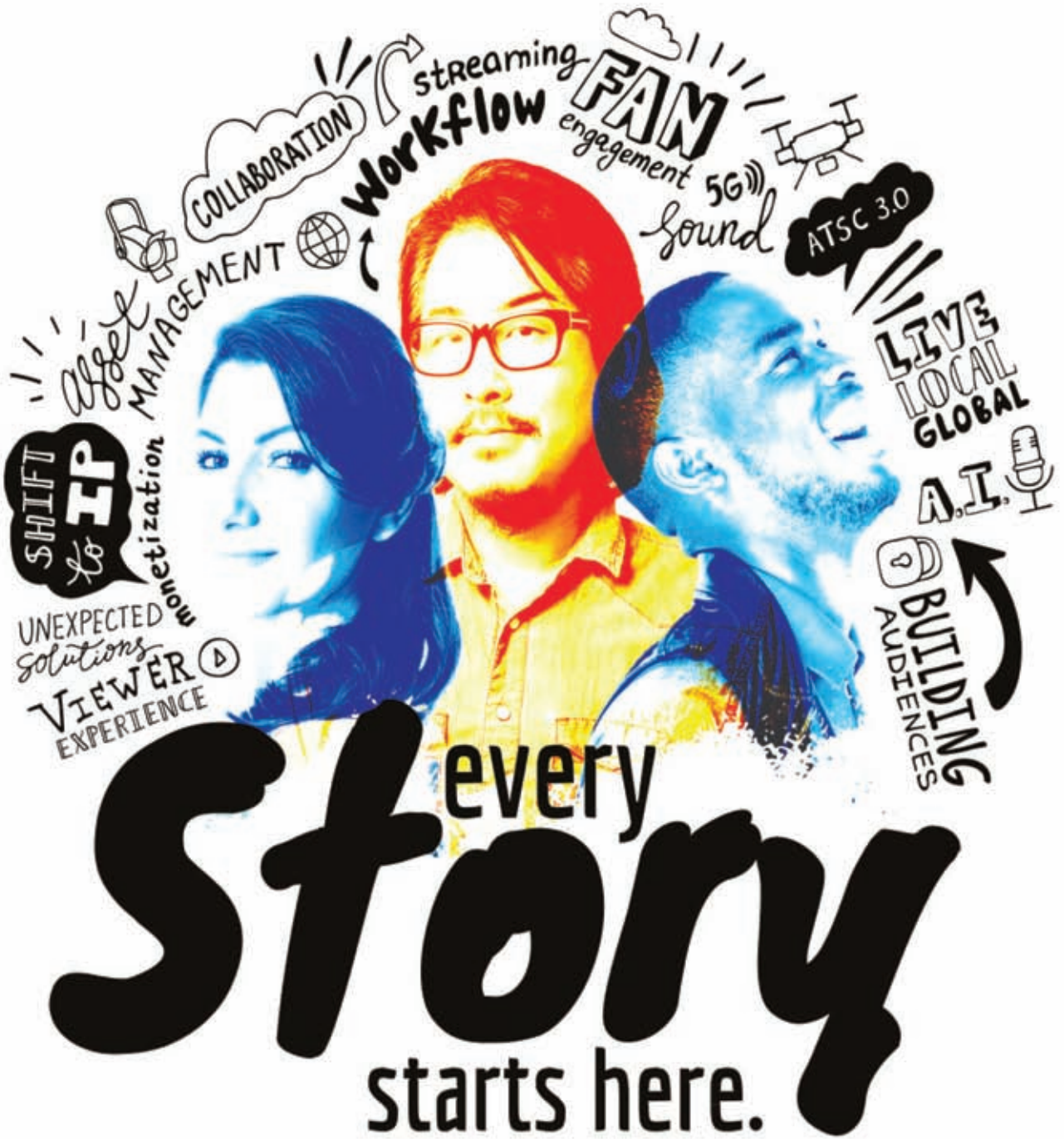


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Name: **INTERSPUTNIK**
International Organization of Space Communications

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Internet: www.intersputnik.com
Contact: Vadim Belov
Job Title: Director General

The Intersputnik International Organization of Space Communications (Intersputnik, Organization) was established under the intergovernmental Agreement of November 15, 1971 on the Establishment of the Intersputnik International System and Organization of Space Communications (Intersputnik Agreement). It is an international organization headquartered in Moscow.

Today, the Organization's 27 member states represent virtually all geographic regions from Central America to South-East Asia and from Europe to Africa.

Intersputnik's core business is satellite capacity leasing to telecommunications companies, broadcasters and corporate customers under contracts with satellite system operators. Through its subsidiary Isatel, the Organization offers full-scale services including installation and operation of satellite telecommunications networks.

Intersputnik's main distinction and decisive advantage lies in the fact that it is an all-purpose supplier of satellite capacity and technological solutions helping customers to choose from a broad variety of different systems present in the global market and get all information they need from a single source.

Unrivalled experience of successful operation of satellite systems is Intersputnik's principal asset and the availability of the Organization's own spectrum and orbit resource its recipe for success. Using this resource Intersputnik implements full-scale projects deploying satellites in its own positions to cover the fastest growing regions with swelling demand for satellite services.

Name: **ISOTROPIC NETWORKS**

Address: W2835 Krueger Rd, Lake Geneva, WI 53147, USA.

Tel: +1 262 248 9600
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Email: Contact Form
Internet: www.isosat.net
Contact: Hank Zbierski
Job Title: Founder and Chief Executive Officer

IsoTropic Networks is a global, solutions based provider of Satellite Internet Services. IsoTropic owns and operates its Teleport facilities and is widely recognized as a premier iDirect Host Network Operator, (HNO).

Its engineering team can integrate satellite, fibre and copper in a seamless fashion to provide reliable, robust communications solutions anywhere on the planet, anytime you need them.

Headquartered in Lake Geneva, Wisconsin, IsoTropic Networks facilities are secure, redundant and robust. Staffed 24/7 by IsoTropic personnel you can be assured of only the finest satellite service available.

Name: **ITC GLOBAL**

Address: 3430 S. Sam Houston Parkway E, Suite #500, Houston, TX 77047, USA.

Tel: +1 727 898 3835
Email: Marketing@itcglobal.com
Internet: www.itcglobal.com
Contact: Ian Dawkins
Job Title: Chief Executive Officer

Part of the Panasonic family, ITC Global was founded in 2001 to bring carrier-grade telecommunications and networking technologies to developing markets and remote and harsh locations.

The company's vision and mission are simple. Build the world's best satellite communications provider by offering the best technical solutions, backed by the best customer service in the industry.

It specializes in satellite-based communications for industrial operations in extreme environments, including deep-water energy exploration, remote mining and transoceanic shipping. Today ITC Global is the number one provider of satellite communications networks to the mining industry and among the top three providers to the oil and gas industry.

Name: **JONSA TECHNOLOGIES**

Address: No. 206 Cheng Kung 3 Rd, Nan Kang Industrial Park, Nantou City, Taiwan.

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Contact: Sales Specialist
Job Title: Tim Chien

JONSA is a leading global provider of stabilized satellite antenna products. Built upon its patented RF, design structural oriented, stabilization and upstream and downstream process integrations of manufacturing, the company's products support a wide range of industries, including commercial, offshore/oceanic environment, defence, disaster, rescue area & weather data analysis and so on. Its comprehensive range of antenna systems includes satellite TV, VSAT, WISP, and mast mounting bracket solutions.

Name: **KRATOS TTS**

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The Kratos Technology & Training Solutions Division specializes in information technology, satellite communications and training to help customers achieve consistently higher levels of performance. Kratos is also a lifecycle training solutions developer, specializing in assuring the readiness, reliability and operational effectiveness of Warfighter and C5ISR systems. It helps organizations and teams optimize performance by improving training outcomes while reducing training time and costs. Kratos develops and delivers the optimal blend of media, from computer-based training to full-fidelity training devices, employing advanced workforce competency and instructional design capabilities to help organizations meet and exceed mission performance goals.

Name: **KYMETA**

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Contact: Marc Stolzman
Job Title: Chief Financial Officer and President

Kymeta is making seamless, always-connected mobile

GVF: Satellite...Solutions...The World
www.gvf.org

communications possible across satellite and cellular networks to deliver a single, global, mobile network. End-to-end mobile communications are delivered with Kymeta KALO™ connectivity services, and the only commercially-available, electronically-steered, flat-panel satellite terminal that goes places traditional satellite antennas cannot. Backed by US and international patents and licenses, the Kymeta KyWay™ satellite terminal makes high-throughput, mobile communications possible in cars, trains, buses, trucks, boats, and much more.

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Contact: Arya Damar
Job Title: President Director

Founded in 1988, Lintasarta is one of the most comprehensive and advanced information and communication technology service providers in Indonesia, connecting businesses throughout the length and breadth of the archipelago, bringing data communication, business information services and Internet even to remote areas.

Name: LIQUID TELECOMMUNICATIONS LTD
Address: 5th Floor, Ebene Mews, 57 Cybercity, Ebene, Mauritius.
Tel: +230 466 7620
Email: Contact Form
Internet: www.liquidtelecom.com
Contact: Nic Rudnick
Job Title: Chief Executive Officer

Liquid Telecom is the leading independent data, voice and IP provider in eastern, central and southern Africa. It supplies fibre optic, satellite and international carrier services to Africa's largest mobile network operators, ISPs and businesses of all sizes. It also provides payment solutions to financial institutions and retailers, as well as award winning data storage and communication solutions to businesses across Africa and beyond.

Name: LOCKHEED MARTIN
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Contact: Jennifer Warren
Job Title: Vice President, Technology Policy & Regulation

Lockheed Martin is a global security and aerospace company that employs approximately 100,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services.

Name: MARLINK
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Marlink is the pioneer of business critical communication solutions for customers operating in remote environments. The company is the largest technology-independent satellite communication and digital solutions provider serving the maritime and enterprise markets.

Marlink's multi-band communication services covering Ku, Ka, C and L-band extended with mobile and terrestrial links, enable over 200,000 customers to operate in an ever smarter, safer and more profitable way.

With over 75 years' experience in developing innovative business critical communication solutions, Marlink's legacy is to deliver the benefits of a digital and connected world to its customers' remote operations.

Today Marlink is the leading maritime communication and maritime VSAT operator in the world. It's leveraging strong partnerships with all major satellite network operators in the industry and delivering its communication solutions direct to the customer and via an unrivalled network of service provider partners.

Name: MEASAT
Address: MEASAT Teleport and Broadcast Centre, Jalan Teknokrat 1/2, 63000 Cyberjaya, Malaysia.
Tel: +60 (3) 8213 2188
Fax: +60 (3) 8213 2233
Email: sales@measat.com
Internet: www.measat.com
Contact: Yau Chyong Lim
Job Title: Chief Operating Officer

Since 1996, MEASAT has been providing premium satellite solutions to customers across the Asia-Pacific region, and now has a reach that covers over 150 countries across Asia, Africa, Europe, Middle East and Australia, representing 80 percent of the world's population.

The MEASAT satellite fleet includes the state-of-the-art MEASAT-3, MEASAT-3a and MEASAT-3b satellites co-located at 91.5°E, supporting Asia's premium DTH and video distribution neighbourhood; MEASAT-5 at 119.5°E serving the broadband needs in Malaysia; and, AFRICASAT-1a at 46.0°E.

The MEASAT fleet supports leading DTH platforms in Malaysia, Brunei, India and Indonesia, providing DTH multi-channel television services to over 20 million subscribers. The fleet is also used by many leading international channel operators to distribute television programming to pay television platforms, and by telecommunications operators to support remote connectivity, cellular backhaul, IP trunking and corporate VSAT networks.

Name: MEDIA BROADCAST SATELLITE GMBH
Address: Erdfunkstelle 1, 61250 Usingen, Germany.
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Email: info@mb-satellite.com
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Contact: Andreas Rohde
Job Title: Head of Marketing

Media Broadcast Satellite, operator of one of the world's largest teleports, has successfully been implementing and operating communication solutions for globally active customers since the 1970s.

Through its own teleport in Usingen near Frankfurt, Media Broadcast Satellite offers tailor-made solutions for the areas of broadcast, data, teleport and data centres. Satellites between 76° East and 60° West can be reached through more than 135 antennas in the Ku, Ka and C-band. To ensure a maximum of security and stability of its solutions, Media Broadcast Satellite operates a NOC manned 24 hours per day on 365 days of the year and a fully redundant RF, IT and power supply infrastructure.

The high-quality standard of the services "Made in Usingen/Germany" is underlined by relevant ISO certifications as well as by its own engineering team supporting the customers in all stages of transmission, distribution and service management. Media Broadcast Satellite's range of services includes both, standard communication services and complete managed service solutions for DTH platforms (SD/HD), data networks and teleport co-location/gateways.

Name: METHERA GLOBAL COMMUNICATIONS
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Internet: www.metheraglobal.com
Contact: James Taylor
Job Title: Director - Business & Market Development

METHERA GLOBAL COMMUNICATIONS (Methera) is a new-start UK communications technology company aiming to enable the delivery of digital services and applications to rural and underserved communities. Central to its vision is the implementation of a Medium Earth Orbit (MEO) Ka-band satellite constellation that is optimised to deliver highly cost-competitive superfast and ultrafast, resilient, broadband and data services to targeted nations around the world. This, together with the development of optimised applications tailored for underserved communities, will revolutionise and expedite the adoption of digital services worldwide. Methera leads a strong UK consortium, covering all of the key capabilities required for system design, development, implementation and operation. UK Government grants, Seed, Founder and Director investments are funding the execution of a fast-moving development programme that will lead to the launch of the initial satellite constellation in 2021.

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Job Title: Vice President Sales & Marketing

Mission Microwave Technologies, Inc., was founded in 2014 to create the next generation of Solid-State Power Amplifiers (SSPAs) and Block Upconverters (BUCs). It utilizes advanced GaN transistors, unique power combining technology, and novel full-system designs to create the industry's most efficient, lightweight, and compact high-power SSPA's. Its management team has more than 100 years of combined experience supplying high-performance, high-reliability SSPA's to commercial, military, and space customers.

ND SATCOM

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Contact: Michael Weixler
Job Title: Director Product Management and Marketing

With over three decades of experience, ND SatCom is the premier supplier of and integrator for innovative satellite communication equipment systems and solutions to support customers with critical operations anywhere in the world. Customers in more than 130 countries have chosen ND SatCom as a trusted and reliable source of high-quality and secure turnkey and custom system-engineered communication solutions. The company's products and solutions are used in more than 200 transnational networks in government, military, telecom and broadcast environments.

ND SatCom's flagship product, the SKYWAN platform, enables international users to communicate securely, effectively and quickly over satellite.

Name: OASIS NETWORKS
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Contact: Nimrod Kapon
Job Title: Director

Oasis Networks was established in 2004 to provide high quality field engineering, satellite systems integration and maintenance services.

In this time, it has worked in over 100 countries and successfully completed more than 1,000 projects for clients across a wide range of industry sectors.

Its work is carried out to the highest industry standards and is ISO 9001:2008 certified to assure clients of management quality. In addition, it specialises in the delivery of a fast and flexible service made possible by over 150 trusted, highly trained and security cleared local field engineers ready for deployment. The ability to combine advanced technical and industrial know-how with the realities of installing complex systems, in remote regions without infrastructure, ensures competitive advantage whether servicing clients from small ISP's to multinational corporations who operate in emerging markets.

It has a truly international presence and has completed projects across Africa, the Americas and Asia and it takes pride in offering a range of tailored client service solutions.

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Job Title: Managing Director, Wholesale and Satellite

Optus is an Australian leader in integrated telecommunications, delivering cutting-edge communications, information technology and entertainment services. In 2001 Singtel became the parent company of Optus, paving the way to become a strong and strategic telecommunications player within the Asia-Pacific region.

With more than 130 years of operating experience the Singtel Group is Asia's leading communications group providing a wide spectrum of multimedia and infocomms technology (ICT) solutions, including voice, data and video services over fixed and wireless platforms.



Photo courtesy of ND SatCom

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Contact: Eric Shin
Job Title: Vice President, Sales and Marketing

ProBrand is the world leading designer and manufacturer of advanced RF (microwave) electronics and antenna systems. Founded in 1983 with its US headquarters in Marietta, Georgia, it serves some of the largest telecommunications and satellite operators in the world.

Specializing in high-volume ODU & IDU terminals and CPE's, it links devices, homes, and people to the wireless and satellite signals blanketing Earth.

In short, ProBrand links the world.

Name: QUADSAT
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Email: info@quadsat.com
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Contact: Joakim Espeland
Job Title: Chief Executive Officer

Founded in March 2017 and having recently set up an office in Harwell, UK, QuadSAT is a Danish company that has developed brand new tools and techniques for testing and calibrating satellite antennas being deployed in high-value maritime and aeronautical markets.

Combining the latest drone technology with a simulated satellite payload and mathematical algorithms, QuadSAT simplifies the requirements for satellite antenna testing, qualification and calibration.

In addition, use of QuadSAT's products reduce vessel and aircraft downtime for such testing procedures, significantly reducing operational expenses.

As well as satellite antenna qualification and calibration, QuadSAT can also be used to identify interference to satellite transmissions with pinpoint accuracy, which is vital to minimize inadvertent or other rogue interference. QuadSAT's customers include some of the world's leading satellite operators, satellite antenna manufacturers, VSAT network operators' maintenance teams and antenna testing facilities.



Photo courtesy of Pexels

Name: RCS COMMUNICATIONS
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RCS is a professional ICT (Information Communication Technologies) company for businesses and organisations looking for a service provider that understands the terrain, accepts responsibility for performance and ensures future-relevance for clients in a fast-changing world. It offers a wide range of Internet connectivity, networking, radio, energy saving and mobile satellite solutions in partnership with selected suppliers and service partners.

RCS combines in-country experience across East and Central Africa, offering international best practises and a proven track record for delivering projects in challenging environments to specification and within agreed timeframes.

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Contact: Dr. Omid Sotoudeh
Job Title: Founder and Chief Executive Officer

ReQuTech specializes in development of tailored antenna systems. It works with customers to find the optimal solution to satisfy their requirements. Its goal is to find the most suitable solution for each project based on required volumes as well as budget and time to market constraints.

ReQuTech conducts design, prototyping, test and production of the products to satisfy each project requirements. ReQuTech takes responsibility for the entire product development chain from design to manufacturing and in so doing making sure to reduce risks and over all time and budget for its customers.

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Contact: Caroline De Vos
Job Title: Founder & Chief Operations Officer

Founded in 2010, SatADSL develops creative solutions to provide Internet access to communities and enterprises in Sub-Saharan Africa. It offers tailor-made service plans, hardware and value-added services to provide reliable and affordable high-quality IP access. Its founders have combined their in-depth technical knowledge about space telecommunication technologies and extensive field experience to offer their expertise and develop cutting edge, turnkey solutions that can be utilized across Africa in any sector. It has built strong connections with industry leaders such as Newtec and the European Space Agency that places SatADSL in prime position to offer professional, affordable and dependable Internet access that can play a pivotal role in supporting social and economic growth.

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Contact: Rami Osman
Job Title: Work Director and Account Manager

Saudi Net Link Company was established in the Kingdom of Saudi Arabia in 1995. One of region's leading telecommunications companies, it has offices in Jeddah, Riyadh and Al-Khobar. Saudi Net Link Company is a specialist communication company that over the past few years has expanded its operation to encompass a wide range of services. SNL customers are large and small business organizations with complex networking requirements typically spanning multiple locations and categories of communications systems. Enterprise customers range from large multinational corporations, government agencies, utilities, energy companies and educational institutions to small and medium-sized businesses with multiple locations. SNL owns five HUB gateways operating inside and outside the Kingdom of Saudi Arabia serving more than 2,000 remotes terminals in MENA and European countries.

Name: SIMBA ENTERPRISES
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Contact: Sissy Johnson
Job Title: Operations Manager

Founded in 2005 by President and CEO Mr. Ali Sajjad, Simba Enterprises, LLC is a certified SDB, HubZone company headquartered just 40 miles outside of Washington, D.C in Leesburg, Virginia. Simba Enterprises is a small business providing advanced performance in the delivery of professional services, strategic telecommunications, and information management solutions. It has outstanding references from military and commercial clients that consistently report on its stellar support services around its core strength in commercial satellite telecommunications and information technology support services now demonstrated at more than 45 Forward Operating Bases in Afghanistan. Simba Enterprise's qualified personnel, most of whom have advanced engineering degrees, specialize in VSAT

deployments, voice over IP, OMT and RF Integrations, IP Networking and information technology implementations. The Simba Enterprises team has deployed turnkey telecommunications solutions globally and provides a full range of program management and professional support services. Its capabilities include system design, engineering, test and evaluation, supply chain logistics, and technology life cycle management.

At Simba Enterprises, its mission is to provide advanced performance and quality solutions that enable customers to consistently achieve their strategic objectives.

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Contact: Donald Jacobs
Job Title: President & Chief Executive Officer

Skycasters brings affordable broadband satellite internet access, satellite VPN equipment, mobile satellite internet, and corporate data services to all types of organizations, including rural and underserved business locations. Its system is an excellent choice for multi-user business customers located in remote areas where conventional broadband data service is not available or cost-effective. With satellite internet access, it doesn't matter how far the customer is from the telephone company's central office. Wherever you are throughout North and Central America, Skycasters delivers true broadband speed.

Name: SKY PERFECT JSAT CORPORATION
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Contact: Shinji Takada
Job Title: Representative Director, President

SKY Perfect JSAT Corporation is the only provider of multichannel pay TV broadcasting and satellite communications in Japan, and the largest in Asia and Oceania.

SKY Perfect JSAT maximizes the strengths available from a hybrid business, operating both a stable space & satellite business and a proven, high-growth multi-channel pay TV business under one roof.

At the same time the company is building better services and a greater capacity to compete through efficient and agile business management policies.

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Embratel Star One, a wholly-owned subsidiary from Claro, is the largest satellite company of Brazil and Latin America and operates five GEO satellites (Star One C1, C2, C3, C4, C12 and D1), and three in inclined orbit (Brasilsat B2, B3 and B4). Firstly designated as Star one, the company was created in December of 2000.

Then, it was renamed to Embratel Star One in 2014. To meet new infrastructure demands in Brazil, along with the requirements of major sporting events, such as the Olympics, the company launched two new satellites: Star One C4, in July 2015 and Star One D1, in December 2016.

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Contact: Marcus Thomas
Job Title: Chief Technology Officer

Subsentio is a trusted third party service bureau that helps telecommunications carriers and Internet providers meet their law enforcement assistance obligations. The company provides its clients with the technical solutions needed to comply with their lawful electronic surveillance requirements. Subsentio will review and validate court surveillance orders, implement the lawful surveillance, and provide similar support in response to other legal demands such as subpoenas and court orders for records held by the service provider.

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Contact: Thomas Lindell
Job Title: Sales & Marketing Director

Swedish Microwave (SMW) is a leading manufacturer of professional Low Noise Blockdownconverters (LNB) for the satellite market.

The products are used in VSAT systems (Very Small Aperture Terminals), SNGs (Satellite News Gathering), cable-TV headends, marine VSAT, and satcom on-the-move applications.

All work is in-house allowing custom-design products, short delivery times, high flexibility, quick service and support.

Swedish Microwave designs and manufactures its products in Motala, Sweden, and has shipped to more than 120 countries.

Since Swedish Microwave (SMW) started in 1986 the business has seen many companies come and go. Today it is one of Europe's oldest manufacturers of Low Noise Block converters (LNB), serving a global market.

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Contact: Alan Afrasiab
Job Title: CEO and Founder

Talia is a top-tier provider of Internet, voice, and video services, recognised as a market leader throughout the Middle East, Africa, and Europe. Experts in satellite, voice, video, and broadcast communications, Talia provides global network coverage, enabling enterprises, PTTs, mobile carriers, and broadcasters to connect to the largest global meet me room, and linking the major regional telecoms hubs around the world.

With headquarters in the UK, Talia operates its own Teleport facility in Germany, and has support and sales offices in the US, UAE, Nigeria, South Sudan, Uganda and Iraq, making Talia ideally positioned to meet the demands of today's global market.

Talia provides solutions for enterprises, media companies, NGOs, and government agencies.

Name: TELEFONICA INTERNATIONAL WHOLESALE SERVICES
Address: Ronda de la comunicación s/n, Edificio Central - 2ª planta; 28050-Madrid, Spain.
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Email: Contact Form
Internet: www.wholesale.telefonica.com/en/
 Telefonica Business Solutions, a leading provider of a wide range of integrated communication solutions for the B2B market, manages globally the Enterprise (Large Enterprise and SME), MNC (Multinational Corporations), Wholesale (fixed and mobile carriers, ISPs and content providers) and Roaming businesses within the Telefonica Group. Business Solutions develops an integrated, innovative and competitive portfolio for the B2B segment including digital solutions (Cloud, IoT, Security) and telecommunication services (voice, data, mobile, unified and global solutions). Telefonica Business Solutions is a multicultural organization, working in over 40 countries and with service reach in over 170 countries.



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Contact: Kjell Aksberg
Job Title: Director of Operations

Telenor Satellite is a major EMEA satellite provider of broadcast and data communication services for customers in the broadcast, maritime, and oil and gas markets. Utilising a hybrid network that comprises of its 1° West satellite fleet, teleports and a terrestrial fibre network, it provides reliable communications in remote locations on land and at sea – committed to keeping its customers connected via satellite. Telenor Satellite is headquartered at Telenor Group offices in Fornebu, just outside Oslo. The company is 100 percent owned by Telenor Broadcast Holding AS, a wholly owned holding company of Telenor Group, one of the world's major mobile operators.



Photo courtesy of Shutterstock

Satellite...Solutions...The World

Name: TELSTRA
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Internet: www.telstra.com.au
Contact: Sandeep Kumar
Job Title: Head of Global Satellite Sales

Telstra is Australia's leading telecommunications and technology company, offering a full range of communications services and competing in all telecommunications markets.

In Australia it provides 17.7 million retail mobile services, 4.9 million retail fixed voice services and 3.6 million retail fixed broadband services.

The company believes the more connected people are, the more opportunities they have. That's why it helps create a brilliant connected future for everyone, everyday.

That's why it builds technology and content solutions that are simple and easy to use, including Australia's largest and fastest national mobile network.

The company strives to serve and know its customers better than anyone else – offering a choice of not just digital connection, but digital content as well.

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Contact: Christian Bergan
Job Title: VP, Sales & Marketing

TSAT's satellite communications solutions enable management of mission critical infrastructure in harsh and hard to reach remote locations. Private networking, ruggedized hardware and low operational cost makes TSAT the preferred solution, even for small networks. For more than two decades, TSAT customers across the globe have relied on their TSAT networks to provide maximum uptime and peace of mind.

TSAT is the only private (dedicated) satellite networking solution on the market with a miniature VSAT HUB. The solution is specifically designed to deal with mission critical applications such as SCADA and M2M in the energy and utility markets. The ruggedized and utility hardened hardware is engineered to provide years of reliable operation in remote locations and harsh environments, in a manner no other competing solution does. Furthermore, TSAT is designed to comply with IEC-61850, the global standard for utility and industrial communication and automation.

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Contact: Moe Abutaleb
Job Title: President and Chief Executive Officer

UltiSat Inc., a Speedcast Company, is a global leader in the provision of mission-critical, managed network solutions and high-touch professional services. Its products and services incorporate Fixed Satellite Service (FSS), Mobile Satellite Service (MSS), wireless and terrestrial technologies. UltiSat solutions are offered to end users in some of the most remote and harsh locations in over 135 countries on seven continents around the globe.

With customer networks that vary from a few sites to hundreds of locations, UltiSat's technical expertise and technology-agnostic approach ensures that its customers get the best-fit/best-value solutions. UltiSat customers include US and foreign government agencies, government contractors, and Inter-Governmental Organizations (IGOs).

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Contact: John Donnithorne
Job Title: Technical Sales Manager

An industry leader in mobile and flyaway satellite earth stations, GigaSat – part of Ultra Electronics CIS - creates products to take on the harshest environments in the world, from the Sahara to Mt Everest.

All products are manufactured exclusively at GigaSat's UK factory, dramatically reducing production time from an industry standard of months to a matter of several weeks. The stringent in-house production has also enabled GigaSat to receive the highest certifications of MIL-STD-810 and WGS.



Name: YAHCLICK
Address: Sweihan road, Al Falah, next to Zayed military camp, Abu Dhabi, UAE.
Tel: +971 2 510 0000
Fax: +971 2 510 0001
Email: info@yahsat.ae
Internet: www.yahclick.com

YahClick (powered by Hughes) is a satellite broadband service offering reliable, cost-effective, and high-performance internet connectivity to unserved and underserved regions across the Middle East, Africa, Central and South West Asia.

Delivered through the latest generation of High Throughput Satellites (HTS), the service uses the efficiencies provided by the reusable ka-band satellite frequency and is powered by multi-spot beam technology to make satellite broadband affordable and dependable in areas where there is limited to no terrestrial infrastructure.

YahClick (powered by Hughes) is designed to cater to a wide range of applications across multiple market sectors—from high-speed internet access, distance learning and digital signage/media solutions, to the most demanding enterprise and government networking requirements. It is also designed to provide “direct-to-premise services” for homes, small to medium-sized businesses, community centers and schools that benefit from local government programs as well as “community hotspot” solutions across the regions it covers. Solutions are delivered through in-market Service Partners that are appointed after a rigorous selection process to ensure best in class local support.

YahClick (powered by Hughes) is a Joint Venture between Yahsat, a leading global satellite operator based in the United Arab Emirates (UAE) and wholly owned by Mubadala Investment Company, and Hughes Network Systems (HUGHES), a subsidiary of EchoStar Corporation (NASDAQ: SATS).

YahClick Industry Classifications

- **Solutions:** Consumer, Oil & Gas, Cellular, Healthcare, Humanitarian, Banking and Finance, Education, Construction, Hospitality, Broadcasting, Mining, Farming, Agriculture.
- **Industry Services:** Ka-band, Satellite Broadband, HTS.
- **Products:** Broadband, Enterprise, Cellular backhaul, WiFi, e-Health, e-Learning.





Name: YAHSAT
Address: Sweihan road, Al Falah, next to Zayed military camp, Abu Dhabi, UAE.
Tel: +971 2 510 0000
Email: info@yahsat.ae
Internet: www.yahsat.ae
Contact: Steven Doiron
Job Title: Head of Spectrum and Regulatory Affairs
 Established in 2007, Yahsat is a leading global satellite operator, providing multipurpose satellite solutions for broadband,

broadcast, government and communications use across the Middle East, Africa, Europe, Central and South West Asia and South America. Headquartered in Abu Dhabi, UAE, and wholly owned by Mubadala Investment Company, the investment vehicle of the Government of Abu Dhabi.

Yahsat is the first company in the Middle East and Africa to offer Ka-band services via its Al Yah 1 and Al Yah 2 satellites. The services include:

- YahClick (powered by Hughes) - offers broadband satellite solutions for enterprises, communities and private users;
- Yahsat Government Solutions - offers managed solutions and government capacity;
- YahLink - offers IP trunking solutions, corporate networking and backhauling capacity;
- Yahlive – a joint venture between Yahsat and SES, offers premium services to broadcasters and a select choice of TV channels;
- Following the launch of Yahsat's third satellite Al Yah 3, Yahsat's commercial Ka-band coverage has extended to additional 19 markets, reaching 60 percent of Africa's population and over 95 percent of Brazil's population; and
- In 2018, Yahsat acquired Thuraya, the UAE's mobile satellite services operator and announced a joint venture with global leader Hughes to strengthen its global reputation as the 6th largest satellite operator in the world in terms of revenue, with a fleet of five satellites.

Yahsat Industry Classifications

- **Solutions:** Defense, Government, Consumer Enterprise, Oil & Gas, Mobile, Maritime, Health, Disaster Preparedness, Banking and Bridging the Digital Divide.
- **Industry Services:** Ku-band Systems, Ka-band Systems, C-band Systems, L-band Systems.
- **Products:** Complete Networks, Bandwidth, System Integration, broadcasting.

Photo courtesy of Pexels



SpaceBridge Inc. is an established vendor and global market leader of broadband satellite communications systems.

Previously known as Advantech Wireless Inc. the company is now be doing business as SpaceBridge Inc. With headquarters in Montreal Canada and two affiliate R&D innovation centers, sales and support offices in Canada, Brazil, Colombia, United Kingdom, Middle East, Indonesia, China and Russia - SpaceBridge is ideally positioned to meet the demands of today's global market. The company is an ISO9001 registered vendor.

The company develops and provides satellite equipment and services for deploying satellite communication networks: VSAT HUBs, VSAT Terminals in Point-to-Point, Point-to-Multi-Point, Mesh topologies as well as SCPC and broadcast modems for GEO and NGSO satellite constellations.

SpaceBridge also provides Cloud-Based autonomous managed services for its customers helping them to eliminate initial high CapEx investments and save on network management OpEX. SpaceBridge's diverse portfolio includes ASAT™ product line supporting different verticals with various technologies and applications, focused on: Cellular Backhaul, 2G/3G/4G and 5G, Industrial Internet of Things-IIoT, Commercial and Military Satcom-On-The-Move, high-speed broadband, multicast IPTV, voice over IP, videoconferencing, L2/L3 VPN, Virtual Network Operator and HD/UHD TV broadcasting.

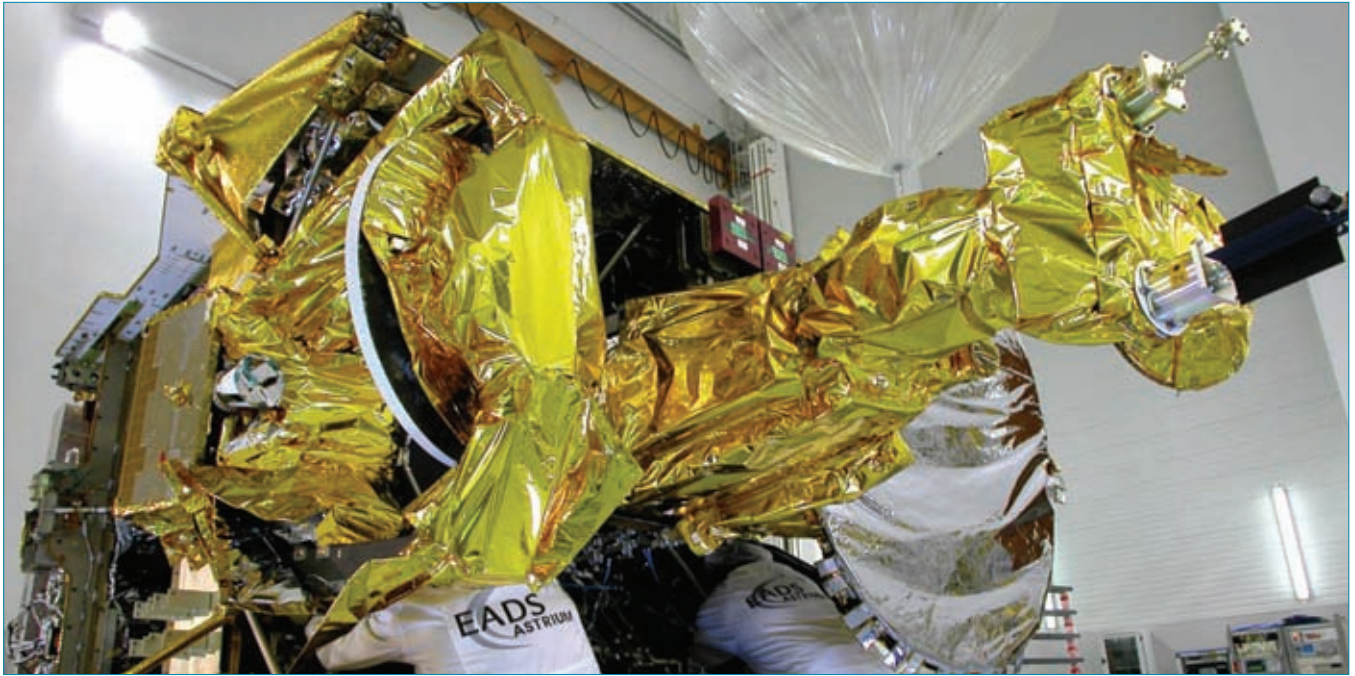
ASAT™ Wave Switch™ technology that SpaceBridge brought to the market in 2015, allows return link dynamically selecting and switching to the most-appropriate waveform either MF-TDMA, ASCPC or SCPC-optimizing satellite resource usage for the network owner and operator.

As part of the significant revolution in the satellite market with LEO/MEO satellite constellations taking-off, SpaceBridge is working in close partnership with NewSpace players, proactively participating in this change of the satellite communication landscape, developing VSAT systems which are capable of utilizing this capacity leap and delivering 4G, 5G backhauling, IIoT and many other applications.

Spacebridge Inc. (formerly Advantech Wireless Inc.), now doing business as SpaceBridge™

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Arabsat-4, courtesy EADS Astrium.



Serving the growing needs of the Arab world

Founded in 1976 by the 21 member-states of the Arab League, Arabsat has been serving the growing needs of the Arab world for over 40 years, operating from its headquarters in Riyadh-KSA and two satellite control stations in Riyadh and Tunis.

Now one of the world's top satellite operators and by far the leading satellite services provider in the Arab world, it carries over 500 TV channels, 200 radio stations, pay-TV networks and wide variety of HD channels reaching tens of millions of homes in more than 80 countries across the Middle East, Africa and Europe—including an audience of over 170 million viewers in the Middle East and North Africa (MENA) region alone tuned into Arabsat's video "hotspot" at 26°E.

Operating a growing fleet of owned satellites at the 20°E, 26°E, 30.5°E, 39°E and 44.5°E, Arabsat is the only satellite operator in the MENA region offering the full spectrum of broadcast, telecommunications and broadband services.

Youngest regional fleet

This capacity will continue to expand with the launching of new satellites, making Arabsat satellites' fleet the youngest in the region.

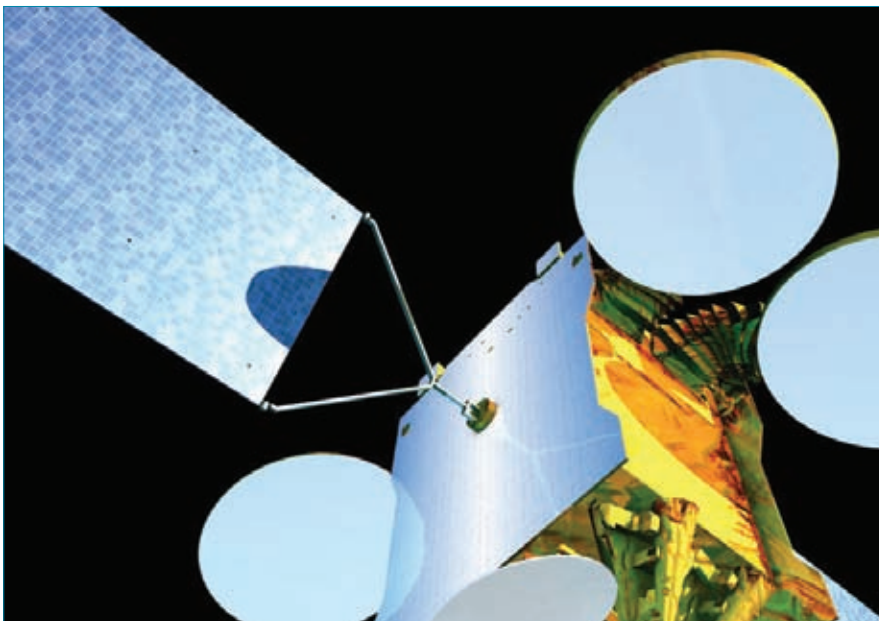
These latest technology birds are equipped to provide, not only the highest downlink power over the widest coverage area than any other satellite fleet around, but also services in the most recent bands including Ka-band for innovative interactive services, in addition to enabling an extraordinary

complete access to European markets, all through either one single Pan- Arab+Europe extended beam, a purely MENA beam, or highly sophisticatedly designed market-specific spot beams (North W.Africa, W.Africa, S.Africa, East MENA and C.Asia).

Arabsat offers the most secure, reliable, and versatile fleet with 'hot' in-orbit back-up and guaranteed long-term expansion space capacity.

Arabsat also maintains strategic partnerships with most of the world's leading satellite companies and VAS integrators. With the acquisition of Hellas Sat, one of the leading telecom groups in southeastern Europe, these partnerships and acquisitions continue to expand Arabsat's reach with new orbital slots and frequency rights, allowing customers to reach farther than ever and deliver content and state-of-the-art solutions to any end-viewers audience or business partner around the world.

Arabsat-5A, courtesy EADS Astrium.



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SESSION HIGHLIGHTS

What's the (Next)
Big Idea?

Standards for
Integrating Satellite
into the 5G Future

Software-Defined Satellites
for a Software-Defined
Industry

Global Satellite Operators:
The Future is Now

From the Outside Looking In:
Industry 4.0 in Space

Executive Roundtable:
LEO/MEO Systems
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CPI's 160W Ka-band GaN BUC provides up to 100W of linear power at the flange

CPI: solid state VSAT solutions

Communications & Power Industries LLC (CPI), a US based company, has a long history of providing solutions for radio frequency, power control, instrumentation, defense communications, medical, scientific, and maritime, commercial, & military VSAT system needs. Over its 68 year history, the company has grown to be a global leader in medium and high power communications products including TWTAs and solid state power amplifiers.

CPI has continued to build upon its solid state product line, acquired from Codan six years ago. From this acquisition, CPI has gained more than fifty years of additional experience in high frequency technology. CPI's VSAT-related engineering capabilities are based in San Jose, CA (USA), Boalsburg, PA (USA), Adelaide, SA (Australia), and Georgetown, Ontario (Canada), reflecting the company's strong commitment to research and development. The product lines are manufactured at CPI's manufacturing facility in Georgetown.

Solutions for VSAT applications

A critical element of the transmit side is the block up-converter and amplifier (commonly referred to as the BUC, BUC/SSPA or SSPB). CPI's satcom products line provides a host of BUC solutions in C, X, Ku and Ka-bands. These solutions cover RF output power ranges from 8 watts up to 200 watts, and include GaN technology allowing for more efficient and more compact designs.

Typically, VSAT systems require output powers from as low as 1 watt to upwards of 50 watts. Therefore, CPI Satcom offers an attractive

set of BUCs for higher-end VSAT terminals. For military systems, CPI has experience with X, Ku- and Ka-band products included in DISA and ARSTRAT/WGS certified terminals. This familiarity has proven valuable to our customer base in regards to the necessary performance required to provide smooth integration of our product into the terminals.

For both commercial and military applications, CPI has recently begun to develop a line of GaN-based solid state transceivers, including compact designs light enough for man-pack applications, and high power products suitable for troposcatter communications.

In addition to the more standard BUC offerings, CPI's solid state portfolio offers customized modules for certain specific applications as well as low noise amplifiers and even an LNB series at X-Band. This flexibility allows CPI to engage in many opportunities where other providers may have limitations.



GaN-based Solid State BUC

Customer service and support

CPI Satcom Product's culture of service and support is widely known among its loyal customer base. Although CPI's robust designs, low lifetime cost of ownership, outstanding reliability and quick delivery are elements that play important roles in the selection of products for VSAT applications, customers also appreciate CPI for the company's responsiveness and commitment. With a staff of seasoned application engineers, a network of global repair and service centers, and 24/7/365 support, it is clear that the selection of CPI is the start of a valued partnership rather than a 'won'-and-done deal.

Final word

CPI provides a wide range of established RF BUC, amplifier and transceiver solutions for commercial, military, airborne and maritime communication network needs. Known for its technical innovation, reliable product offerings and unparalleled support, the company is one of the truly outstanding choices one can make for VSAT related products.



40 dBm X-band GaN Transceiver *courtesy of CPI*



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Capacity Management Centre

World-class operator

Es'hailSat, the Qatar Satellite Company, is a communications satellite operator headquartered in Doha, Qatar. Es'hailSat was established in 2010 as an independent company with the goal to manage and develop Qatar's presence in space. The company provides independent, high-quality, advanced satellite services to broadcasters, businesses and governments in the MENA region and beyond.

Vision

Es'hailSat aims to be a world class operator who effectively contributes to the success of Qatar's National Vision 2030 by adding a new dimension to the diversifying economy.

Mission

Es'hailSat will provide advanced satellite services to strategic stakeholders and commercial customers, who value broadcasting and communications

independence, quality of service and wide geographical coverage.

With a goal to be a truly global satellite operator and service provider, Es'hailSat started operations of its first satellite Es'hail-1 at 25.5°E in 2013 supporting key broadcasters in the region, beIN SPORTS and Al Jazeera Media Network. Es'hail-2, the company's second satellite was launched on November 15, 2018 and is co-located with Es'hail-1 at the MENA broadcast hotspot of 25.5°E / 26°E orbital location.

Es'hail-1 is successfully supporting the strong demand for broadcasting services, telecommunications and critical data distribution in the region. Having started service on Qatar National Day, 18th December 2013, with Al Jazeera Media Network and beIN SPORTS, it has gone from strength to strength with coverage of the FIFA World Cups 2018 & 2014, Rio Olympics 2016, UEFA Euro 2016 and the launch of new niche Arabic channels over the last few years.

Having both Ku-band and Ka-band capacity at the 25.5°E and 26°E hotspot position enables Es'hailSat to provide the region with the most advanced and sophisticated services in broadcast, telecommunications and broadband.

Es'hailSat's expansion plan is set to continue with new satellites in prime hotspot locations, offering customers the most flexible

and reliable service. Es'hailSat also adopts the concept of "world-wide footprints" through partnerships with leading regional and international satellite operators around the globe.

Es'hailSat aims to bring a new dimension to Qatar's diversifying economy by building a world-class company and a center of excellence in the region. As well as developing satellite system in space, Es'hailSat is also investing in local infrastructure and talent, to nurture and grow satellite technology for Qatar, key to providing a secure, independent communications network to meet the needs of stakeholders, customers now and in the future.

Es'hail-2

Es'hailSat is delivering additional premium satellite capacity in the MENA region with the expansion of the Es'hailSat fleet. Es'hail-2, successfully launched on November 15, 2018 and will further boost broadcasting and global connectivity for Qatar and the entire Middle East and North African region. Es'hail-2 is a high-powered, advanced satellite with both Ku-band and Ka-band capabilities to provide TV distribution, telecoms and government services. The satellite footprint covers the Middle East and North Africa and will be positioned at the 26°E hotspot location.

New Teleport for MENA

The new Es'hailSat Teleport is a state-of-the-art facility providing satellite Telemetry, Tracking and Commanding (TT&C) facilities and capacity management, together with a wide range of teleport services such as uplink, downlink, contribution, multiplexing, encoding, playout and broadcasting, tailored for our stakeholders, customers and business partners. The high-tech teleport will have back-up studios for TV channels and serve as a disaster recovery facility for broadcasters. The site is connected to key media broadcasters in Qatar and the region, and to the international fibre gateway by means of a redundant, dedicated and diverse fibre optic link. The teleport is a custom built facility for Es'hailSat fleet of satellites and is fully owned, operated and controlled by Es'hailSat.

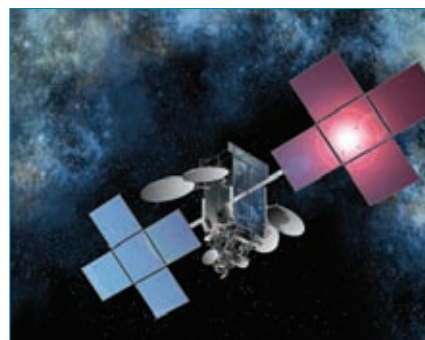
Solving challenges of interference for MENA broadcasters

As secure transmissions continue to be of paramount importance in the MENA region, Es'hailSat is working with various parties to reduce and eliminate satellite interference and provide a secure transmission network for our customers. With Qatar hosting the 2022 FIFA World Cup, Es'hailSat is encouraging its customers to use Carrier ID as part of its cooperation within satellite community for interference reduction and identification.

Es'hailSat satellites have been designed and built with state of the art anti-jamming capabilities that help us avoid any intentional or unintentional interference. This feature is critical for customers using the satellites for mission critical work and for broadcasters who greatly value uninterrupted signals reaching their customers. In addition, a geo-location system is available at the teleport to accurately identify origins of any interference



Es'hail-2



Es'hail-1



Receiving Growth Strategy of the Year award during Broadcast Eurasia & 4th Global Satellite Show 2018

and take appropriate action with or against the interfering party.

PRODUCTS/SERVICES

Premium content on Es'hail-1

Es'hail-1 continues to go from strength to strength, demonstrating the value of Es'hailSat's offering in terms of technical capabilities and performance, and also in terms of independence and security of content we broadcast. In addition to providing transmission for established news, sports and entertainment channels, a growing number of new channels from around the region are choosing Es'hailSat to broadcast their channels in the MENA region. With steady subscriber growth since starting transmission on Es'hail-1, beIN Sports continues to roll out new HD and SD channels via Es'hailSat satellites, seeking to diversify and expand its audience with new content including movies, entertainment and sports. In addition, with Al Jazeera's bouquet of HD channels on Es'hail-1, 25.5°E / 26°E is truly a hotspot for quality high definition channels.

Broadcast services

Operating from the MENA orbital hotspot of 25.5°E/26°E, covering key consumer markets in GCC and North Africa, Es'hailSat's high powered satellites provide the key infrastructure to media networks and broadcasters to distribute TV channels directly to consumers via small satellite dish. Customers are able to leverage on

Es'hailSat's satellites and teleport infrastructures to provide services such as linear TV, video on demand, high definition TV and 4K TV among others. Es'hailSat's highly efficient and cost effective solutions for Digital News Gathering (DSNG), playout, content transfer, uplink, occasional use services, etc. can be tailored to specific customer requirements.

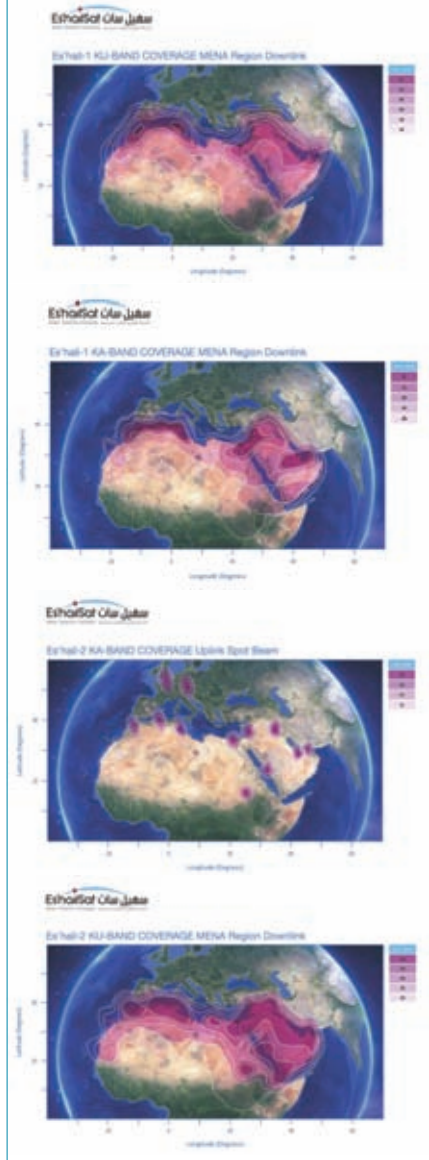
Telecommunication services

Es'hailSat's collaboration with Ooredoo allows both companies to work together on a range of new satellite and world-class communications services for Qatar and the region. Partnering with Ooredoo helps drive home grown innovation and stimulate the development of a full portfolio of solutions to support VSAT, voice, data and broadband business via satellite.

Growing demand for Ka-band

Demand for Ka-band services across the MENA region, especially in hub based solutions and mobility services, is growing and Es'hailSat's Ka-band hub located in Doha provides flexibility to service providers allowing them to choose a style of engagement and commitment to suit their business needs. Through the hub's high-tech infrastructure, Managed Service Providers (MSPs) can provide telecom solutions that support a range of satellite-based data communications applications, ensuring their customers benefit from flexible and efficient

Satellite Footprints



technologies providing higher compression with lower latency, WAN optimization and bandwidth optimization for OPEX savings. The main services provided by Es'hailSat's hub are Internet Services, VoIP Services and Corporate Network Connectivity.



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Es'hailSat Teleport, Al Ghuwariyah

Hughes HQ. Photo courtesy of Hughes Network Systems



Powering a connected future

Hughes Network Systems, LLC (HUGHES), is the global leader in broadband satellite technology and services for home and office. Its mission is to power a connected future for people, enterprises and things—bridging the digital divide and enabling the networks that drive business, governments and communities forward.

Technology and service leader

Headquartered in Germantown, Maryland, with sales and support offices globally, Hughes is a subsidiary of EchoStar Corporation, a premier provider of satellite operations. Inventor of the commercial VSAT over three decades ago, Hughes has consistently maintained industry leadership as the #1 global provider with approximately 50 percent market share (*Ref COMSYS 2017 VSAT Report, 14th Edition), having shipped more than seven million terminals of all kinds to customers in more than 100 countries. The Hughes JUPITER™ System is the world's most widely deployed High-Throughput Satellite (HTS) platform, operating on more than 20 satellites by leading service providers, delivering broadband enterprise, mobility, cellular backhaul and community Wi-Fi applications, as well as powering broadband services to aircraft around the world.

Hughes operates service businesses in the US, Europe, India, Brazil and South America. Its flagship high-speed satellite Internet service is HughesNet®, the world's largest satellite network, with over 1.3 million residential and business customers across the Americas. For large enterprises and governments, HughesON® Managed

Network Services provide complete connectivity solutions employing an optimized mix of satellite and terrestrial technologies, with to date over 450,000 managed sites globally.

Bridging the Digital Divide

In the US, it is estimated that more than 14 million households are either unserved or

underserved by terrestrial Internet providers, while in South America it exceeds 20 million. Hughes helps close this digital divide through its market-leading satellite Internet service, HughesNet, which was ranked #1 by the FCC among all ISPs for meeting or exceeding advertised download speeds four years in a row (2014-2017). Building on its success in North America, HughesNet was expanded

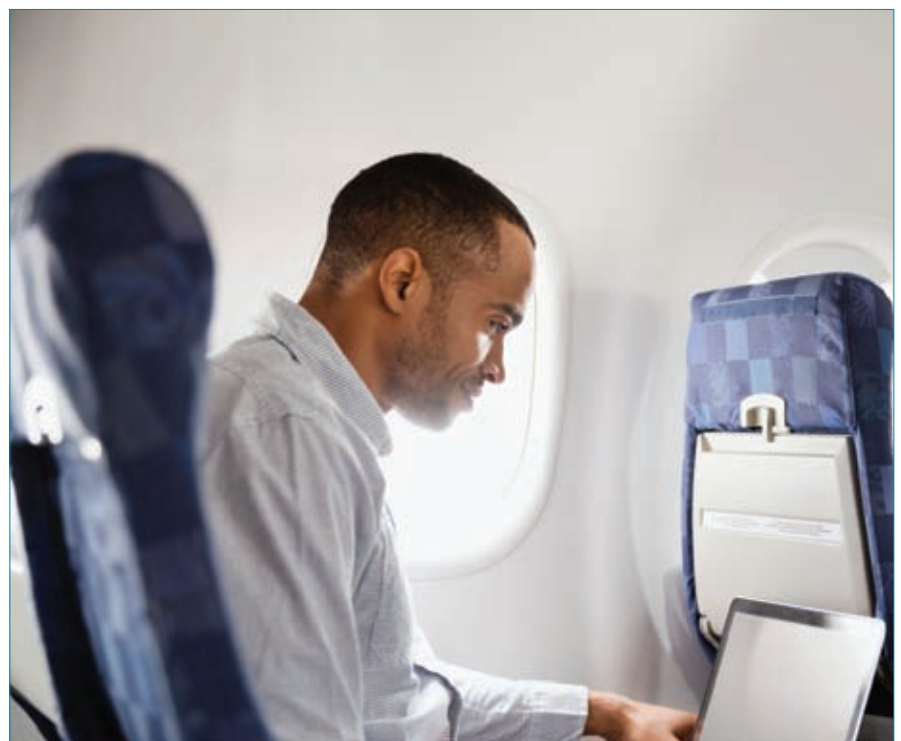


Photo courtesy of Getty Images

during the past two years bringing coverage to over 80 percent of the Americas, including Brazil, Chile, Colombia, Ecuador and Peru.

Hughes continues to assess opportunities globally, where lack of affordable broadband Internet access is acute. The company recently commenced a joint venture with Yahsat to provide commercial Ka-band satellite broadband service across Africa, the Middle East and southwest Asia.

Serving enterprises and governments

For enterprises and governments, HughesON Managed Network Services provide complete connectivity solutions, spanning more than 450,000 locations globally. Employing the most cost-effective mix of fixed, wireless and satellite technologies, HughesON solutions include SD-WAN, VoIP, digital signage, online training and more. The award-winning HughesON Managed SD-WAN solution is now in over 30,000 sites, combining world-class security and ActiveTechnologies™ to deliver more capacity and improved application performance, yielding high availability, low-cost multi-site networks.

Working with industry leaders such as



Photo courtesy of Getty Images

Global Eagle, SES and Thales, Hughes enables broadband connectivity for more than 1,100 commercial aircraft, with the latest JUPITER Aero solution delivering seamless, in flight broadband connectivity across multiple satellites of over 600Mbps per aircraft. To meet growing demand from the US Department of Defence for more Beyond-Line-of-Sight ISR on airborne platforms, Hughes offers its robust HM System technology to connect manned, unmanned,

fixed and rotary wing aircraft to enable enhanced situational awareness for warfighters.

For mobile network operators (MNOs), Hughes satellite-based backhaul solutions enable rapid, cost-effective service expansion into rural or hard-to-serve markets, optimizing space segment utilization through advanced traffic management algorithms. Satellite-enabled Wi-Fi hotspots across Mexico, Russia and Brazil extend MNO service even further into underserved communities.

Powering a connected future

Hughes is driven to innovate and power a connected future. The company plays an integral part in the global telecom ecosystem to deliver ubiquitous, high-availability and secure technology solutions advancing industry standards and interoperability between satellite and terrestrial systems, including those based on cellular 2G, 3G, 4G/LTE and 5G standards. Hughes products employ global standards approved by the TIA, ETSI and ITU organizations, including IPoS/DVB-S2, RSM-A, and GMR-1. As a founding member of the DVB-S2X joint licensing patent program ("patent pool"), Hughes has been a major contributor to the widely deployed DVB-S2X technical standard for satellite transmission that enables higher throughputs and bandwidth efficiency. Through its development of LEO systems technology for OneWeb, Hughes is also advancing the model of a complementary GEO/LEO satellite architecture, leveraging the latest technologies to succeed.

At the forefront of satellite technology, Hughes continues to lead the industry – innovating technologies, standards and solutions to power a connected future for people, enterprises and things and change the world for the better.



Photo courtesy of Hughes Network Systems



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Premier supplier and integrator

ND SatCom has more than 30 years of experience as a premier supplier of and integrator for innovative satellite communication equipment systems, supporting critical operations throughout the world. ND SatCom has customers in more than 130 countries and delivers efficient and secure turnkey and custom communications solutions from its base in Immenstaad, Germany. Bernd Lehr, Director of Sales, outlines ND SatCom's recent achievements and outlook for the future.

Question: 2018 was a busy year for ND SatCom. What can you tell us about the highlights and key milestones achieved over the year?

Bernd Lehr: We've achieved a lot in all three of our business sections. We are very active in the defence market, the broadcast sector,

and the government and enterprise market.

In the defence market, we finalised the modification of terminals for the German armed forces, and we've been awarded a contract for the Polish Army. In the government market, we've rolled out two significant Air Traffic Control (ATC) networks,

one in Bolivia via Thales, and one with Atech/Brazil. In the broadcast sector, meanwhile, we've been happy to deliver our satcom on-the-move system to ten video news vehicles for SABC, which are transmitting all types of services.

Question: The satellite industry is in a major state of change; we're moving from high throughput satellites (HTS) to extreme throughput satellites (XTS), and small satellites and mega-constellations. What kind of opportunities does all this change offer ND SatCom?

Bernd Lehr: There is a close cooperation with the Intelsat engineering team for the Epic^{NG} satellites with SKYWAN. We've done intensive testing with partners at different ground stations, utilising different flyaway, land, and maritime terminals.

The unique features of our SKYWAN technology can be used in any operation. Regarding the XTS developments, this is under investigation by ND SatCom for future technologies.

One of the challenges is that we must always be ready for these new technologies and be prepared for the future. We've increased our sales staff in reaction to the changing markets, as well as our engineering personnel in Africa and in Asia. We see good demand in our core markets, defence, broadcast and governmental, while these changes are going on. Satcom on-the-move, which is required by all three of our markets, is growing strongly.

Question: In a rapidly-changing industry, geographic and end-user markets are being impacted significantly. How have ND SatCom's key markets been developing?

Bernd Lehr: We think there is big demand for mobile satellite communications, especially in Africa and Latin America. The reason for that demand is that they have poor terrestrial connectivity. It's different in Europe, where we need to concentrate more on the broadcast market, which is also rapidly changing, and where we're seeing more Ka-band transmissions. We're still building our SNG trucks, so this is something we need to react to. We're also now trying to focus on the Asian market.

We have a lot of capability in the broadcast market, such as our Ka2Go terminal, which





Bernd Lehr, Director of Sales, ND SatCom

is very well-known in the market. There's still a very strong demand for SNG and uplink stations, and we're establishing better pick-up stations for the broadcast markets which increases reliability and signal availability. The newer IP and OTT markets are bringing in a great deal of change for broadcasters, and we're reacting to that with our SKYWAN 5G modem, which transmits any service over IP in one hop to the destination. We clearly see that DTH is falling and OTT is going up.

Defence is our strongest business sector where we have long-term contracts with different military institutions, including the German armed forces and much of the rest of Europe.

Our reach in the governmental markets is mostly around ATC networks, but we also see now through the satcom on-the-move - business possibilities in the first responder and police market. We've been performing demonstrations for this market; we did one in April last year in South Africa, where we welcomed several companies and institutions, including the police and military police, to witness a live demonstration. The attendees are convinced that our system is excellent for their needs, especially in situations where reliable service is a must.

Question: We hear you have a new satcom on the move solution, which is already being used by SABC in South Africa. What can you tell us about the solution, and how it compares with others on the market?

Bernd Lehr: The solution comprises our SOTM enhanced SKYWAN satellite modem, a low-profile antenna, and our media fleet manager software. The satcom on-the-move vehicles are being operated assuming that everyone is using video traffic only, but in parallel, voice calls, Internet and email traffic is also supported. Data can be sent, which is required by all the different types of customers, including defence, broadcasters, and governmental agencies.

Broadcasters have bandwidth demands up to 7Mbps for HD video that our News-on-the-Move solution can transmit.

The defence customers, on the other hand require maximum bandwidth too but the antenna to be much smaller rendering it

invisible to the enemy. That's very important for those customers. With our solution, all customers can choose proper antenna and transmit from the very first second; our SKYWAN modem interfaces to all these SOTM antenna and ultra-fast re-establishes the link after shadowing or tunnels avoiding frozen video images or cut off voice calls. Nothing needs to be adjusted; it's all done automatically with SKYWAN.

What only SKYWAN modems do to reduce OpEx is bandwidth sharing: A bandwidth pool can be used for peak traffic by all the remote sites in a satellite network while enforcing lowest jitter and real-time services. This helps lower the costs for our customers.

Question: Let's talk about other product development. Does ND SatCom have anything else new in the pipeline?

Bernd Lehr: There are new features and capabilities of our SKYWAN 5G modem that we are developing with respect to mobile and the mobility area. We already released LTE enhancements and encryption modules for SKYWAN. Now, beam switching for mobile terminals in meshed networks using HTS satellites is under development for first

responders, police forces, special forces and homeland security customers that bring their own mobile cells.

Question: What's on the horizon for ND SatCom in 2019 and beyond?

Bernd Lehr: We are mainly focusing on continuation and extension of our current areas. We're also strengthening our regional sales, and enhancing our product portfolio as an independent group with verified solutions of mobile terminals for mobile cells – we have branded it SMART MOBILE² NETWORKS.

ND SATCOM

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19-21 March

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MilSatCom USA West Coast 2019 [SMi]
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CommunicAsia 2019 [UBM]
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Maritime CIO Forum London 2019 [Digital Ship]
20 June | 30% delegate discount

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Maritime CIO Forum Tokyo 2019 [Digital Ship]
29 August | 30% delegate discount

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19 September | 30% delegate discount

Maritime CIO Forum Singapore 2019 [Digital Ship]
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Space & Satellite Regulatory Colloquium 2019 [Reed Smith]
18 October

iShipping Copenhagen 2019 [Digital Ship]
23-24 October | 30% delegate discount

Asia Video Summit 2019 [Asia Video Industry Association (AVIA)]
30 October

AeroConnect 2019 [GVF-EMP]
November (tbc) | Free delegate attendance

Global MilSatCom 2019 [SMi]
5-7 November

Green Ship Technology North America 2019 [KNect365]
12-14 November | 20% delegate discount

Shipping North America 2030 [KNect365]
12-14 November | 20% delegate discount

Digital Ship Conference 2019 Athens [Digital Ship]
13-14 November | 30% delegate discount

AfricaCom 2019 [KNect365]
13-15 November | 2 free delegate passes

SpaceCom 2019 [NTP Events]
27 November | 2 free delegate passes

Maritime CIO Forum Bergen 2019 [Digital Ship]
27 November | 30% delegate discount

HTS Roundtable 2019 [GVF-EMP]
December (tbc) | Free delegate attendance

Maritime Cyber Resilience Forum London 2019 [Digital Ship]
December (tbc) | 30% delegate discount



Photo courtesy of IBC



ANGACOM 2019

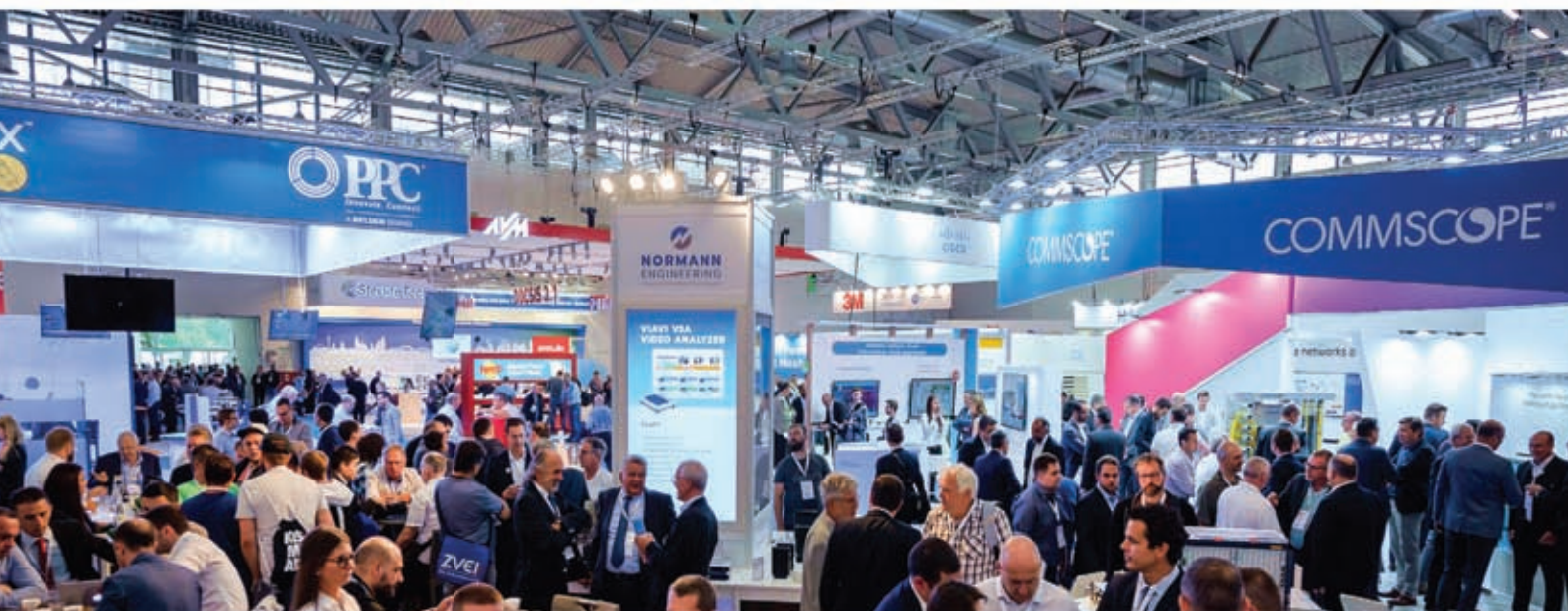
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